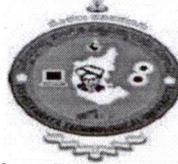


VISVESVARAYA TECHNOLOGICAL UNIVERSITY
“Jnana Sangama”, Belgaum 590014, KARNATAKA, INDIA



Project Phase-II Report
On

“Rider’s Safety Mechanism for Rental Vehicles”

Submitted in Partial fulfillment of the requirement for the award of degree

Of

Bachelor of Engineering

In

Computer Science & Engineering

Of Visvesvaraya Technological University, Belgaum.

Submitted by:

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
AMC ENGINEERING COLLEGE

(NAAC & NBA Accredited, approved by AICTE, New Delhi & Affiliated to VTU, Belagavi)

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Year 2019-20



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CERTIFICATE

Certified that the Project work entitled "Rider's Safety Mechanism for Rental Vehicles" carried out by bonafide students UMASHANKAR SWAMI(1AM16CS189), TANZEEL AHMAD(1AM16CS184), VIVEK RAJA(1AM16CS201), PIYUSH JAMWAL(1AM16CS205) of AMC Engineering College, in partial fulfillment for the award of Bachelor of Engineering in Computer Science & Engineering of Visvesvaraya Technological University, Belgaum during the year 2019-2020. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report. The Project Phase-II report has been approved as it satisfies the academic requirements in respect of Project Work prescribed for the said Bachelor of Engineering degree.

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DECLARATION

We the undersigned students of 8th semester **Department of Computer Science & Engineering, AMC Engineering College**, declare that our project work entitled "**RIDER's SAFETY MECHANISM IN RENTAL VEHICLES**" is a bonafide work of ours. Our project is neither a copy nor by means a modification of any other engineering project.

We also declare that this project was not entitled for submission to any other university in the past and shall remain the only submission made and will not be submitted by us to any other university in the future.

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First and foremost, I would like to thank the almighty.

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In the end, I sincerely thank my beloved family members and friends for their valuable suggestions, encouragement and unwavering support.

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ABSTRACT

The objective of the smart helmet is to provide safety of helmet theft, alcohol detection and apparatus for detecting and reporting accidents. Helmet theft is one of the main issues faced in today's world. Many people book a ride and take away the helmet with them while ending the trip. Which in turn cause a great loss to the company or the organization.

Nowadays most of the countries are forcing the motor riders to wear the helmet and not to use the vehicles when the person is in drunken condition. But still the rules are being violated by the users. In order to overcome this, we introduce an intelligent system, Smart Helmet, which automatically checks whether the person is wearing the helmet and has non- alcoholic breath while driving. Here we have a transmitter at the helmet and the receiver at the bike. There is a switch used to sure the wearing of helmet on the head. The ON condition of the switch ensures the placing of the helmet in proper manner. An alcohol sensor is placed near to the mouth of the driver in the helmet to detect the presence of alcohol. The data to be transferred is coded with RF encoder and transmitted through radio frequency transmitter. The receiver at the bike receives the data and decodes it through RF decoder. The engine should not ON if any of the two conditions is violated. MCU controls the function of relay and thus the ignition, it controls the engine through a relay and a relay interfacing circuit

Our main motive is to avoid the delay in aid after accidents. Smart helmet is connected to a smartphone via Bluetooth. The microcontroller in the smart helmet is used to keep track of related information of all parameters regarding accidents. Impact sensor is used to detect the vibrations of the impact on the helmet due to accident and gyroscope detects sudden changes in the X, Y and Z axes. When accidents happen, Sensors send data to node and NodeMCU sends data to application through cloud, related information is sent to emergency contacts and nearby hospital through the android app .

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CHAPTER 1

INTRODUCTION

1.1 Aim and Objective:

The aim is to build a smart helmet which is capable of alcohol detection and also can send notification to nearest hospital if any accident takes place. We also insure the safety of helmet theft in rental vehicles.

The objective is to help in reducing the number of deaths in road accidents in two-wheelers and also provide helmet security to the rental vehicles, which reduces the company loss.

1.2 Problem Statement:

- Helmet theft in rental vehicles (Bounce).
- IoT-Enabled Alcohol Detection System inside the helmet.
- IoT Based Automatic Vehicle Accident Detection.

CHAPTER 2

LITERATURE SURVEY

2.1 Helmet theft in rental vehicle's using RFID TAGS:

According to article published in times of India, it stated that," *At least 1,000-2,000 helmets are stolen in a month. The number has been steadily increasing as the number of bikes has gone up from 4000 in June to over 10,000 now*".

2.2 Alcohol Detection inside helmet:

James and John proposed an alcohol detection system that alerts the driver through his/her cell phone. The major components of this system was the GSM module and the LM358 module. This system was a huge advancement from breath analyzers as it was based on GSM technology using the GSM module and dumped the use of an alarm circuit but still employed the LM358 Op-Amp. The system alerted via text messages using a GSM module and had a unique ringtone for such text messages set on the cell phone. Its major demerit was the lack of an LCD unit and an alarm circuit which could be useful in cases where the driver is not in possession of his/her phone.

Another alcohol detection system was developed in based on PIC16F877A microcontroller. The presence of the microcontroller allowed for ease of manipulation of the threshold depending on body chemistry. The presence of the microcontroller gave room for addition of other features in the future. The only major drawback was the system's inability for a direct real time implementation due to it being powered by an AC power supply, as the alcohol sensor wouldn't have the opportunity to have at least 3 hr. full run in time it would get if on DC supply (vehicle battery) to give the sensor the degree of accuracy it requires for its operation.

2.3 Accident's Detection and informing nearest hospital:

Dr. Himadri Nath Saha et al. [2], provided a methodology on proposed paper. This methodology identifies if one is wearing a helmet or not. It also detects occurrence of any accidents and overconsumption of alcohol. They made the use of components such as flex sensor, impact sensor, accelerometer, GPS module (SIM 28ML), breath analyzer (MQ3), Bluetooth module (BLE HM-10), Arduino nano, and voltage regulator (9V to 5V). The helmet module consists of the Arduino nano

connected to sensors, GPS module, Bluetooth module and battery module. This helmet module is connected to the smartphone using Bluetooth.

Sometimes the false accident detection leads to the ringing of the alarm. Successive button-click activity reported an alarm as false. This was a drawback as it let to repeatedly respond to the alarm while driving.

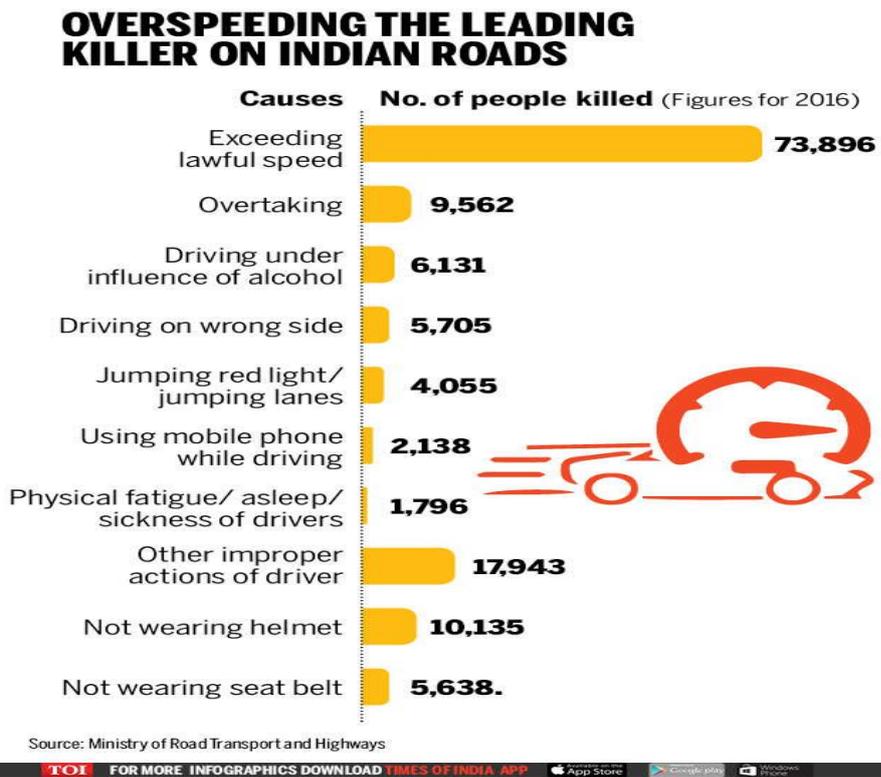


Fig. 2.3 Surveys

CHAPTER 3

SYSTEM REQUIREMENTS SPECIFICATIONS

3.1 Hardware Requirements:

- Accelerometer Sensor
- Cables and Connectors
- RFID sensor
- RFID tag
- Power Supply
- RF Encoder
- RF Transmitter
- Helmet Sensor Switch
- MQ3 sensor
- GPS
- NodeMcu8266
- OEM Vibration Sensor Module Alarm SW-420

3.1.1 NodeMCU

Development boards, such as Arduino and Raspberry Pi, are common choices when prototyping new IoT devices. Those development boards are essentially mini-computers that can connect to and be programmed by a standard PC or Mac. After it has been programmed, the development boards can then connect to and control sensors in the field.

Because the “I” in IoT stands for internet, the development boards need a way to connect to the internet. In the field, the best way to connect to the internet is by using wireless networks.

What is NodeMCU?

The NodeMCU (Node Microcontroller Unit) is an open source software and hardware development environment that is built around a very inexpensive System-on-a-Chip (SoC) called the ESP8266. The ESP8266, designed and manufactured by Espressif Systems, contains all crucial elements of the modern computer: CPU, RAM, networking (Wi-Fi), and

even a modern operating system and SDK. When purchased at bulk, the ESP8266 chip costs only \$2 USD a piece. That makes it an excellent choice for IoT projects of all kinds.

However, as a chip, the ESP8266 is also hard to access and use. The user has to solder wires, with the appropriate analog voltage, to its PINs for the simplest tasks such as powering it on or sending a keystroke to the computer on the chip. And, the user has to program it in low-level machine instructions that can be interpreted by the chip hardware. While this level of integration is not a problem when the ESP8266 is used as an embedded controller chip in mass-produced electronics, it is a huge burden for hobbyists, hackers, or students who want to experiment with it in their own IoT projects.

Borrowing a page from the successful playbooks of Arduino or a Raspberry Pi, the NodeMCU project aims to simplify ESP8266 development. It has two key components.

- An open source ESP8266 firmware that is built on top of the chip manufacturer's proprietary SDK. The firmware provides a simple programming environment based on eLua (embedded Lua), which is a very simple and fast scripting language with an established developer community.
- A DEVKIT board that incorporates the ESP8266 chip on a standard circuit board. The board has a built-in USB port that is already wired up with the chip, a hardware reset button, wifi antenna, LED lights, and standard-sized GPIO (General Purpose Input Output) pins that can plug into a bread board.

But, what about Arduino, the user asks? The Arduino project creates an open source hardware design and software SDK for a versatile IoT controller. Similar to NodeMCU, the Arduino hardware is a microcontroller board with a ready USB connector, LED lights, and standard data pins. It also defines standard interfaces to interact with sensors or other boards. But unlike NodeMCU, the Arduino board can have different types of CPU chips with memory chips, and a variety of programming environments. In fact, there is an Arduino reference design for the ESP8266 chip as well.



Fig No- 3.1.1.1 NodeMCU

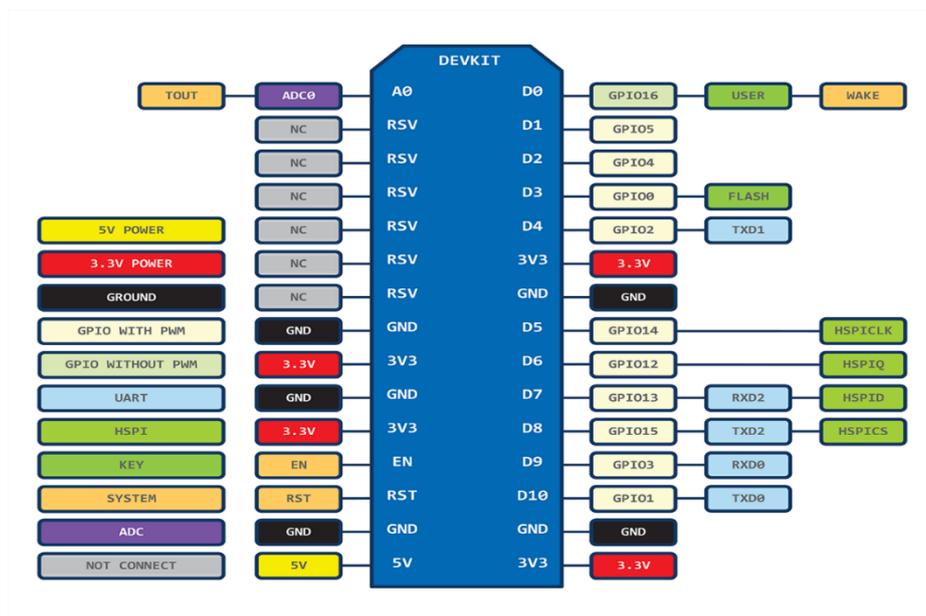


Fig No- 3.1.1.2 Pin Diagram of NodeMCU

3.1.2 RFID Reader

RFID (radio frequency identification) is a form of wireless communication that incorporates the use of electromagnetic or electrostatic coupling in the radio frequency portion of the electromagnetic spectrum to uniquely identify an object, animal or person.

RFID systems:

An RFID system consists of three components: a scanning antenna and transceiver (often combined into one reader, also known as an interrogator) and a transponder, the RFID tag. An RFID tag consists of a microchip, memory and antenna. The RFID reader is a network-connected device that can be permanently attached or portable. It uses radio frequency waves to transmit signals that activate the tag. Once activated, the tag sends a wave back to the antenna, where it is translated into data.

Types of RFID tags:

There are two main types of RFID tags: active RFID and passive RFID. An active RFID tag has its own power source, often a battery. A passive RFID tag, on the other hand, does not require batteries; rather it receives its power from the reading antenna, whose electromagnetic wave induces a current in the RFID tag's antenna.

RFID tags typically hold less than 2,000 KB of data, including a unique identifier/serial number. Tags can be read-only or read-write, where data can be added by the reader or existing data overwritten. The read range for RFID tags varies based on factors including type of tag, type of reader, RFID frequency, and interference in the surrounding environment or from other RFID tags and readers. Generally speaking, active RFID tags have a longer read range than passive RFID tags due to the stronger power source.

Types of RFID systems:

There are three main types of RFID systems: low frequency (LF), high frequency (HF) and ultra-high frequency (UHF). Microwave RFID is also available. Frequencies vary greatly by country and region. Low-frequency RFID systems range from 30 KHz to 500 KHz, though the typical frequency is 125 KHz. LF RFID has short transmission ranges, generally anywhere from a few inches to less than six feet. High-frequency RFID systems range from 3 MHz to 30 MHz, with the typical HF frequency being 13.56 MHz. The standard range is anywhere from a few inches to several feet. UHF RFID systems range from 300 MHz to 960 MHz, with the typical frequency of 433 MHz and can generally be read from 25-plus feet away. Microwave RFID systems run at 2.45 GHz and can be read from more than 30-plus feet away.

The frequency used will depend on the RFID application, with actual obtained distances sometimes varying considerably from what might be expected. For example, when the U.S. State Department announced it was to issue electronic passports enabled with an RFID chip, it said the chips would only be able to be read from approximately four inches away. However, the State Department was soon confronted with evidence that RFID readers could skim the information from the RFID tags from much farther than 4 inches, some claiming upward of 33 feet away, proving the difference between advertised and actual range can vary immensely. If read longer ranges are needed, using particular tags with additional power can boost read ranges to 300-plus feet.

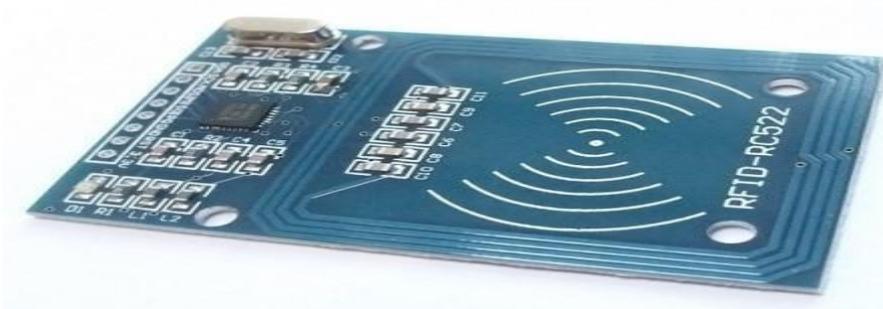


Fig. 3.1.2 RFID Reader

3.1.3 RFID Tag

A Radio Frequency Identification Tag (RFID tag) is an electronic tag that exchanges data with a RFID reader through radio waves.

Most RFID tags are made up of at least two main parts. The first is an antenna, which receives radio frequency (RF) waves. The second is an integrated circuit (IC), which is used for processing and storing data, as well as modulating and demodulating the radio waves received/sent by the antenna.

In the context of RFID technology, the term “tag” also includes labels and cards. The kind of tag depends on the body or object to which the tag is attached. RFID systems can operate in either Ultra High Frequency (UHF), High Frequency (HF) or Low Frequency (LF). Thus, tags also can vary in terms of the frequencies on which they operate.

These tags can be attached to almost any object. Although the usual target objects are apparel, baggages, containers, construction materials, laundry and bottles, they also may be attached to animals, humans and vehicles. Some RFID tags are designed for

rugged, outdoor-based applications.

These are built to endure natural and incandescent light, vibration, shock, rain, dust, oil and other harsh conditions. They are normally passive in that to function, they do not require batteries and can operate 24/7 without risk of power loss. Such heavy-duty tags are usually attached to trucks, cargo containers and light rail cars for cargo tracking, fleet management, vehicle tracking, vehicle identification and supply container tracking, among others.



Fig. 3.1.3 RFID Tag

3.1.4 MQ 3 Alcohol Sensor

MQThis module is made using Alcohol Gas Sensor MQ3. It is a low cost semiconductor sensor which can detect the presence of alcohol gases at concentrations from 0.05 mg/L to 10 mg/L. The sensitive material used for this sensor is SnO₂, whose conductivity is lower in clean air. It's conductivity increases as the concentration of alcohol gases increases. It has high sensitivity to alcohol and has a good resistance to disturbances due to smoke, vapor and gasoline. This module provides both digital and analog outputs. MQ3 alcohol sensor module can be easily interfaced with Microcontrollers, Arduino Boards, Raspberry Pi etc.

This alcohol sensor is suitable for detecting alcohol concentration on your breath, just like your common breathalyzer. It has a high sensitivity and fast response time. Sensor provides an analog resistive output based on alcohol concentration. The drive circuit is very simple, all it needs is one resistor. A simple interface could be a 0-3.3V ADC.



Fig. 3.1.4 MQ 3 Sensor

3.1.5 IR Sensor

This is a multipurpose infrared sensor which can be used for color detection. The sensor provides a digital as well as analog output. An on board LED is used to indicate the presence of an object. This digital output can be directly connected to an Arduino, Raspberry Pi or any other microcontroller to read the sensor output. IR sensors are highly susceptible to ambient light and the IR sensor on this sensor is suitably covered to reduce effect of ambient light on the sensor. The on board potentiometer should be used to calibrate the sensor.

An infrared light emitting diode (IR LED) emits light of Infrared range 700 nanometers (nm) to 1 mm. This light is not visible by naked eyes but can be seen by a camera (that is why these are also used in night vision cameras). A photo diode gives response in term of change in resistance when light falls on it. That change is measured in terms of voltage.

An IR LED and a Photo diode are used in a combination for proximity and color detection. An IR LED (transmitter) emits IR light, that light gets reflected by the object, the reflected light is received by an IR receiver (Photo Diode). Amount of reflection and reception varies with the distance. This difference causes to change in input voltage through IR input. This variation in input voltage is used for proximity detection.

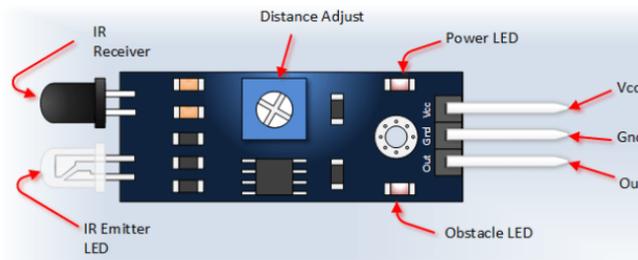


Fig 3.1.5 IR Sensor

3.1.6 OEM Vibration Sensor Module Alarm SW-420 Sensor

The Vibration module based on the vibration sensor SW-420 and Comparator LM393 to detect if there is any vibration that beyond the threshold. The threshold can be adjusted by the on-board potentiometer. When this no vibration, this module output logic LOW the signal indicate LED light, And vice versa.

Uses: For a variety of shocks triggering, theft alarm, smart car, an earthquake alarm, motorcycle alarm. This module when compared with normally open penumatic shock sensor module, shock triggered much longer can drive relay module

the use of the company's production of SW-420 normally closed type vibration sensors. comparator output signal clean wave well, driving ability, 15mA

rated voltage and 3.3V-5V output: digital switching output (0 and 1) a bolt-hole for easy installation

small Board PCB dimensions: 3.2cm x 1.4cm. using wide LM393 voltage comparator

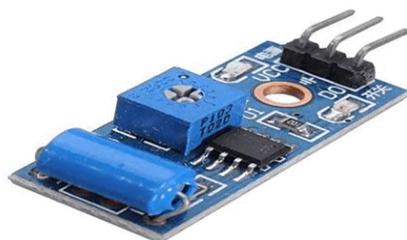


Fig. 3.1.6 IR Sensor

3.1.7 MPU6050 sensor

MPU6050 sensor has many functions over the single chip. It consists a MEMS accelerometer, a MEMS gyro, and temperature sensor. This module is very accurate while converting analog values to digital because it has a 16bit analog to digital converter hardware for each channel. This module is capable to capture x, y and z channel at the same time. It has an I2C interface to communicate with the host controller. This **MPU6050 module is a compact chip having both accelerometer and gyro**. This is a very useful device for many applications like drones, robots, motion sensors. It is also called **Gyroscope or Triple axis accelerometer**.



Fig.3.1.7 MPU6050 Sensor

3.2 Software Requirements

- Arduino IDE
- ThinkSpeak Cloud
- Android Studio
- Notepad++

3.2.1 Arduino IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It is used to write and upload programs to Arduino board. The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub `main()` into an executable cyclic executive program with the GNU toolchain, also included with the IDE distribution. The Arduino IDE employs the program argued to convert the executable code into a text file in hexadecimal encoding that is loaded into the Arduino board by a loader program in the board's firmware.

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension. `.ino`. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right-hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open,

and save sketches, and open the serial monitor. The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store your programs. The sketches in your sketchbook can be opened from the File Sketchbook menu or from the Open button on the toolbar. The first time the Arduino software is run, it will automatically create a directory for your sketchbook. We can view or change the location of the sketchbook location from with the Preferences dialog.

Beginning with version 1.0, files are saved with a .ino file extension. Previous versions use the .pde extension. We may still open .pde named files in version 1.0 and later, the software will automatically rename the extension to .ino.

Tabs allows you to manage sketches with more than one file (each of which appears in its own tab). These can be normal Arduino code files (no visible extension), C files (.c extension), C++ files (.cpp), or header files (.h).

Once we have selected the correct serial port and board, we press the upload button in the toolbar or select the Upload item from the Sketch menu. Current Arduino boards will reset automatically and begin the upload. With older boards that lack auto-reset, we will need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error.

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the Sketch > Import Library menu. This will insert one or more #include statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its #include statements from the top of your code. Some libraries are included with the Arduino software. Others can be downloaded from a variety of sources or through the Library Manager. Starting with version 1.0.5 of the IDE, you do can import a library from a zip file and use it in an open sketch.

Support for third-party hardware can be added to the hardware directory of your sketchbook directory. Platforms installed there may include board definitions core libraries, bootloaders, and programmer definitions. To install, create the hardware directory, then unzip the third-party platform into its own sub-directory . To uninstall, simply delete its directory.

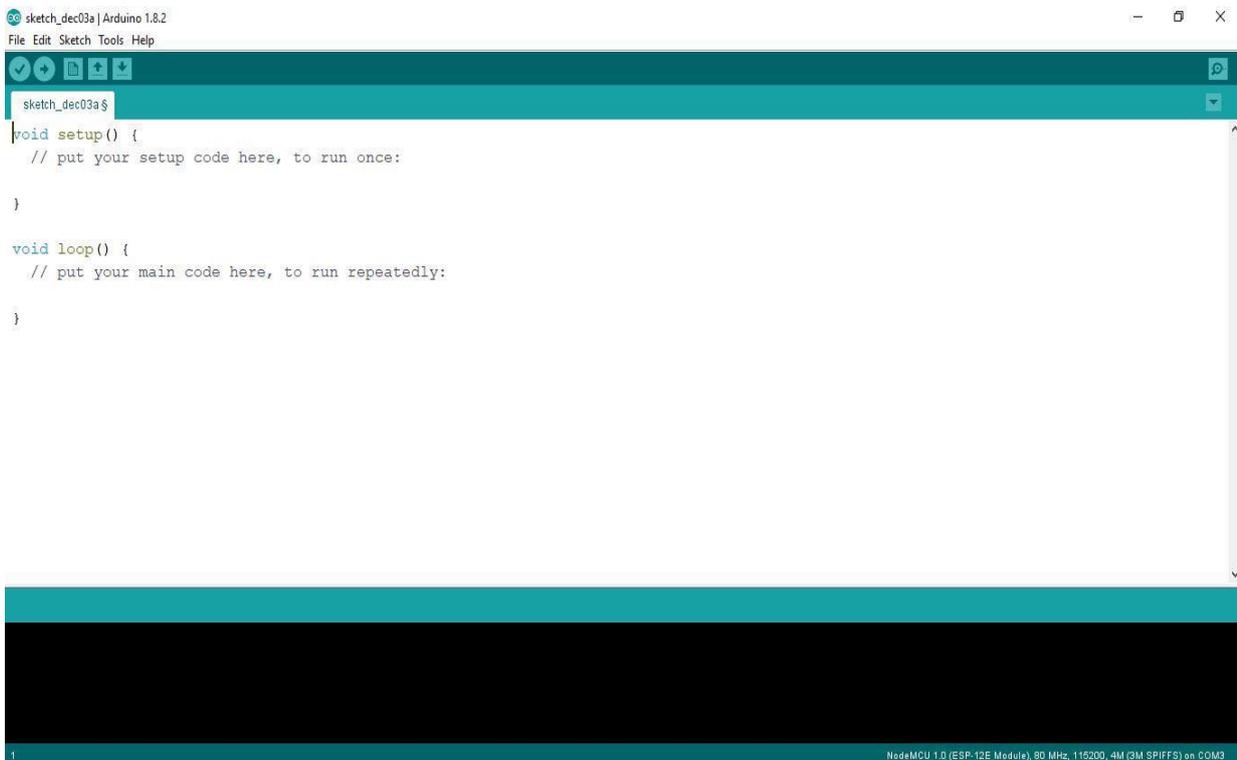


Fig. 3.2.1 A sample Arduino IDE

3.2.2 ThingSpeak Cloud

According to its developers, "ThingSpeak is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates". ThingSpeak was originally launched by ioBridge in 2010 as a service in support of IoT applications.

ThingSpeak has integrated support from the numerical computing software MATLAB from MathWorks, allowing ThingSpeak users to analyze and visualize uploaded data using Matlab without requiring the purchase of a Matlab license from Mathworks.

ThingSpeak has a close relationship with Mathworks, Inc. In fact, all of the ThingSpeak documentation is incorporated into the Mathworks' Matlab documentation site and even enabling registered Mathworks user accounts as valid login credentials on the ThingSpeak website. The terms of service and privacy policy of ThingSpeak.com are between the agreeing user and Mathworks, Inc.

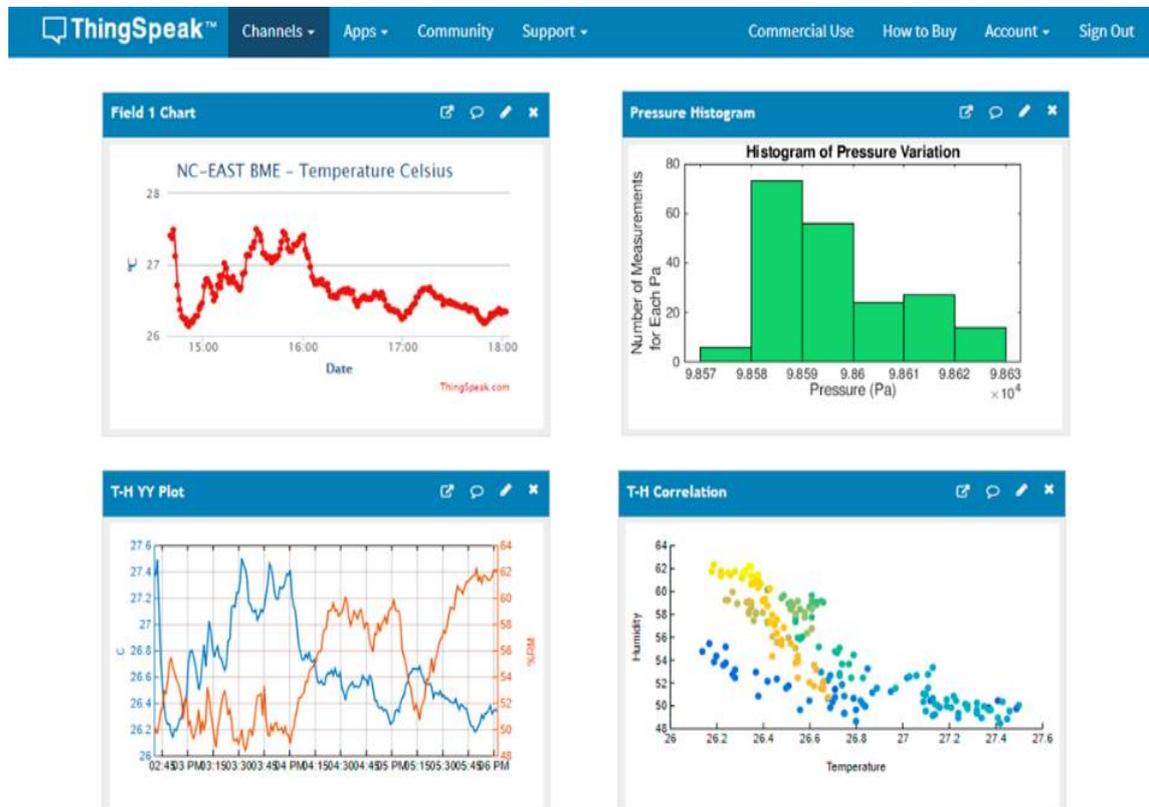


Fig. 3.2.2 ThingSpeak Cloud

3.2.3 Notepad++

Notepad++ is a text editor and source code editor for use with Microsoft Windows. It supports tabbed editing, which allows working with multiple open files in a single window. The project's name comes from the C increment operator.

Notepad++ is distributed as free software. At first the project was hosted on SourceForge.net, from where it has been downloaded over 28 million times, [2][3] and twice won the SourceForge Community Choice Award for Best Developer Tool. [4] The project

was hosted on TuxFamily from 2010 to 2015; since 2015 Notepad++ has been hosted on GitHub. Notepad++ uses the Scintilla editor component.

Notepad++ was developed by Don Ho in September 2003. The developer used JEXT (a Java-based text editor) at his company but, dissatisfied with its poor performance, he began to develop a text editor written in C++ with Scintilla. He developed it in his spare time since the idea was rejected by his company. Notepad++ was built as a Microsoft Windows application. The author considered, but rejected, the idea of using widgets to port it to the Mac OS X and Unix platforms.

Notepad++ was first released on Source Forge on 25 November 2003, as a Windows-only application. It is based on the Scintilla editor component, and is written in C++ with only Win32 API calls using only the STL to increase performance and reduce program size.

In January 2010 the US government obliged US-based open source project hosts to deny access from Cuba, Iran, North Korea, Sudan, and Syria to comply with U.S. law. As a response to what the developer felt was a violation of the free and open-source software (FOSS) philosophy, in June 2010 Notepad++ moved out of US territorial jurisdiction by releasing a version on TuxFamily, in France. Some community services of Notepad++ (Such as the forums and bug tracker) remained on SourceForge until 2015 when Notepad++ left SourceForge completely.

In 2011 Lifehacker described Notepad++ as The Best Programming Text Editor for Windows, stating that "if you prefer a simple, lightweight, and extensible programming plain-text editor, our first choice is the free, open-source Notepad++. Lifehacker criticized its user interface, stating that. It is, in fact, fairly ugly. Luckily you can do a lot to customize its looks, and what it lacks in polish, it makes up for in functionality.

In 2014 Lifehacker readers voted Notepad++ as the Most Popular Text Editor, with 40% of the 16,294 respondents specifying it as their most-loved editor. The Lifehacker team summarized the program as being "fast, flexible, feature-packed, and completely free. In 2015 Stack Overflow conducted a worldwide Developer Survey, and Notepad++ was voted as the most used text editor worldwide with 34.7% of the 26,086 respondents claiming to use it daily. Stack Overflow noted that the more things change, the more likely it is those things are written in JavaScript with NotePad++ on a Windows machine. The 2016 survey had NotePad ++ at 35.6%. In 2015, in response to the staff hijacking of projects hosted on SourceForge, Notepad++ left SourceForge completely with the forums being moved to NodeBB and the bug tracker to GitHub.

Notepad++ also has features that improve plain text editing experience in general, such as:

- Auto save
- Finding and replacing strings of text with regular expressions
- Guided indentation
- Line bookmarking
- Macros
- Simultaneous editing
- Split screen editing and synchronized scrolling
- Line operations, including sorting, case conversion (Uppercase, lowercase, camel case, sentence case), and removal of redundant whitespace
- Tabbed document interface

CHAPTER 4

BLOCK DIAGRAM OF SYSTEM ARCHITECTURE

4.1 Module 1: Helmet Theft Block Diagram

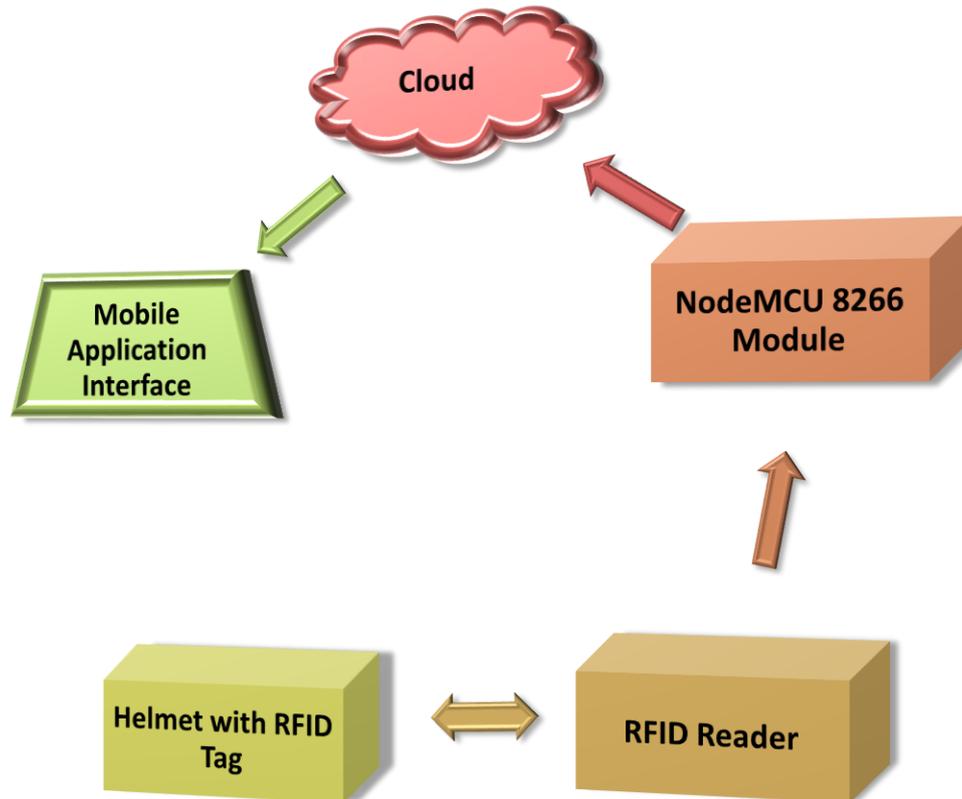


Fig. 4.1 Helmet Theft Block Diagram

In present time the helmet theft is one of the biggest problem faced by the rental vehicles(bounce),Which lead to a great loos to the company and it also creates the trouble for the rider who want the bike for ride.

For this issue of helmet theft, we have used Rfid tags, which help in the detection of whether the helmet is inside the bike or not. For this the Rfid should be placed inside the helmet and then the rfid receiver will be placed inside the luggage box which will check the Rfid tag(helmet). We use NodeMCU 8266 to send data to cloud from Rfid Reader .Now every time when the data from the Rfid receiver the NodeMCU push the data to cloud where the data will be saved as the helmet is present or not inside the luggage box.

We have also developed an app using which one can see if helmet is inside or not. This app can be used for both the service provider of rental vehicles and the rider who book the ride.

Thus using this module we can prevent the helmet theft and also the user will not be able to end the trip and the rental charge will continue. Preventing helmet theft in rental vehicles will reduce business loss.

4.2 Module 2: Alcohol Detection Block Diagram

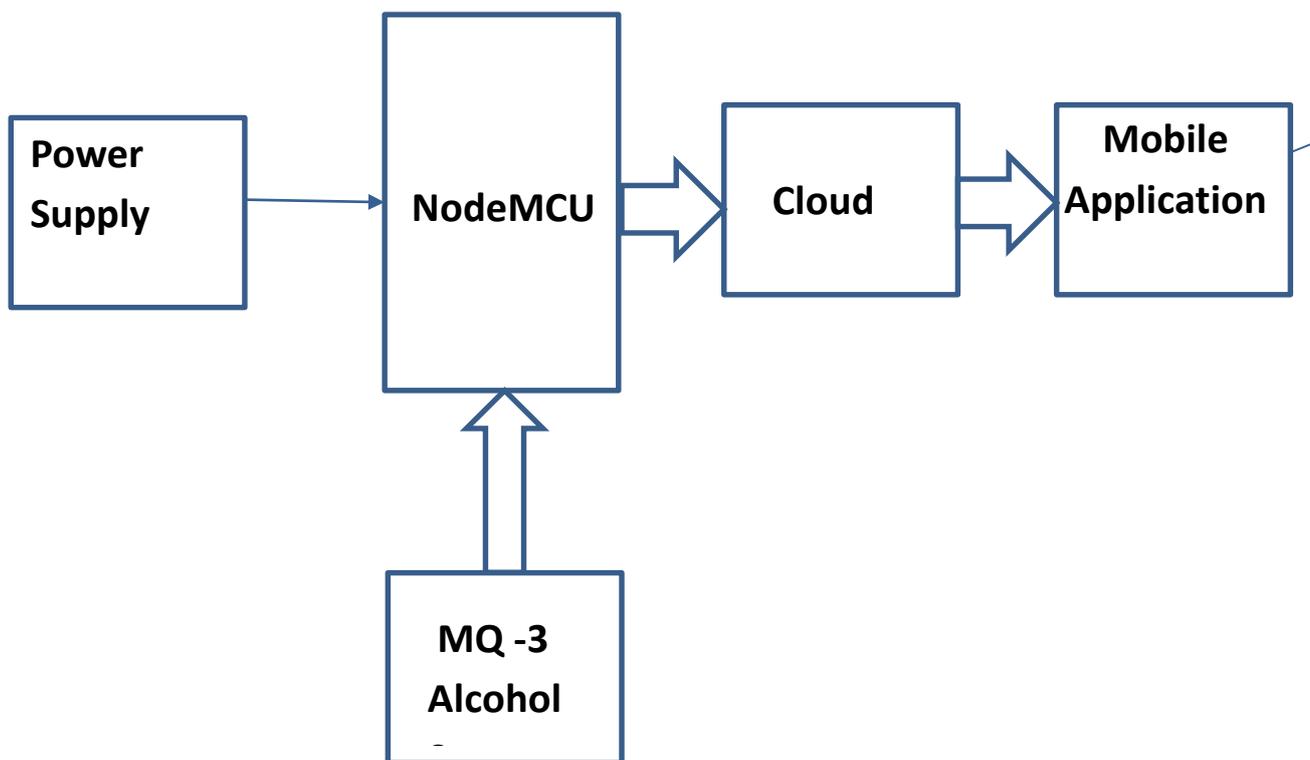


Fig. 4.2 Alcohol detection

In this module we have tested for the accident detection, the above block diagram illustrate the same.

Here we have used MQ3 sensor for checking for alcohol level of the rider. Initially the system look for whether the rider is wearing his helmet or not. Only if the rider has put on his helmet the engine will start, else the system won't star. This is done using the IR sensor which is attached to helmet. Thus making it important for all riders to wear the helmet to start their ride.

Once the user is wearing the helmet the MQ3 comes into action .The MQ3 sensor will test the alcohol level in the user body. Initially a threshold value is set for the alcohol level .Now

whenever the alcohol level is more than the set threshold value than the notification will be sent to the cloud using the NodeMCU.

The data from the NodeMCU is sent to the cloud from where the alcohol level can be checked and this data can also be seen from the app . The app shows whether the alcohol is detected or not.

Only if the user is wearing the helmet and there is no alcohol detection or alcohol level is less than the threshold level the rider will be able to take ride or else he won't be able to take ride.

4.3 Module 3: Accident Detection Block Diagram

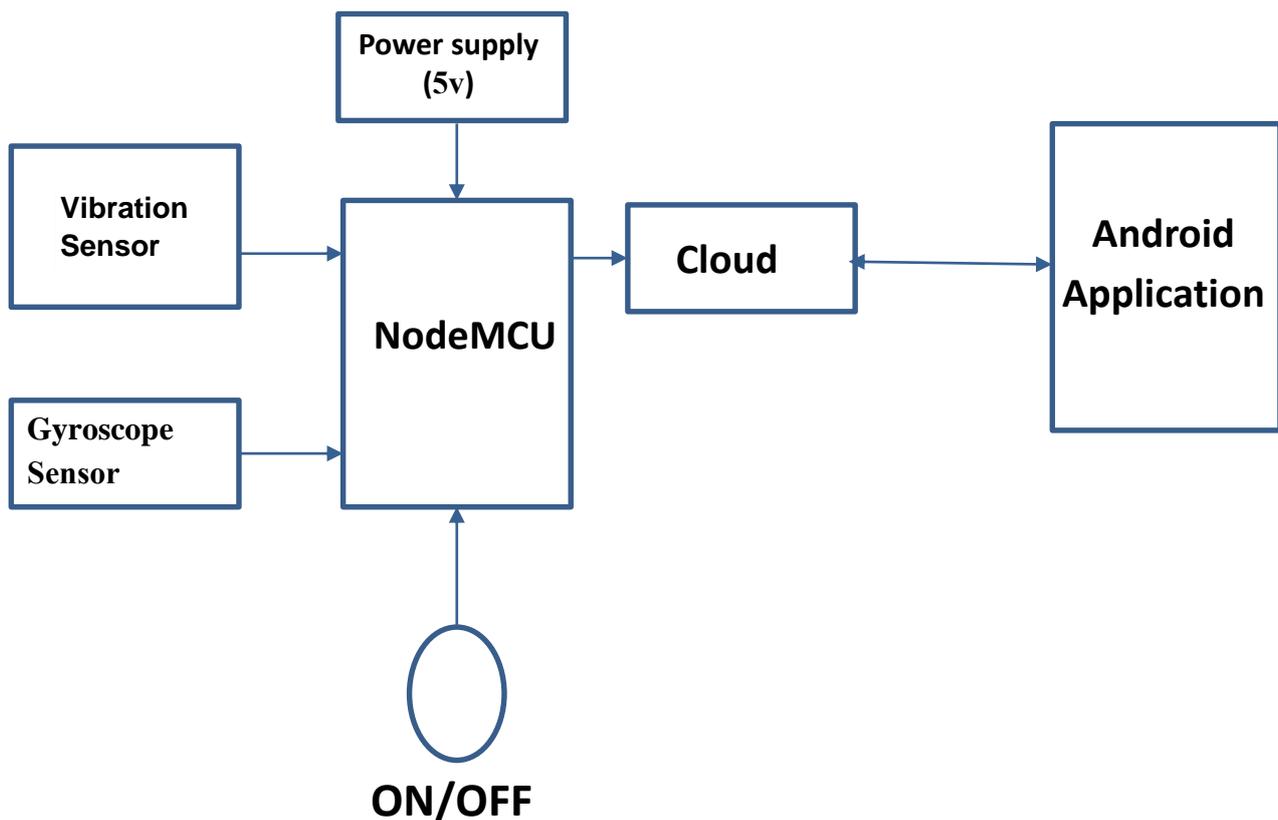


Fig. 4.3 Accident detection

The above block diagram represents the **Accident Detection** module in our Rider Safety Mechanism. Here we have used impact sensor and accelerometer sensor to detect the external force caused during an accident. The sensor will sense the force and through arduino module which is powered by 5v power supply and will send the data to cloud .The GPS module connected to the system will send the co-ordinates of the user's location to cloud.

All the above data which are fed in cloud is also reflected in our android app (Rider Safety.apk).

CHAPTER 5

SYSTEM DEVELOPMENT METHODOLOGY

5.1 Module 1: Helmet Theft

For helmet theft we are connecting a sensor to the helmet. So that the system can identify whether helmet is kept inside luggage box or not. To detect this, we are connecting an RFID sensor to the helmet and a RFID tag to the vehicle. Thus if helmet is inside the luggage box then the helmet comes in contact with the RFID tag. Thus it will send a high output signal to Arduino. Using the Wi-Fi module data will be send to service provider server. If helmet is kept inside only then the ride of the user ends or else the trip will continue and the charges may be applied to the user. To end the trip, the user, have to put the helmet back and only then he can end the trip.

5.2 Module 2: Accident Detection

This proposed system includes sensors such as Vibration sensor, accelerometer sensor, flex sensor etc. that will be mounted on helmet surface. These sensors will provide continuous readings to NodeMCU. Gyroscope sensor has three coordinates X, Y, Z, all these three axes some default value. If these default threshold values are crossed, then we can infer that accident has happened. To predict more accurately we are using Vibration sensor sensor. ANDing the sensor logic will high output as their threshold value is crossed and this will indicate that accident has happened. This will send a signal to interfacing module i.e. Arduino. Arduino is connected to smartphones via Bluetooth. Smartphone module consists of an android application in which user has to initially insert certain information such as name, emergency contacts, health related data, etc. As soon as accident is detected, Arduino will send a signal to the smartphone. Then user details and GPS location will be sent to the emergency contacts and nearby hospitals.

5.3 Module 3: Alcohol Detection

We have designed a system which checks the two conditions before we can turn ON the engine of the bike. Our system includes an alcohol sensor and a helmet sensing switch. A switch is used to detect whether the biker is wearing helmet or not. Alcohol sensor is used to detect, if the biker is drunk. According to the sensor's values the signal is send to the Micro-Controller Unit(MCU). Both the switch and the alcohol sensor are fitted in the helmet. If any of the two conditions are violated the engine will not turn ON. Thus we will prevent any drunk rider from driving the vehicle itself, so the enormous number of accidents that happen due to Drink and Drive will be reduced.

CHAPTER 6

WORKING

Initially the when user will book the vehicle for ride. The user has to take helmet out of luggage box first. The helmet contains an Rfid tag and the Rfid receiver is placed inside the luggage box of the vehicle. This Rfid tag and Rfid receiver helps to check the availability of the helmet inside the box. After the user takes out the helmet the user has to wear the helmet .If the user take out the helmet and he is not wearing it, he will not be able to take ride or start ride. The user has to wear the helmet in order to take ride; this can be checked using the IR sensor placed inside the helmet. This sensor will recognize the face of human only then the user can start the ride.

Even if the user is wearing the helmet, he won't be able to take ride. He will be able to take ride only if he has not consumed alcohol. So if the user has consumed alcohol above some threshold value that is set by the company, the user will not be able to start the ride. For checking for the alcohol detection we use the MQ3 sensor.

The MQ3 sensor will check for alcohol when the user puts on his helmet. If this sensor detects any alcohol in the rider body the user will not be able to take ride plus the notification will be sent to the cloud. The data from the cloud is used by the company to retrieve the data.

Once the user is not alcoholic detected the user can start his bike and can take a ride. Now suppose the rider met with an accident the.The vibration sensor is set inside the helmet using which the data about the accident can be retrieved. Initially the vibration threshold is set to some value by the company. Now when the vibration limit exceed the threshold the message as accident has occurred is sent to server or cloud and this is also shown on the app.

Once the company gets the notification about the accident the company will be able to take action or can inform the nearest hospital and can send the company staff to the accident location at the place of accident . At the time when the user wants to end the trip the user has to put the helmet inside the luggage bag or else he will not be able to end his trip.

Suppose the user didn't put helmet inside the trip will not end and the charges will keep on increasing and the user has to pay for which next time when he book his ride .Thus this will help the company to keep an eye on the vehicle and reduce the loss.

At end if there is anything wrong with the sensor or any sensor is not working the user need not worry that any charges will be added to the trip charges he/she is taking. He/she can simply contact the company technician who will come and repair the sensor if needed. And thus serving the best service possible to the customers.

CHAPTER 7

SYSTEM TESTING

As name indicate test nothing but check something. Here software testing nothing but checking the errors, failure and faults. Here fault is a condition which may cause a software to fail. And the error is something which gives the difference between actual and expected results. Failure is a nothing but a component of the system may not work according to its functional specification. Software testing will be done by creating or writing test cases. Here test cases consist following things expected output, actual output and remarks.

7.1 Testing Methods

1. Validation
2. Unit
3. Integration
4. GUI
5. Browser Compatibility
6. Performance
7. Regression
8. Black Box
9. White Box
10. Acceptance

1. Validation Testing

Validation testing as name indicates it is used to validate the system. The users should be able to select the image that he/she wishes to perform the operations on.

2. Unit Testing

Unit testing is used to verify the small piece of code or small part of the program. Here the programmer will write a small piece of code and check for his functionality. If it is working properly then there will be no issues, if it not working or not giving expected output then unit test fails and then code will have corrected and again it will check for the same this process will be repeated until programmer get proper outputs. The advantage of this testing is errors can be find and fixed very easily because it becomes easy for the programmer to find the errors in small piece of code as compared to large programs and hence this will increase the robustness of the system.

3. Integration Testing

As the name indicates that integration means combining so here integration testing is nothing but combining all the modules or components to check whether they are working fine when they are combined together. The unit tested modules or components will be integrated together and then check for their functionalities. In this project we have done the integration testing by creating three components separately and at the end of development these three components put it together and they are working properly and giving the expected results.

4. Graphical User Interface (GUI) Testing

Graphical User Interface testing is used to check the front end design of the project by looking at all the elements used in the page and styles used in the page. Here tester will check whether the all the elements aligned properly or not and checks the size, styles, fonts and so on is designed as per the user needs or not. GUI design is very important because user always attract towards good and stylish designs because nobody likes when you design a large buttons unnecessary at the need of small buttons.

6. Performance Testing

This testing is used to check whether the application is performing as per the requirements or not and to check whether it taking more timing to load the pages and the speed of the computations and results will be tested. For doing this test some automated tools will be used.

7. Regression Testing

This testing will be applied on the whole application and checks if there any functionality is missed out or not and also checks about if there any modification is required for the application as per any new requirements or demand from the clients will be done here.

8. Black Box Testing

This testing is very famous in development lifecycle. This testing can be applied each and every test part. This method checks every functionality of the software module. All features work properly or not.

9. White Box Testing

This testing is specially code base testing. Tester passes some input to the system and check whether it works properly or not. To do testing it accepts some data as input. Especially it checks feature working behavior is working or not.

10. Acceptance Testing

This testing checks whether the system meets business requirements or not. It also verifies the product is ready for delivery. This testing also incorporates user need, user acceptance, user satisfaction. It also checks whether the product is able to meet customer requirements or not. Customer is ready to accept this product or not.

7.2 Test Cases:

Table 7.2.1: Test Case for uploading the code.

Serial Number of Test Case	TC 01
Module Under Test	Arduino Module (NodeMCU8266)
Description	User can upload the .ino file (desired code) into NodeMCU from Arduino software.
Output	User uploaded the .ino file into NodeMCU.
Remarks	Successfully Executed

Table 7.2.2: Test Case for Sensor connection

Serial Number of Test Case	TC 02
Module Under Test	RFID Sensor
Description	User can test sensor connection with Arduino module.
Output	Sensors are working properly.
Remarks	Successfully Executed

Table 7.2.3: Test case for RFID Sensor

Serial Number of Test Case	TC 03
Module Under Test	RFID Sensor
Description	RFID Sensor has two components: 1. RFID Tag 2. RFID Reader User can test RFID reader with its tag.
Output	RFID reader reads different RFID tags successfully.
Remarks	Successfully Executed

Table 7.2.4: Test case for MQ3 Sensor

Serial Number of Test Case	TC 04
Module Under Test	MQ3 Sensor
Description	MQ3 sensor senses the presence of alcohol gas concentration from 0.05 mg/L to 10mg/L.
Output	The sensor successfully detects the presence of alcohol gases along with its concentration.
Remarks	Test Successful.

Table 7.2.5: Test case for IR Sensor

Serial Number of Test Case	TC 05
Module Under Test	IR Sensor
Description	IR sensor emits Infrared light and provides digital as well as analog output.
Input	Keeping an obstacle in front of light
Output	Digital output is produced (LED blinks).
Remarks	Test Successful.

Table 7.2.6: Test case for Vibration Sensor

Serial Number of Test Case	TC 06
Module Under Test	Vibration Sensor
Description	This sensor senses any vibration in the system due to any external force. We can set the threshold to detect different kind of forces.
Input	Providing an external force to the system.
Output	Sensor detects the force if it is greater than threshold.
Remarks	Proper result came.

Table 7.2.7: Test case for Server connection.

Serial Number of Test Case	TC 07
Module Under Test	Server connection
Description	User is connecting the Arduino module with cloud server.
Output	Arduino module is successfully connected with the server via channel id.
Remarks	Test successful.

Table 7.2.8: Test case for Data uploading in cloud.

Serial Number of Test Case	TC 08
Module Under Test	Data upload in cloud.
Description	User uploads the sensors recorder data into the cloud server using Arduino module.
Output	Data uploaded successfully.
Remarks	Test successful.

Table 7.2.9: Test case for Android .apk installation.

Serial Number of Test Case	TC 09
Module Under Test	Android .apk installation
Expected outcome	Android app should get installed in the user's mobiles.
Actual outcome	App is successfully installed.
Remarks	Test successful.

Table 7.2.10: Test case for working of app.

Serial Number of Test Case	TC 10
Module Under Test	Working of app
Description	App will be connected to the server and display the data stored in cloud server.
Output	App successfully connects to the server and displays the data in the UI.
Remarks	Execution success.

CHAPTER 8

SOURCE CODE

```
#include <SPI.h>
#include <MFRC522.h>
#include <ESP8266WiFi.h>
#include <ThingSpeak.h>
#define RST_PIN  D2
#define SS_PIN  D4
int irPin = D1;
int irPin1 = D0;
//Alco
float sensor_volt;
float RS_gas;
float R0;
float ratio;
float BAC;
int R2 = 2000;

//Alco

MFRC522 mfrc522(SS_PIN, RST_PIN); // Create MFRC522 instance

int avail,alco,hWear,accD;
const char ssid[] = "u.s";
const char password[] = "lkjhgfdsa";

WiFiClient client;
```

```
unsigned long myChannelNumber =822168;
const char * myWriteAPIKey ="NH2BS0PYBGLYHID3";

unsigned long myChannelNumber1 =851514;
const char * myWriteAPIKey1 ="HNCFT9F2UFA4QSFI";

unsigned long myChannelNumber2 =851557;
const char * myWriteAPIKey2 ="OD1E7WR0PD71JJ8C";

unsigned long myChannelNumber3 =820704;
const char * myWriteAPIKey3 ="C48OY1PHT39AIY8W";

void setup() {
  Serial.begin(9600); // Initialize serial communications with the PC
  SPI.begin(); // Init SPI bus
  mfrc522.PCD_Init(); // Init MFRC522
  Serial.println("Waiting for RFID-chip...");
  //IR
  pinMode(irPin, INPUT);
  pinMode(irPin1, INPUT);

  //IR

  delay(10);
  // Connect to WiFi network
```

```
Serial.println();
Serial.println();
Serial.print("Connecting to ");
Serial.println(ssid);
WiFi.begin(ssid, password);
while (WiFi.status() != WL_CONNECTED)
{
    delay(500);
    Serial.print(".");
}
Serial.println("");
Serial.println("WiFi connected");
// Print the IP address
Serial.println(WiFi.localIP());
ThingSpeak.begin(client);
}

void loop() {

//IR
    int irValue = digitalRead(irPin);
//Serial.println(irValue);
    if (irValue == 0)
    {
        hWear=1;
        //Serial.println("User Wearing Helmet");
    }
}
```

```

}
else
{
  hWear=0;
  //Serial.println("Please Wear Helmet to Start Engine");
}

//IR

//Alco

int sensorValue = analogRead(A0);
sensor_volt=(float)sensorValue/1024*5.0;
RS_gas = ((5.0 * R2)/sensor_volt) - R2;

/*-Replace the value of R0 with the value of R0 in your test -*/
R0 = 16000;
ratio = RS_gas/R0;// ratio = RS/R0
double x = 0.4*ratio;
BAC = pow(x,-1.431); //BAC in mg/L

Serial.print("\n\nAlcohol level : BAC = ");
Serial.print(BAC*0.01); //convert to g/dL
Serial.println(" g/dL");
//delay(1000);

//Alco

//BAC condition

```

```
//hel
if(!mfr522.PICC_IsNewCardPresent())
{

Serial.print("Helmet Status : Helmet is not inside Scooter Dicky, ");

avail;
Serial.println(avail);
ThingSpeak.setField(1,avail);
ThingSpeak.writeFields(myChannelNumber,myWriteAPIKey);

ThingSpeak.setField(1,alco);
ThingSpeak.writeFields(myChannelNumber1,myWriteAPIKey1);

if(hWear==1)
{
ThingSpeak.setField(1,hWear);
ThingSpeak.writeFields(myChannelNumber2,myWriteAPIKey2);

if(alco==0)
{
Serial.println("Engine Status : User has Worn Helmet and Not Drunk, Start Engine
");
//ThingSpeak.setField(2,alco);
//ThingSpeak.writeFields(myChannelNumber,myWriteAPIKey);
}
```

```

else
{
  Serial.println("Engine Status : User has worn Helmet but Drunk, Unable to Start
Vehicle Engine ");
  //ThingSpeak.setField(2,alco);
  //ThingSpeak.writeFields(myChannelNumber,myWriteAPIKey);
}
}

else
{
  Serial.println("Engine Status : Please Wear Helmet to Start Vehicle Engine ");

  ThingSpeak.setField(1,hWear);
  ThingSpeak.writeFields(myChannelNumber2,myWriteAPIKey2);
}

//IR1
int irValue1 = digitalRead(irPin1);
//Serial.println(irValue1);
if (irValue1 == 0)
{
  accD=1;
  Serial.println("Accident Status : Accident Detected");
  ThingSpeak.setField(1,accD);
  ThingSpeak.writeFields(myChannelNumber3,myWriteAPIKey3);
}
else

```

```
{  
  accD=0;  
  Serial.println("Accident Status : Rider Safe");  
  ThingSpeak.setField(1,accD);  
  ThingSpeak.writeFields(myChannelNumber3,myWriteAPIKey3);  
}  
  
//IR1  
  
return;  
delay(2000);  
}  
  
Serial.print("Helmet Status : Helmet Inside Scooter Dicky, ");  
avail;  
Serial.println(avail);  
Serial.println("Engine Status : Please take out Helmet from vehicle dicky and Wear it  
to Start Vehicle Engine");  
  
//hel  
delay(2000);  
  
mfr522.PICC_HaltA();  
  
ThingSpeak.setField(1,avail);  
ThingSpeak.writeFields(myChannelNumber,myWriteAPIKey);
```

```
ThingSpeak.setField(1,alco);  
ThingSpeak.writeFields(myChannelNumber1,myWriteAPIKey1);  
  
ThingSpeak.setField(1,hWear);  
ThingSpeak.writeFields(myChannelNumber2,myWriteAPIKey2);  
  
}
```

CHAPTER 9

SNAPSHOTS

9.1 Helmet Theft:

9.1.1 Helmet inside luggage box



Fig. 9.1.1.1 Helmet inside

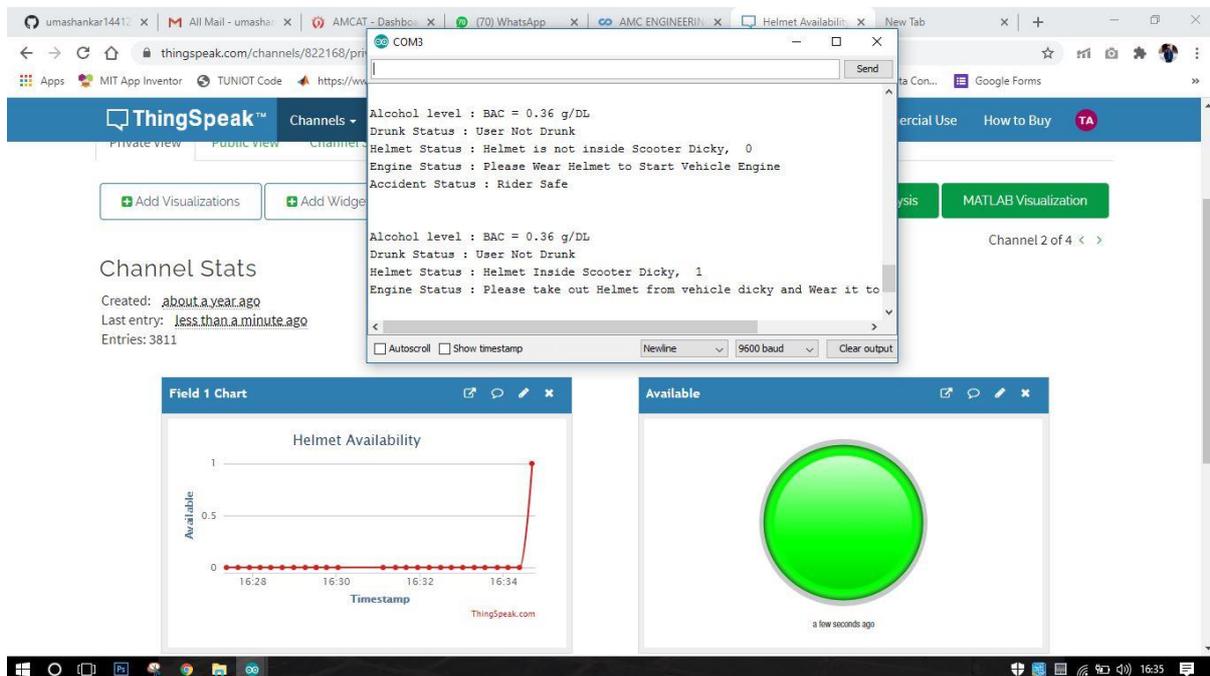


Fig. 9.1.1.2 Helmet inside serial monitor



Fig. 9.1.1.3 Helmet inside Application

9.1.2 Helmet Not inside luggage box

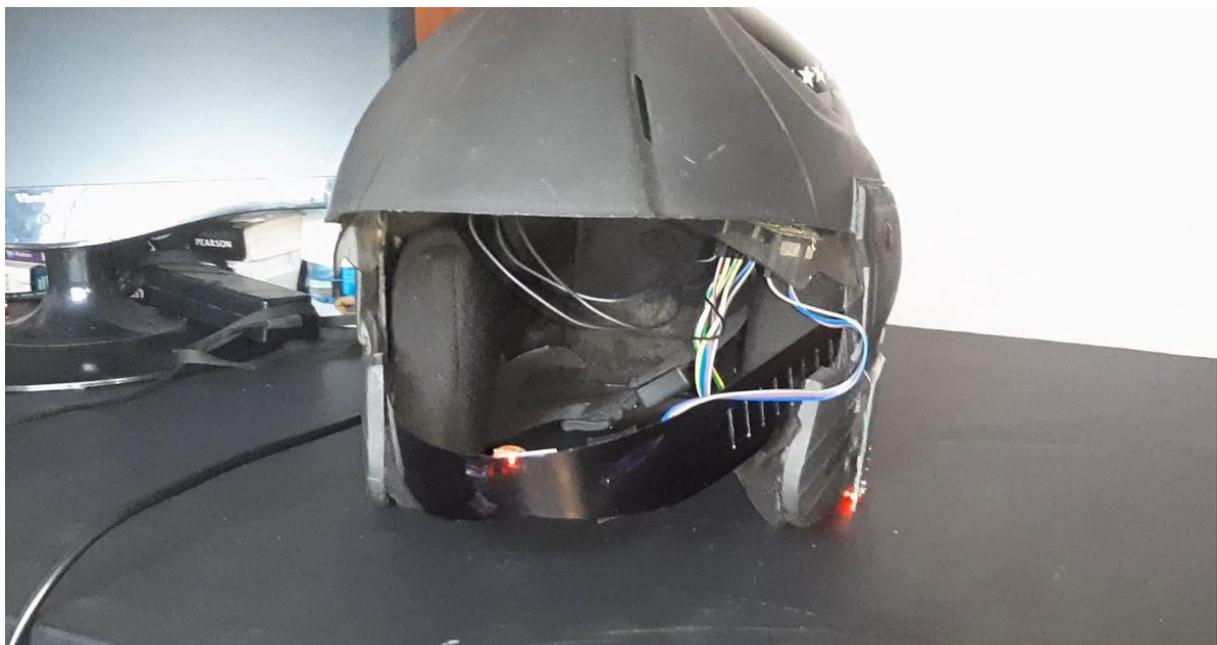


Fig. 9.1.2.1 Helmet Outside

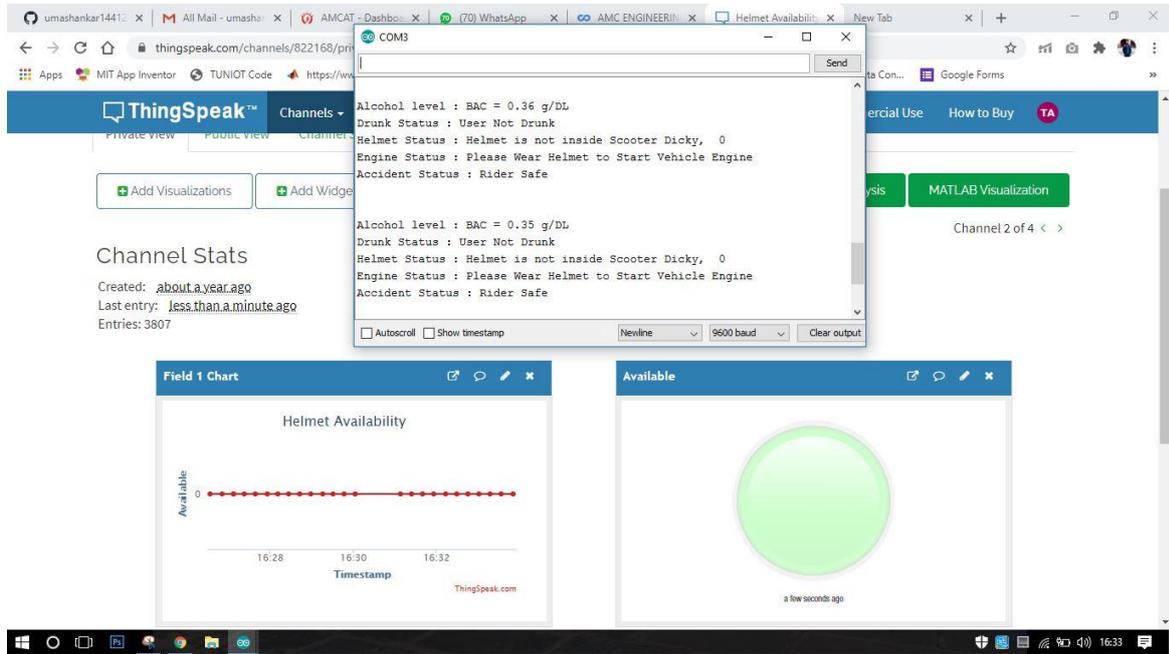


Fig. 9.1.2.2 Helmet inside serial monitor



Fig. 9.1.2.3 Helmet inside Application

9.2 Alcohol Detection:

9.2.1 Rider Drunk



Fig. 9.2.1.1 Rider Drunk

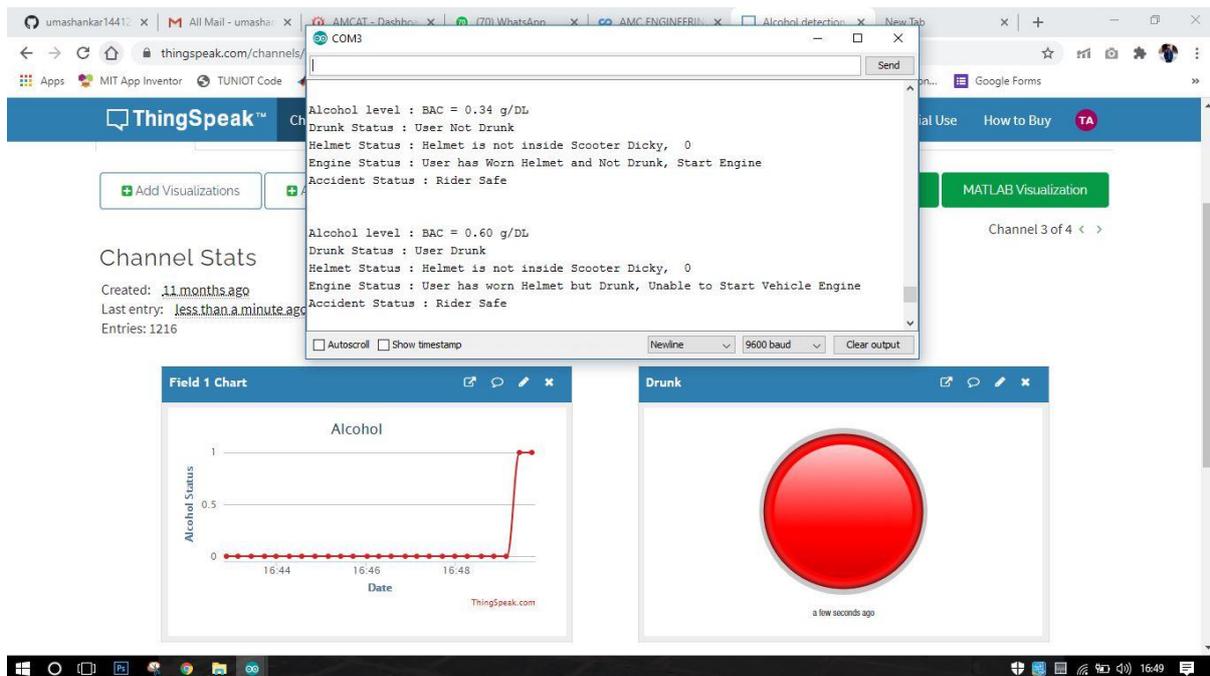


Fig. 9.2.1.2 Rider Drunk Serial monitor



Fig. 9.2.1.3 Application Interface

9.2.2 Rider Not Drunk

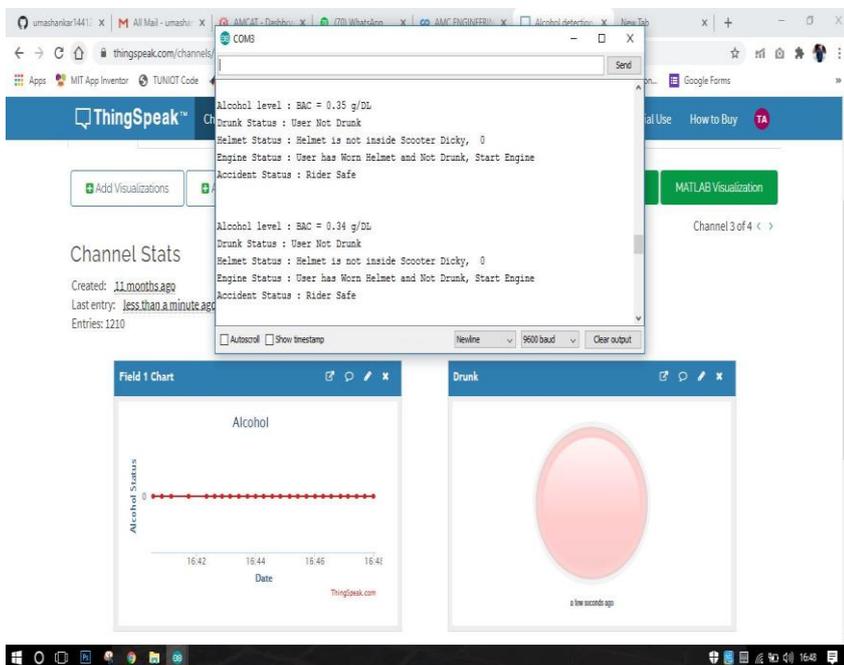


Fig. 9.2.1 Rider not Drunk Serial Monitor and Application Interface



9.3 Accident Detection:

9.3.1 Rider Safe

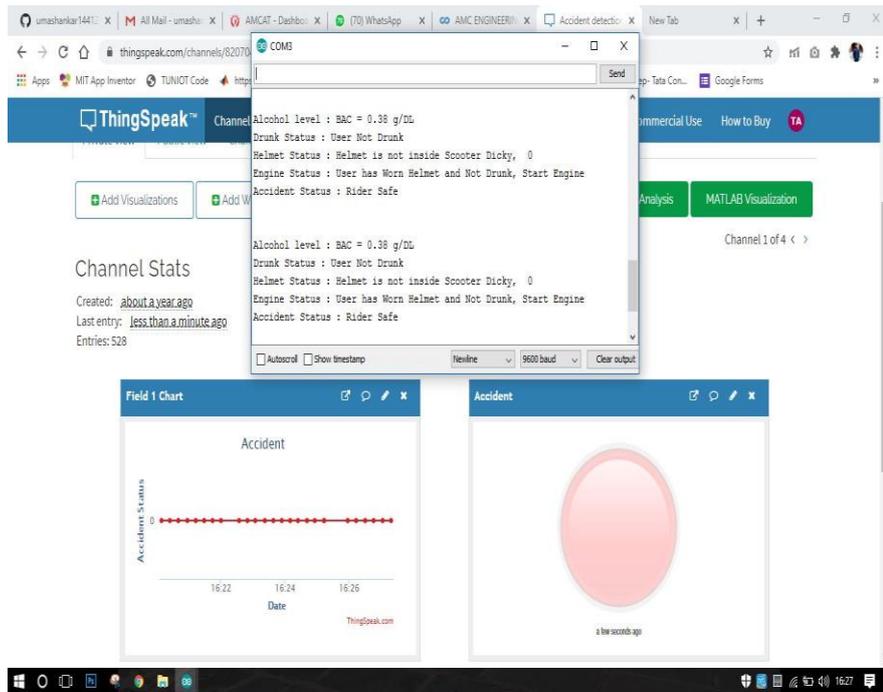


Fig. 9.3.1 Rider is Safe Serial Monitor and Application Interface

9.3.2 Accident Occurred



Fig. 9.3.2.1 Accident Occurred

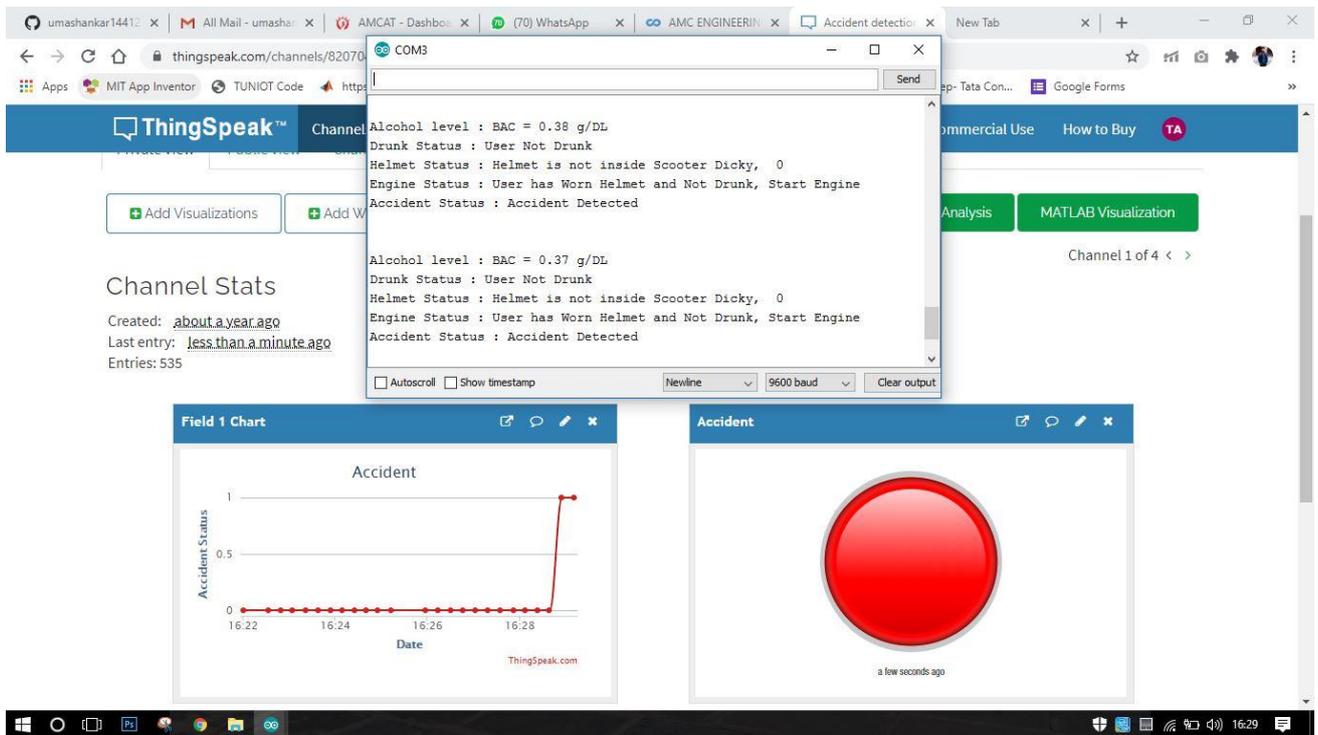


Fig. 9.3.2.2 Accident Occurred Serial Monitor



Fig. 9.3.2.3 Application Interface

CONCLUSION AND FUTURE WORK

Our proposed solution will benefit the rental vehicle service provider and also it will reduce the fatality rate, its main advantage is that we can save lives using this project and further we can also track the location of vehicle if accident occurs. It includes only brief synopses of the many activities the agency will pursue in reducing the number of motorcycle crashes and the fatalities and injuries associated with these devastating incidents. Android application built for the system will ensure the smooth functioning of system.

We can prevent the helmet theft and user will not be able to end the trip and the rental charge will continue. Preventing helmet theft in rental vehicles will reduce business loss. Experimental evaluation of the system showed that the alcohol sensor was able to deliver fast response when alcohol is detected. Also, the ability of alcohol sensor to operate over a long time is feature of proposed system. So our accident detection system will prevent the accidents due to Drink and drive by detecting the alcohol and thus it will reduce the fatality rate. Also if any accident happens then it will notify the emergency contacts and nearby hospitals so the rider will get immediate hospital services. Personal protection is the best weapon against injury mitigation when a crash does occur, followed by rapid emergency response.

“Safety should never be proprietary, and it’s our intention to make an impact well beyond our own system, encouraging others to be more transparent with their data and to share best practices that can make everyone safer.”

-Tony West, Chief Legal Officer

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AMC ENGINEERING COLLEGE

Department of Computer Science & Engineering

Project Outcomes

The student should have the ability to:

CO1: Identify the problem through intense literature survey.
CO2: Use research based knowledge and methods including analysis and synthesis of information.
CO3: Implement suitable engineering tool to carry out project work using programming techniques leading to a logical solution.
CO4: Illustrate the application IOT in Industrial Automation and identify Real World Design constrains.
CO5: Access cloud storage system and cloud security, the risk involved, its impact and develop cloud application.
CO6: To write simple GUI android application, use built-in widgets and components, work with database to store data locally .

CO-PO-PSO Mapping

CO-PO-PSO
CO1 → PO1(2), PO2(3), PSO1(1), PSO2(1)
CO2 → PO1(3), PO2(3), PO4(3), PSO1(2), PSO2(2)
CO3 → PO3(3), PO4(3), PO5(3), PSO1(3), PSO2(3)
CO4 → PO7(3), PO11(1), PO12(3)
CO5 → PO9(3), PO10(3), PSO2(1)
CO6 → PO6(3), PO8(3)

CO No.	Statement	Bloom's Cognitive level	POs/PSOs
C478.1	CO1: Identify the problem through intense literature survey.	Understanding	PO1, PO2/PSO1, PSO2
C478.2	CO2: Use research based knowledge and methods including analysis and synthesis of information.	Apply	PO1, PO2, PO4/PSO1, PSO2
C478.3	CO3: Implement suitable engineering tool to carry out project work using programming techniques leading to a logical solution.	Create	PO3, PO4, PO5/PSO1, PSO2
C478.4	CO4: Illustrate the application IOT in Industrial Automation and identify Real World Design constrains.	Apply	PO7, PO11, PO12
C478.5	CO5: Access cloud storage system and cloud security, the risk involved, its impact and develop cloud application.	Apply	PO9, PO10/PSO2
C478.6	CO6: To write simple GUI android application, use built-in widgets and components, work with database to store data locally .	Create	PO6, PO8

PROGRAM OUTCOMES:

PO1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	Problem analysis: Identity, formulate, review research literature and analyses complex engineering problems reaching sub stained conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	Design/Development of solution: Design solutions for complex, engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4	Conflict investigation of complex problems: Use research based knowledge including design of experiments, analysis and implementation of data , synthesis of information which provide valid inference.
PO5	Modern end system: Create, select and apply appropriate technologies such as machine learning which includes prediction and modelling to complex engineering problems to analyses their limitations.
PO6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, legal, cultural issues and the consequent responsibility relevant to the professional engineering practice.
PO7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, demonstrate the knowledge of, and need for sustainable development.
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
PO9	Individual and team work: Function effectively as an individual, as a member or leader in diverse teams ad in multidisciplinary settings.
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community, with society at large such as, being able to comprehend and write effective reports, design documentation, make effective presentations, give and receive clear instructions.
PO11	Project management and finance: Demonstrate the knowledge and understanding of the engineering, management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	Life-long learning: Recognize the need for, have the preparation and ability to engage In independent life-long learning in the broadcast context of technological change.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1	Graduates possess advanced knowledge of Computer Science and Engineering and excel in leadership roles to serve the society.
PEO2	Graduates of the program will apply Computer Science Engineering tool in core technologies for improving knowledge in the Interdisciplinary Research and Entrepreneurs.
PEO3	Graduates adapt Value-Based Proficiency in solving Real Time problems.

CO-PO Mapping

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
C478.1	2	3										1	1	
C478.2	3	3		3			1					2	2	
C478.3			3	3	3	1	2					3	3	
C478.4	2	1	3			2		2	2		3		3	3
C478.5	2	1	1	2					2	2	1		2	1
C478.6	3	2	3	1				2	2			2	2	3
Average	2.4	2	2.5	2.3	3	1.5	1.5	2	2	2	2	2	2.2	2.3

Strength of CO Mapping to PO/PSOs with Justification

CO->PO Mapping	Justification
C478.1->PO1(2)	We apply the knowledge of engineering fundamental to solve our problem statement.
C478.1->PO2(3)	We identify and review the related research literature to formulate our problem statement.
C478.1->PO12(1)	We learned about the real time problem which will be helpful in future.
C478.1->PSO1(1)	We apply the knowledge of basic data structures and suitable algorithm.
C478.1->PSO2(1)	We build our project by applying modern methodologies like Internet of Things, mobile application and cloud services.
C478.2->PO1(3)	We apply the knowledge of IoT using Arduino.
C478.2->PO2(3)	We formulate our solution using previous solution mentioned in IEEE papers
C478.2->PO4(3)	We analyze and interpret the data to reach the conclusion.
C478.2->PSO1(2)	We use the knowledge of cloud services to analyze the data.
C478.2->PSO2(2)	We build our project by applying modern methodologies like Internet of Things, Mobile application and cloud services.
C478.3->PO3(3)	Design the solution to our problem by using tools like Android Studio, Arduino IDE, Cloud service
C478.3->PO4(3)	Research methods are used to synthesis the information.
C478.3->PO5(3)	We apply the IT tools and techniques like Arduino IDE 3.2 with different sensor respectively to create our project.
C478.3->PSO1(3)	Knowledge of data structure, cloud channel connection are to solve the problem statement.
C478.3->PSO2(3)	Modern methodologies like IoT, Cloud (ThinkSpeak), Android Application are applied to build our project.
C478.4->PO1(2)	Understanding the basic knowledge of internet of thing.
C478.4->PO3(3)	We designed and developed an embedded system.
C478.4->PO11(1)	We apply management principles to manage our project.
C478.4->PO12(3)	Our project engages in lifelong learning in the broadest context of IoT and android application.
C478.5->PSO2(1)	We build project with software development life cycle by applying modern technologies.
C478.5->PO9(2)	While working on this project, we work effectively as an individual or a leader.
C478.5->PO10(2)	We communicate our project effectively through PowerPoint presentation and write effective reports.
C478.6->PO3(3)	We develop the modern graphical user interface for sending the signal and viewing the result.
C478.6->PO8(2)	We apply the ethical principles and the nonce of the engineering practice.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO-1	Professional Skills: Ability of applying the Computing Concepts Data Structures, Computer Hardware, Computer Networks and Suitable Algorithm
PSO-2	Software Skills: Ability to build Software Engineering System with Development Life Cycle by using analytical knowledge in Computer Science & Engineering and applying modern methodologies

PO-PSO Mapping

PO's	PSO1	PSO2
PO1	3	
PO2	2	3
PO3	2	3
PO4	3	2
PO5	1	3
PO6	1	
PO7	1	
PO8		
PO9		2
PO10	1	
PO11	2	
PO12	3	2

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI, KARNATAKA – 590018**



2019-2020

PROJECT REPORT

On

**“Statistical Features-Based Real-Time Detection of Drifted
Twitter Spam”**

**Submitted in partial fulfillment of the requirement for the award of
BACHELOR OF ENGINEERING**

IN

INFORMATION SCIENCE AND ENGINEERING

Submitted by,

ABHISHEK P BODAKE (1AM14IS002)

Under the Guidance of

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DEPARTMENT OF INFORMATION SCIENCE & ENGINEERING



2019-2020

CERTIFICATE

This is to Certify that the project work entitled “**Statistical Features-Based Real-Time Detection of Drifted Twitter Spam**” has been successfully carried out by **ABHISHEK P BODAKE (1AM14IS002)** bonafide student of **VIII SEMESTER, AMC Engineering College** in partial fulfillment of the requirements for the award of degree in **Bachelor of Engineering in Information Science and Engineering** of **Visvesvaraya Technological University, Belgavi** for the academic year **2019-2020**. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the departmental library. The project report has been approved as it satisfies the academic requirements in respect of project work for the said degree.

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5/12/19

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DECLARATION

I, **ABHISHEK P BODAKE(1AM14IS002)** student of **VIII Semester B.E in Information Science, AMC Engineering College** hereby declare that the project work titled **“Statistical Features-Based Real-Time Detection of Drifted Twitter Spam”** has been carried out by us at AMC Engineering College, Bangalore and submitted in partial fulfillment of the course requirements for the award of the degree of **Bachelor of Engineering in Information Science and Engineering of Visvesvaraya Technological University, Belgavi**, for the academic year **2019-20**. I also declare that, to the best of our knowledge and beliefs, the work reported here does not form part of any other dissertation on the basis of which a degree or award was conferred on an earlier occasion on this by any other student.

PLACE: BANGALORE

ABHISHEK P BODAKE(1AM14IS002)

DATE:

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ABHISHEK P BODAKE(1AM14IS002)

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CHAPTER-1

1.1 Introduction

In the past few years, online social networks like Facebook and Twitter have become increasingly prevailing platforms which are integral part of people's daily life. People spend lot of time in micro blogging websites to post their messages, share their ideas and make friends around the world. Due to this growing trend, these platforms attract a large number of users as well as spammers to broadcast their messages to the world. Twitter is rated as the most popular social network among teenagers.

However, exponential growth of Twitter also invites more unsolicited activities on this platform. Nowadays, 200 million users generate 400 million new tweets per day. This rapid expansion of Twitter platform influences more number of spammers to generate spam tweets which contain malicious links that direct a user to external sites containing malware downloads, phishing, drug sales, or scams. These types of attacks not only interfere with the user experience but also damage the whole internet which may also possibly cause temporary shutdown of internet services all over the world.

We have collected various tweets from Bot Repository. Then we further characterize the spam tweets and non-spam tweets. We also derived some lightweight features along with the Top-30 words that are providing highest information gain from Bag-of-Words model. On this processed dataset, we train our model using on machine learning algorithms for tweets classification.

1.2 Existing System

Various work for the spam tweet detection has been carried out earlier by using data mining and machine learning techniques. In existing work, they used word vector to train their model, but they have not explored user or tweet based features to address the problem. As Twitter has increased their character limit to 280 characters, it is essential to scrutinize the tweet's text along with the user-specific features. Despite many existing solutions, there are very few comprehensive solutions that can consolidate tweet's text information along with the user based features which can detect spam tweets in real-time.

1.3 Problem Statement

In existing work, Industries and researchers have applied different approaches to make spam free online reviews portal, social network platform. Some of them are only based on user-based features while others are based on text based features only. However, there is no comprehensive solution that can consolidate review's text information along with the user based features.

1.4 Proposed system

We prepare our dataset by collecting tweets corresponding to tweet ids. In order to get information from tweets' text, we want to extract those words that can be strong indicators to classify the tweets in one of the classes: spam or non-spam. After characterizing the spam and non-spam tweets' text into two separate documents, we construct the following sets:

U_S = Collection of unique words in the spam tweets' text.

U_{NS} = Collection of unique words in the non-spam tweets' text.

For each word T in U_S and U_{NS} we calculate the following probability values:

$$P(T|U_S) = \frac{\text{\# of Spam tweets that contain } T}{\text{total \# of Spam tweets}}$$
$$P(T|U_{NS}) = \frac{\text{\# of Non-Spam tweets that contain } T}{\text{total \# of Non-Spam tweets}}$$

We calculate the information gain γ_T for each word T as follows:

$$\gamma_T = \left| \frac{P(T|U_S)}{P(T|U_{NS})} \times \log_{10} \left[\frac{P(T|U_S)}{P(T|U_{NS})} \right] \right|$$

We sort words in decreasing order based on their γ_T . We take the top 15 words from each of the U_S and U_{NS} using above calculation. We combine these words to form top-30 words that we use in our feature set. The benefit of using these words based on their entropy score in the feature-set is that we were able to reduce uncertainty in the prediction outcome as these words have a different impact of frequency count in spam and non-spam tweets. Hence we expect considering these top 30 words will help us to classify the tweets accurately for each class.

Advantages of Proposed System

- Performance and accuracy is more comparing to other similar application.
- Reduce the Time Complexity.

CHAPTER-2

2.1 Literature survey

1: Statistical Features-Based Real-Time Detection of Drifted Twitter Spam

Twitter spam has become a critical problem nowadays. Recent works focus on applying machine learning techniques for Twitter spam detection, which make use of the statistical features of tweets. In our labeled tweets data set, however, we observe that the statistical properties of spam tweets vary over time, and thus, the performance of existing machine learning-based classifiers decreases. This issue is referred to as “Twitter Spam Drift”. In order to tackle this problem, we first carry out a deep analysis on the statistical features of one million spam tweets and one million non-spam tweets, and then propose a novel Lfun scheme. The proposed scheme can discover “changed” spam tweets from unlabeled tweets and incorporate them into classifier’s training process. A number of experiments are performed to evaluate the proposed scheme. The results show that our proposed Lfun scheme can significantly improve the spam detection accuracy in real-world scenarios.

2: Effect of Spam on Hash tag Recommendation for Tweets

Presence of spam tweets in a dataset may affect the choices of feature selection, algorithm formulation, and system evaluation for many applications. However, most existing studies have not considered the impact of spam tweets. In this paper, we study the impact of spam tweets on hashtag recommendation for hyperlinked tweets (i.e., tweets containing URLs) in HSpam14 dataset. HSpam14 is a collection of 14 million tweets with annotations of being spam and ham (i.e., non-spam). In our experiments, we observe that it is much easier to recommend “correct” hashtags for spam tweets than ham tweets, because of the near duplicates in spam tweets. Simple approaches like recommending most popular hashtags achieves very good accuracy on spam tweets. On the other hand, features that are highly effective on ham tweets may not be effective on spam tweets. Our findings suggest that without removing spam tweets from the data collection (as in most studies), the results obtained could be misleading for hashtag recommendation tasks.

3: HSpam14: A Collection of 14 Million Tweets for Hash tag-Oriented Spam Research

Hash tag facilitates information diffusion in Twitter by creating dynamic and virtual communities for information aggregation from all Twitter users. Because hashtags serve as additional channels for one's tweets to be potentially accessed by other users than her own followers, hashtags are targeted for spamming purposes (e.g., hashtag hijacking), particularly the popular and trending hashtags. Although much effort has been devoted to fighting against email/web spam, limited studies are on hashtag-oriented spam in tweets. In this paper, we collected 14 million tweets that matched some trending hashtags in two months' time and then conducted systematic annotation of the tweets being spam and ham (i.e., non-spam). We name the annotated dataset HSpam14. Our annotation process includes four major steps: (i) heuristic-based selection to search for tweets that are more likely to be spam, (ii) near-duplicate cluster based annotation to firstly group similar tweets into clusters and then label the clusters, (iii) reliable ham tweets detection to label tweets that are non-spam, and (iv) Expectation-Maximization (EM)-based label prediction to predict the labels of remaining unlabeled tweets. One major contribution of this work is the creation of HSpam14 dataset, which can be used for hash tag-oriented spam research in tweets. Another contribution is the observations made from the preliminary analysis of the HSpam14 dataset.

4: An Analysis of 14 Million Tweets on Hash tag-Oriented Spamming

Over the years, Twitter has become a popular platform for information dissemination and information gathering. However, the popularity of Twitter has attracted not only legitimate users but also spammers who exploit social graphs, popular keywords, and hashtags for malicious purposes. In this paper, we present a detailed analysis of the HSpam14 dataset, which contains 14 million tweets with spam and ham (i.e., non-spam) labels, to understand spamming activities on Twitter. The primary focus of this paper is to analyze various aspects of spam on Twitter based on hashtags, tweet contents, and user profiles, which are useful for both tweet-level and user-level spam detection. First, we compare the usage of hashtags in spam and ham tweets based on frequency, position, orthography, and co-occurrence. Second, for content-based analysis, we analyze the variations in word usage, metadata, and near-duplicate tweets. Third, for user-based analysis, we investigate user profile information. In our study, we validate that spammers use popular hashtags to promote their tweets. We also observe differences in the usage of words in spam and ham tweets. Spam tweets are more likely to be emphasized using exclamation points and capitalized words. Further, we observe

CHAPTER-3

System architecture and design

3.1. System design

System Architecture design-identifies the overall hypermedia structure for the WebApp. Architecture design is tied to the goals establish for a WebApp, the content to be presented, the users who will visit, and the navigation philosophy that has been established. Content architecture, focuses on the manner in which content objects and structured for presentation and navigation. WebApp architecture, addresses the manner in which the application is structure to manage user interaction, handle internal processing tasks, effect navigation, and present content. WebApp architecture is defined within the context of the development environment in which the application is to be implemented.

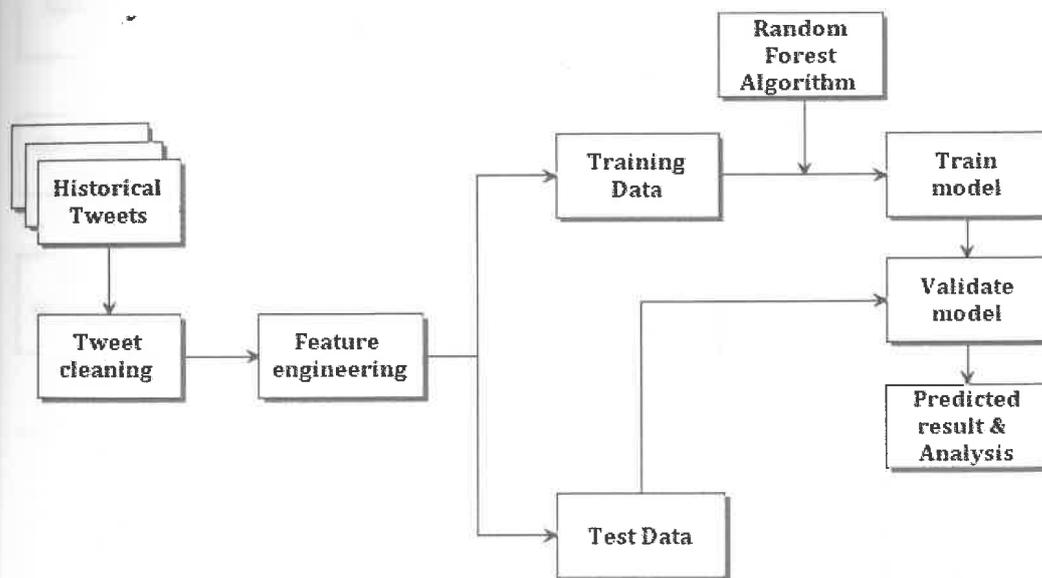


Fig 3.1 System Architecture

It is important to complete all tasks and meet deadlines. There are many project management tools that are available to help project managers manage their tasks and schedule and one of them is the flowchart.

A flowchart is one of the seven basic quality tools used in project management and it displays the actions that are necessary to meet the goals of a particular task in the most practical sequence. Also called as process maps, this type of tool displays a series of steps with branching possibilities that depict one or more inputs and transforms them to outputs.

The advantage of flowcharts is that they show the activities involved in a project including the decision points, parallel paths, branching loops as well as the overall sequence of processing through mapping the operational details within the horizontal value chain. Moreover, this particular tool is very used in estimating and understanding the cost of quality for a particular process. This is done by using the branching logic of the workflow and estimating the expected monetary returns.

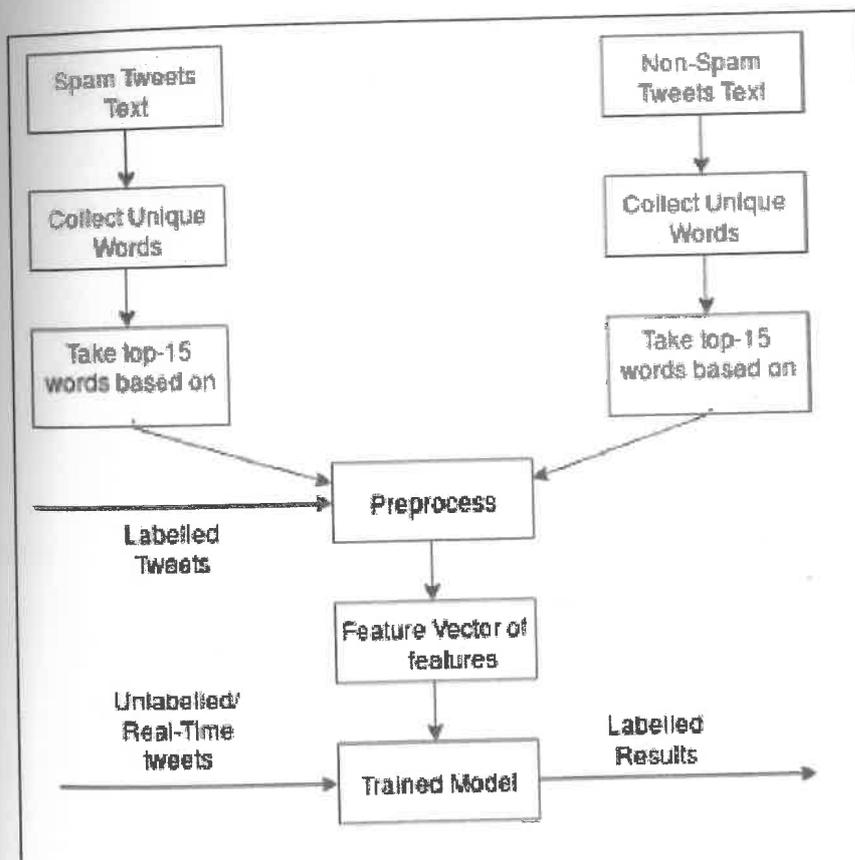


Fig 3.2 Flow Chart Diagram

3.5 Modules Description

1. Data preprocessing
2. Bag-of-Word Model creation
3. Calculate Information Gain from Bag-of-Word Model
4. Spam Detection and Result Analysis

Data preprocessing

Data Preprocessing is a technique that is used to convert the raw data into a clean data set. In other words, whenever the data is gathered from different sources it is collected in raw format which is not feasible for the analysis.

Therefore, certain steps are executed to convert the data into a small clean data set. This technique is performed before the execution of Iterative Analysis. The set of steps is known as data preprocessing. It includes -

- Data Cleaning
- Data Integration
- Data Transformation
- Data Reduction

Data preprocessing is necessary because of the presence of unformatted real-world data. Mostly real-world data is composed of -

- **Inaccurate data (missing data)** - There are many reasons for missing data such as data is not continuously collected, a mistake in data entry, technical problems with biometrics and much more.
- **The presence of noisy data (erroneous data and outliers)** - The reasons for the existence of noisy data could be a technological problem of gadget that gathers data, a human mistake during data entry and much more.
- **Inconsistent data** - The presence of inconsistencies are due to the reasons such that existence of duplication within data, human data entry, containing mistakes in codes or names, i.e., violation of data constraints and much more.

Therefore, in this project to handle raw tweets, Data Preprocessing is performed.

Bag-of-Word Model creation

From the collected tweets we collect around thousands of unique out of which we identify 30 words that are possibly strong indicators for marking a tweet as spam or non-spam.

We sampled our Feature-set with Bag-of-Words model. Multiple unique words have been identified from the tweets' text. Using these many words along with extracted features set, we built our feature set.

Calculate Information Gain from Bag-of-Word Model

After characterizing the spam and non-spam tweets' text into two separate documents, we construct the following sets:

U_S = Collection of unique words in the spam tweets' text.

U_{NS} = Collection of unique words in the non-spam tweets' text.

For each word T in U_S and U_{NS} we calculate the following probability values:

$$P(T|U_S) = \frac{\text{\# of Spam tweets that contain } T}{\text{total \# of Spam tweets}}$$

$$P(T|U_{NS}) = \frac{\text{\# of Non-Spam tweets that contain } T}{\text{total \# of Non-Spam tweets}}$$

We calculate the information gain γ_T for each word T as follows:

$$\gamma_T = \left| \frac{P(T|U_S)}{P(T|U_{NS})} \times \log_{10} \left[\frac{P(T|U_S)}{P(T|U_{NS})} \right] \right|$$

We sort words in decreasing order based on their γ_T . We take the top 15 words from each of the U_S and U_{NS} using above calculation. We combine these words to form top-30 words that we use in our feature set. The benefit of using these words based on their entropy score in the feature-set is that we were able to reduce uncertainty in the prediction outcome as these words have a different impact of frequency count in spam and non-spam tweets. Hence we expect considering these top 30 words will help us to classify the tweets accurately for each class.

CHAPTER-4

IMPLEMENTATION TECHNOLOGIES

Python Introduction:

Python is an easy to learn, powerful programming language. It has efficient high-level data structures and a simple but effective approach to object-oriented programming. Python's elegant syntax and dynamic typing, together with its interpreted nature, make it an ideal language for scripting and rapid application development in many areas on most platforms.

The Python interpreter and the extensive standard library are freely available in source or binary form for all major platforms from the Python Web site, <https://www.python.org/>, and may be freely distributed. The same site also contains distributions of and pointers to many free third party Python modules, programs and tools, and additional documentation.

The Python interpreter is easily extended with new functions and data types implemented in C or C++ (or other languages callable from C). Python is also suitable as an extension language for customizable applications.

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently where as other languages use punctuation, and it has fewer syntactical constructions than other languages.

- **Python is Interpreted** – Python is processed at runtime by the interpreter. You do not need to compile your program before executing it. This is similar to PERL and PHP.
- **Python is Interactive** – you can actually sit at a Python prompt and interact with the interpreter directly to write your programs.
- **Python is Object-Oriented** – Python supports Object-Oriented style or technique of programming that encapsulates code within objects.
- **Python is a Beginner's Language** – Python is a great language for the beginner-level programmers and supports the development of a wide range of applications from simple text processing to WWW browsers to games.

Features:

Python's features include – All these.

- **Easy-to-learn** – Python has few keywords, simple structure, and a clearly defined syntax. This allows the student to pick up the language quickly.
- **Easy-to-read** – Python code is more clearly defined and visible to the eyes.
- **Easy-to-maintain** – Python's source code is fairly easy-to-maintain.
- **A broad standard library** – Python's bulk of the library is very portable and cross-platform compatible on UNIX, Windows, and Macintosh.
- **Interactive Mode** – Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.
- **Portable** – Python can run on a wide variety of hardware platforms and has the same interface on all platforms.
- **Extendable** – you can add low-level modules to the Python interpreter. These modules enable programmers to add to or customize their tools to be more efficient.
- **Databases** – Python provides interfaces to all major commercial databases.
- **GUI Programming** – Python supports GUI applications that can be created and ported to many system calls, libraries and windows systems, such as Windows MFC, Macintosh, and the X Window system of Unix.
- **Scalable** – Python provides a better structure and support for large programs than shell scripting.

Why python emerging as a leader:

There's battle out there happening in the minds of aspiring data scientists to choose the best data science tool. Though there are quite a number of data science tools that provide the much-needed option, the close combat narrows down between two popular languages – Python and R.

Naive Bayes uses a similar method to predict the probability of different classes based on various attributes. This algorithm is mostly used in text classification and with problems having multiple classes.

The following code shows an example of Naive Bayes implementation –

```
import csv
import random
import math

def loadCsv(filename):
    lines = csv.reader(open(filename, "rb"))
    dataset = list(lines)
    for i in range(len(dataset)):
        dataset[i] = [float(x) for x in dataset[i]]
    return dataset

def splitDataset(dataset, splitRatio):
    trainSize = int(len(dataset) * splitRatio)
    trainSet = []
    copy = list(dataset)
    while len(trainSet) < trainSize:
        index = random.randrange(len(copy))
        trainSet.append(copy.pop(index))
    return [trainSet, copy]

def separateByClass(dataset):
    separated = {}
    for i in range(len(dataset)):
        vector = dataset[i]
        if (vector[-1] not in separated):
            separated[vector[-1]] = []
```

```
        separated[vector[-1]].append(vector)
    return separated

def mean(numbers):
    return sum(numbers)/float(len(numbers))

def stdev(numbers):
    avg = mean(numbers)
    variance = sum([pow(x-avg,2) for x in numbers])/float(len(numbers)-1)
    return math.sqrt(variance)

def summarize(dataset):
    summaries = [(mean(attribute), stdev(attribute)) for attribute in zip(*dataset)]

def summarizeByClass(dataset):
    separated = separateByClass(dataset)
    summaries = {}
    for classValue, instances in separated.iteritems():
        summaries[classValue] = summarize(instances)
    return summaries

def calculateProbability(x, mean, stdev):
    exponent = math.exp(-(math.pow(x-mean,2)/(2*math.pow(stdev,2))))
    return (1 / (math.sqrt(2*math.pi) * stdev)) * exponent

def calculateClassProbabilities(summaries, inputVector):
    probabilities = {}
    for classValue, classSummaries in summaries.iteritems():
        probabilities[classValue] = 1
    for i in range(len(classSummaries)):
```

```
mean, stdev = classSummaries[i]
x = inputVector[i]
probabilities[classValue] *= calculateProbability(x, mean, stdev)
return probabilities
```

```
def predict(summaries, inputVector):
    probabilities = calculateClassProbabilities(summaries, inputVector)
    bestLabel, bestProb = None, -1
    for classValue, probability in probabilities.iteritems():
        if bestLabel is None or probability > bestProb:
            bestProb = probability
            bestLabel = classValue
    return bestLabel
```

```
def getPredictions(summaries, testSet):
    predictions = []
    for i in range(len(testSet)):
        result = predict(summaries, testSet[i])
        predictions.append(result)
    return predictions
```

```
def getAccuracy(testSet, predictions):
    correct = 0
    for i in range(len(testSet)):
        if testSet[i][-1] == predictions[i]:
            correct += 1
    return (correct/float(len(testSet))) * 100.0
```

```
def main():
    filename = 'pima-indians-diabetes.data.csv'
```

```
splitRatio = 0.67
dataset = loadCsv(filename)
trainingSet, testSet = splitDataset(dataset, splitRatio)
print('Split {0} rows into train = {1} and test = {2}
rows').format(len(dataset), len(trainingSet), len(testSet))
# prepare model
summaries = summarizeByClass(trainingSet)
# test model
predictions = getPredictions(summaries, testSet)
accuracy = getAccuracy(testSet, predictions)
print('Accuracy: {0}%').format(accuracy)
main()
```

When you run the code given above, you can observe the following output –

```
Split 1372 rows into train = 919 and test = 453 rows
```

```
Accuracy: 83.6644591611%
```

Artificial intelligence

Artificial Intelligence encompasses a very broad scope. You could even consider something like Dijkstra's shortest path algorithm as Artificial Intelligence. However, two categories of AI are frequently mixed up: Machine Learning and Deep Learning. Both of these refer to statistical modeling of data to extract useful information or make predictions. In this article, we will list the reasons why these two statistical modeling techniques are not the same and help you further frame your understanding of these data modeling paradigms.

Machine learning

Machine Learning is a method of statistical learning where each instance in a dataset is described by a set of features or attributes. In contrast, the term “Deep Learning” is a method of statistical learning that extracts features or attributes from raw data. Deep Learning does this by utilizing neural networks with many hidden layers, big data, and powerful computational resources. The terms seem somewhat interchangeable, however, with Deep Learning method, The algorithm constructs representations of the data automatically. In contrast, data representations are hard-coded as a set of features in machine learning

The goal for unsupervised learning is to model the underlying structure or distribution in the data in order to learn more about the data.

These are called unsupervised learning because unlike supervised learning above there is no correct answers and there is no teacher. Algorithms are left to their own devices to discover and present the interesting structure in the data.

Unsupervised learning problems can be further grouped into clustering and association problems.

- **Clustering:** A clustering problem is where you want to discover the inherent groupings in the data, such as grouping customers by purchasing behavior.
- **Association:** An association rule learning problem is where you want to discover rules that describe large portions of your data, such as people that buy X also tend to buy Y.

Some popular examples of unsupervised learning algorithms are:

- k-means for clustering problems.
- Apriori algorithm for association rule learning problems.

Semi-Supervised Machine Learning

Problems where you have a large amount of input data (X) and only some of the data is labeled (Y) are called semi-supervised learning problems.

These problems sit in between both supervised and unsupervised learning.

A good example is a photo archive where only some of the images are labeled, (e.g. dog, cat, person) and the majority are unlabeled to domain experts. Whereas unlabeled data is cheap and easy to collect and store.

You can use unsupervised learning techniques to discover and learn the structure in the input variables.

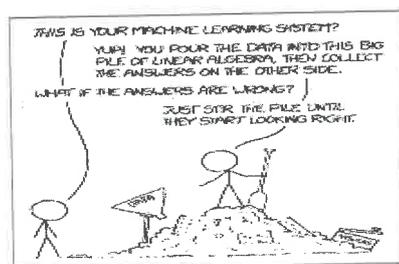
You can also use supervised learning techniques to make best guess predictions for the unlabeled data, feed that data back into the supervised learning algorithm as training data and use the model to make predictions on new unseen data.

Data Size:

Both Machine Learning and Deep Learning are able to handle massive dataset sizes, however, machine learning methods make much more sense with small datasets. For example, if you only have 100 data points, decision trees, k-nearest neighbors, and other machine learning models will be much more valuable to you than fitting a deep neural network on the data. This is due to the next topic of difference, Interpretability

Interpretability:

Example for how interpretability works in ML & DL:



A lot of the criticism of deep learning methods and machine learning algorithms such as Support Vector Machine or (maybe, because you can at least visualize the constituent probabilities making up the output), Naive Bayes, are due to their difficulty to interpret. For example, when a Convolutional Neural Network outputs 'cat' in a dog vs. cat problem, nobody seems to know why it did that. In contrast, when you are modeling data such as an electronic health record or bank loan dataset with a machine learning technique, it is much easier to understand the reasoning for the model's prediction.

One of the best examples of interpretability is decision trees where you follow logical tests down nodes of the tree until you reach a decision. Another machine learning algorithm with high interpretability is k-Nearest Neighbors. This is not a parametric learning algorithm but still falls under the category of machine learning algorithms. It is very interpretability because you easily reason about the similar instances for yourself.

SDLC

It will cover the details explanation of methodology that is being used to make this project complete and working well. Many methodology or findings from this field mainly generated into journal for others to take advantages and improve as upcoming studies. The method is

use to achieve the objective of the project that will accomplish a perfect result. In order to evaluate this project, the methodology based on System Development Life Cycle (SDLC), generally three major step, which is planning, implementing and analysis.

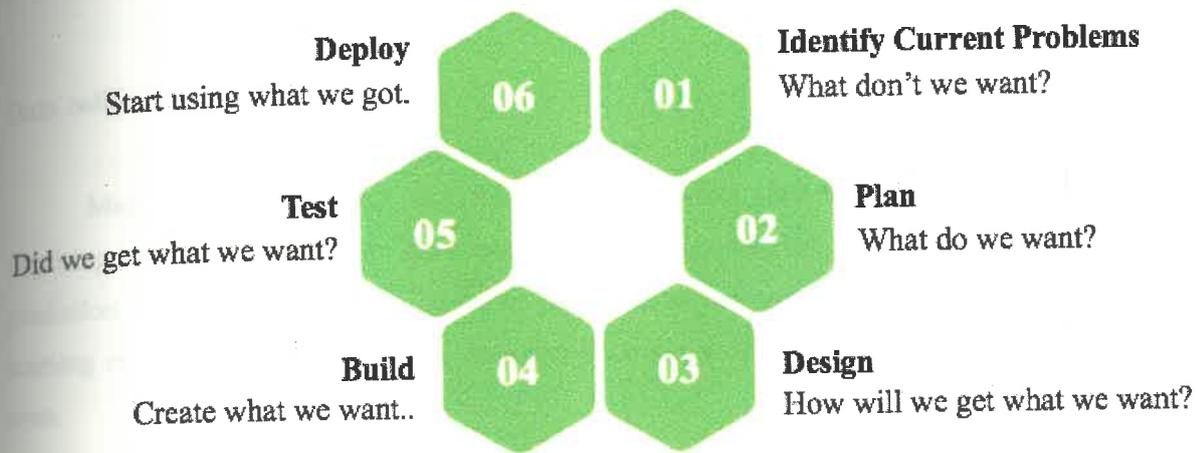


Fig 1: Software Development Life Cycle

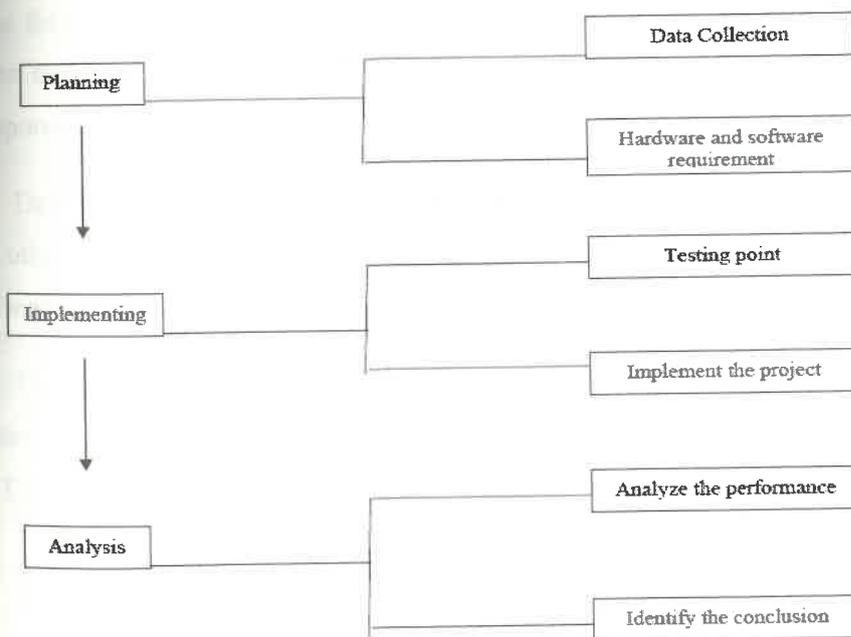


Fig 2: Steps of Methodology

Planning:

To identify all the information and requirement such as hardware and software, planning must be done in the proper manner. The planning phase has two main elements namely data collection and the requirements of hardware and software.

Data collection:

Machine learning needs two things to work, data (lots of it) and models. When acquiring the data, be sure to have enough features (aspect of data that can help for a prediction, like the surface of the house to predict its price) populated to train correctly your learning model. In general, the more data you have the better so make to come with enough rows.

The primary data collected from the online sources remains in the raw form of statements, digits and qualitative terms. The raw data contains error, omissions and inconsistencies. It requires corrections after careful scrutinizing the completed questionnaires. The following steps are involved in the processing of primary data. A huge volume of raw data collected through field survey needs to be grouped for similar details of individual responses.

Data Preprocessing is a technique that is used to convert the raw data into a clean data set. In other words, whenever the data is gathered from different sources it is collected in raw format which is not feasible for the analysis.

Therefore, certain steps are executed to convert the data into a small clean data set. This technique is performed before the execution of Iterative Analysis. The set of steps is known as Data Preprocessing. It includes -

- Data Cleaning
- Data Integration
- Data Transformation
- Data Reduction

each other. "Performance Metrics for Predictive Modeling In classification problems, the primary source of performance measurements is a coincidence matrix (**classification matrix or a contingency table**)". Above figure shows a coincidence matrix for a two-class classification problem. The equations of the most commonly used metrics that can be calculated from the coincidence matrix are also given in Fig 2.7.

		True Class	
		Positive	Negative
Predicted Class	Positive	True Positive Count (TP)	False Positive Count (FP)
	Negative	False Negative Count (FN)	True Negative Count (TN)

$$\text{True Positive Rate} = \frac{TP}{TP + FN}$$

$$\text{True Negative Rate} = \frac{TN}{TN + FP}$$

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

$$\text{Precision} = \frac{TP}{TP + FP}$$

$$\text{Recall} = \frac{TP}{TP + FN}$$

Figure 3: confusion matrix and formulae

As being seen in above figure, the numbers along the diagonal from upper-left to lower-right represent the correct decisions made, and the numbers outside this diagonal represent the errors. "The true positive rate (also called hit rate or recall) of a classifier is estimated by dividing the correctly classified positives (the true positive count) by the total positive count. The false positive rate (also called a false alarm rate) of the classifier is estimated by dividing the incorrectly classified negatives (the false negative count) by the total negatives. The overall accuracy of a classifier is estimated by dividing the total correctly classified positives and negatives by the total number of samples.

The architecture of a ConvNet is analogous to that of the connectivity pattern of Neurons in the Human Brain and was inspired by the organization of the Visual Cortex. Individual neurons respond to stimuli only in a restricted region of the visual field known as the Receptive Field. A collection of such fields overlap to cover the entire visual area.

Flexibility

Sometimes you just don't want to use what is already there but you want to define something of your own (for example a cost function, a metric, a layer, etc.).

Although Keras 2 has been designed in such a way that you can implement almost everything

It also discusses the various array functions, types of indexing, etc. An introduction to Matplotlib is also provided. All this is explained with the help of examples for better understanding.

Numpy is a Python package. It stands for 'Numerical Python'. It is a library consisting of multidimensional array objects and a collection of routines for processing of array.

Numeric, the ancestor of NumPy, was developed by Jim Hugunin. Another package Numarray was also developed, having some additional functionality. In 2005, Travis Oliphant created NumPy package by incorporating the features of Numarray into Numeric package. There are many contributors to this open source project.

Operations using NumPy

Using NumPy, a developer can perform the following operations –

- Mathematical and logical operations on arrays.
- Fourier transforms and routines for shape manipulation.
- Operations related to linear algebra. NumPy has in-built functions for linear algebra and random number generation.

NumPy A Replacement for Mat Lab

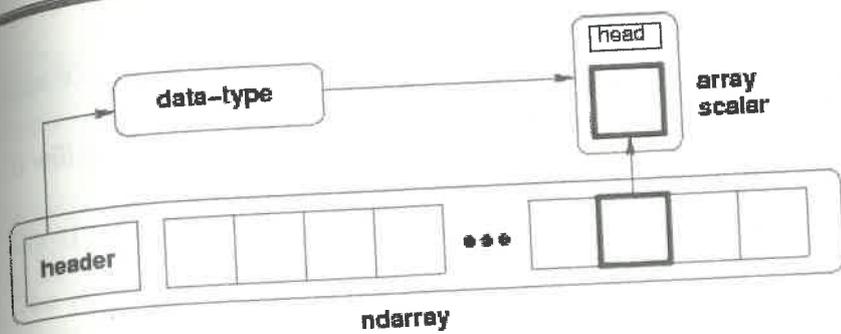
NumPy is often used along with packages like **SciPy** (Scientific Python) and **Matplotlib** (plotting library). This combination is widely used as a replacement for MatLab, a popular platform for technical computing. However, Python alternative to MatLab is now seen as a more modern and complete programming language.

It is open source, which is an added advantage of NumPy.

The most important object defined in NumPy is an N-dimensional array type called **ndarray**. It describes the collection of items of the same type. Items in the collection can be accessed using a zero-based index.

Every item in an ndarray takes the same size of block in the memory. Each element in ndarray is an object of data-type object (called **dtype**).

Any item extracted from ndarray object (by slicing) is represented by a Python object of one of array scalar types. The following diagram shows a relationship between ndarray, data type object (dtype) and array scalar type –



An instance of ndarray class can be constructed by different array creation routines described later in the tutorial. The basic ndarray is created using an array function in NumPy as follows –

numpy.array

It creates an ndarray from any object exposing array interface, or from any method that returns an array.

The ndarray objects can be saved to and loaded from the disk files. The IO functions available are –

- **load()** and **save()** functions handle /numPy binary files (with **npyextension**)
- **loadtxt()** and **savetxt()** functions handle normal text files

NumPy introduces a simple file format for ndarray objects. This **.npy** file stores data, shape, dtype and other information required to reconstruct the ndarray in a disk file such that the array is correctly retrieved even if the file is on another machine with different architecture.

numpy.save()

The **numpy.save()** file stores the input array in a disk file with **npyextension**.

```
import numpy as np
a = np.array([1,2,3,4,5])
np.save('outfile',a)
```

To reconstruct array from **outfile.npy**, use **load()** function.

```
import numpy as np
b = np.load('outfile.npy')
```

You can think of it as an SQL table or a spreadsheet data representation.

`pandas.DataFrame`

A pandas DataFrame can be created using the following constructor –

```
pandas.DataFrame( data, index, columns, dtype, copy)
```

The parameters of the constructor are as follows –

Sr.No Parameter & Description

Sr.No	Parameter & Description
1	data data takes various forms like ndarray, series, map, lists, dict, constants and also another DataFrame.
2	index For the row labels, the Index to be used for the resulting frame is Optional Default <code>np.arange(n)</code> if no index is passed.
3	columns For column labels, the optional default syntax is - <code>np.arange(n)</code> . This is only true if no index is passed.
4	dtype Data type of each column.
5	copy This command (or whatever it is) is used for copying of data, if the default is False.

Create DataFrame

A pandas DataFrame can be created using various inputs like –

- Lists
- dict
- Series
- Numpy ndarrays
- Another DataFrame

In the subsequent sections of this chapter, we will see how to create a DataFrame using these inputs.

Create an Empty DataFrame

A basic DataFrame, which can be created is an Empty Dataframe.

Example

```
#import the pandas library and aliasing as pd
import pandas as pd
df = pd.DataFrame()
print df
```

Its **output** is as follows –

```
Empty DataFrame
Columns: []
Index: []
```

Create a DataFrame from Lists

The DataFrame can be created using a single list or a list of lists.

Example 1

```
import pandas as pd
data = [1,2,3,4,5]
df = pd.DataFrame(data)
```

```
print df
```

Its **output** is as follows –

```
0
0 1
1 2
2 3
3 4
4 5
```

Example 2

```
import pandas as pd
```

```
data = [['Alex',10],['Bob',12],['Clarke',13]]
```

```
df = pd.DataFrame(data,columns=['Name','Age'])
```

```
print df
```

Its **output** is as follows –

	Name	Age
0	Alex	10
1	Bob	12
2	Clarke	13

The **Pandas I/O API** is a set of top level reader functions accessed like `pd.read_csv()` that generally return a Pandas object.

The two workhorse functions for reading text files (or the flat files) are `read_csv()` and `read_table()`. They both use the same parsing code to intelligently convert tabular data into a **DataFrame** object –

```
pandas.read_csv(filepath_or_buffer, sep=',', delimiter=None, header='infer',
names=None, index_col=None, usecols=None
pandas.read_csv(filepath_or_buffer, sep='\t', delimiter=None, header='infer',
```

Basic plots in Matplotlib :

Matplotlib comes with a wide variety of plots. Plots helps to understand trends, patterns, and to make correlations. They're typically instruments for reasoning about quantitative information.

Uses of matplotlib

- Matplotlib is a plotting library for the Python programming language and its numerical mathematics extension NumPy. It provides an object-oriented API for **embedding** plots into applications using general-purpose GUI toolkits like Tkinter, wxPython, Qt, or GTK+.
- MATLAB-like interface, particularly when combined with IPython. For the power user, you have full control of line styles, font properties, axes properties, etc, via an object oriented interface or via a set of functions familiar to MATLAB users.
- Matplotlib is a Python package for 2D plotting that generates production-quality graphs. It supports interactive and non-interactive plotting, and can save images in several output formats (PNG, PS, and others). It can use multiple window toolkits (GTK+, wxWidgets, Qt, and so on) and it provides a wide variety of plot types (lines, bars, pie charts, histograms, and many more).
- In addition to this, it is highly customizable, flexible, and easy to use. The dual nature of Matplotlib allows it to be used in both interactive and non-interactive scripts. It can be used in scripts without a graphical display, embedded in graphical applications, or on web pages. It can also be used interactively with the Python interpreter or IPython.

Merits of Matplotlib

- The idea behind Matplotlib can be summed up in the following motto as quoted by John Hunter, the creator and project leader of Matplotlib:
- "Matplotlib tries to make easy things easy and hard things possible".
- Matplotlib was born in the scientific area of computing, where gnuplot and MATLAB were (and still are) used a lot.

Statistical Features-Based Real-Time Detection of Drifted Twitter Spam

- Matplotlib was modeled on MATLAB, because graphing was something that MATLAB did very well. The high degree of compatibility between them made many people move from MATLAB to Matplotlib, as they felt like home while working with Matplotlib.
- But what are the points that built the success of Matplotlib? Let's look at some of them:
- **It uses Python:** Python is a very interesting language for scientific purposes (it's interpreted, high-level, easy to learn, easily extensible, and has a powerful standard library) and is now used by major institutions such as NASA, JPL, Google, DreamWorks, Disney, and many more.
- **It's open source, so no license to pay:** This makes it very appealing for professors and students, who often have a low budget.
- **It's a real programming language:** The MATLAB language (while being Turing-complete) lacks many of the features of a general-purpose language like Python.
- **It's much more complete:** Python has a lot of external modules that will help us perform all the functions we need to. So it's the perfect tool to acquire data, elaborate the data, and then plot the data.
- **It's very customizable and extensible:** Matplotlib can fit every use case because it has a lot of graph types, features, and configuration options.
- **It's integrated with LaTeX markup:** This is really useful when writing scientific papers.
- **It's cross-platform and portable:** Matplotlib can run on Linux, Windows, Mac OS X, and Sun Solaris (and Python can run on almost every architecture available).
- The aim of Matplotlib is to generate graphs. So, we need a way to actually view these images or even to save them to files. We're going to look at the various output formats available in Matplotlib and the graphical user interfaces (GUIs) supported by the library.
- Matplotlib supports both the categories, particularly with the following output formats:

Format	Type Description	Description
EPS	Vector	Encapsulated PostScript
JPG	Raster	Graphic format with lossy compression method for photographic output.

PDF	Vector	Portable Document Format (PDF).
PNG	Raster	Portable Network Graphics (PNG), a raster graphics format with a lossless compression method (more adaptable to line art than JPG).
PS	Vector	Language widely used in publishing and as printers jobs format.
SVG	Vector	Scalable Vector Graphics (SVG), XML based.

Matplotlib is a plotting library for Python. It is used along with NumPy to provide an environment that is an effective open source alternative for MatLab. It can also be used with graphics toolkits like PyQt and wxPython.

Matplotlib module was first written by John D. Hunter. Since 2012, Michael Droettboom is the principal developer. Currently, Matplotlib ver. 1.5.1 is the stable version available. The package is available in binary distribution as well as in the source code form on www.matplotlib.org.

Conventionally, the package is imported into the Python script by adding the following statement –

```
from matplotlib import pyplot as plt
```

Here **pyplot()** is the most important function in matplotlib library, which is used to plot 2D data. The following script plots the equation $y = 2x + 5$

Example

```
import numpy as np

from matplotlib import pyplot as plt

x = np.arange(1,11)

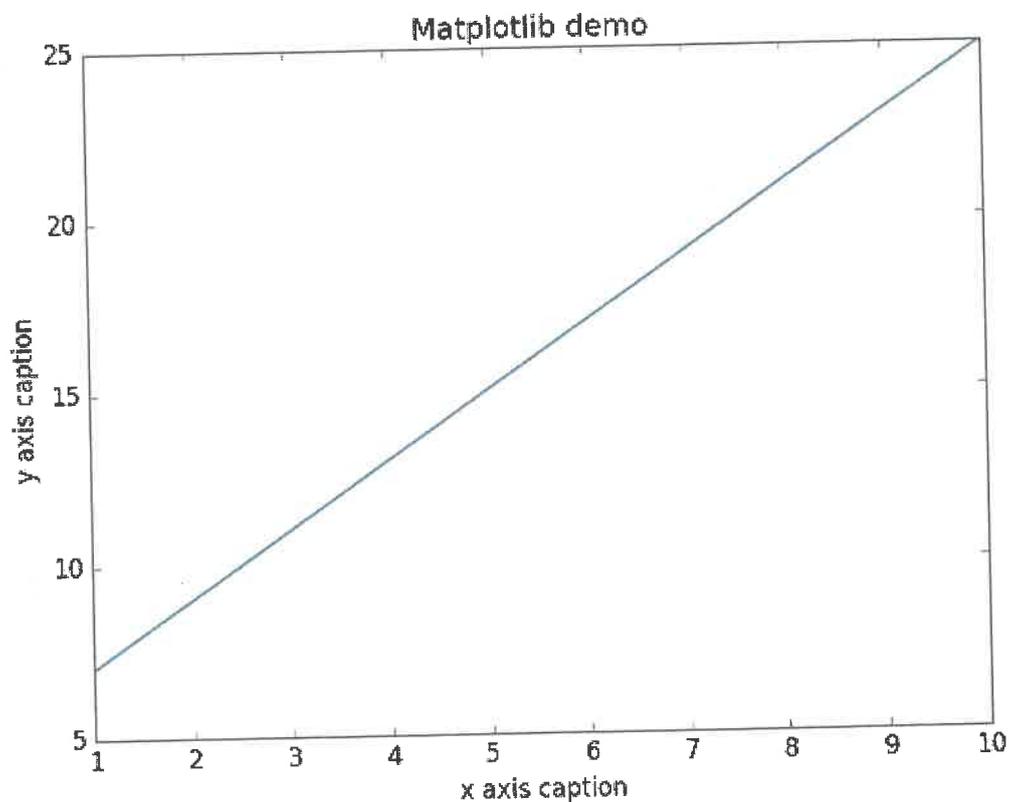
y = 2 * x + 5
```

```
plt.title("Matplotlib demo")  
plt.xlabel("x axis caption")  
plt.ylabel("y axis caption")  
plt.plot(x,y)  
plt.show()
```

An ndarray object **x** is created from **np.arange()** function as the values on the **x axis**. The corresponding values on the **y axis** are stored in another **ndarray object y**. These values are plotted using **plot()** function of pyplot submodule of matplotlib package.

The graphical representation is displayed by **show()** function.

The above code should produce the following output –



Instead of the linear graph, the values can be displayed discretely by adding a format string to the **plot()** function. Following formatting characters can be used.

NumPy has a `numpy.histogram()` function that is a graphical representation of the frequency distribution of data. Rectangles of equal horizontal size corresponding to class interval called **bin** and **variable height** corresponding to frequency.

```
numpy.histogram()
```

The `numpy.histogram()` function takes the input array and bins as two parameters. The successive elements in bin array act as the boundary of each bin.

```
import numpy as np

a = np.array([22,87,5,43,56,73,55,54,11,20,51,5,79,31,27])

np.histogram(a,bins = [0,20,40,60,80,100])

hist,bins = np.histogram(a,bins = [0,20,40,60,80,100])

print hist

print bins
```

It will produce the following output –

```
[3 4 5 2 1]
[0 20 40 60 80 100]
```

```
plt()
```

Matplotlib can convert this numeric representation of histogram into a graph. The `plt()` function of pyplot submodule takes the array containing the data and bin array as parameters and converts into a histogram.

```
from matplotlib import pyplot as plt

import numpy as np

a = np.array([22,87,5,43,56,73,55,54,11,20,51,5,79,31,27])

plt.hist(a, bins = [0,20,40,60,80,100])

plt.title("histogram")

plt.show()
```

CHAPTER -5

TESTING AND IMPLEMENTATION

5.1 Software testing introduction

Software testing is a process used to help identify the correctness, completeness and quality of developed computer software. Software testing is the process used to measure the quality of developed software. Testing is the process of executing a program with the intent of finding errors. Software testing is often referred to as verification & validation

5.2 Explanation for SDLC & STLC

SDLC: The software development life cycle (SDLC) is a conceptual model used in project management that describes the stages involved in an information system development project, from an initial feasibility study through maintenance of the completed application.

5.3 PHASES OF SOFTWARE DEVELOPMENT

- Requirement Analysis
- Software design
- Development or Coding
- Testing
- Maintenance

5.3.1 Requirement analysis

The requirements of a desired software product are extracted. Based the business scenario the SRS (Software Requirement Specification) document is prepared in this phase.

5.3.2 Design

Plans are laid out concerning the physical construction, hardware, operating systems, programming, communications, and security issues for the software. Design phase is concerned with making sure the software system will meet the requirements of the product.

There are 2 stages in design,

HLD – High Level Design

LLD – Low Level Design

HLD – gives the architecture of the software product to be developed and is done by architects and senior developers.

LLD – done by senior developers. It describes how each and every feature in the product should work and how every component should work. Here, only the design will be there and not the code.

5.3.3 Testing

Testing is evaluating the software to check for the user requirements. Here the software is evaluated with intent of finding defects.

5.3.4 Maintenance

Once the new system is up and running for a while, it should be exhaustively evaluated. Maintenance must be kept up rigorously at all times. Users of the system should be kept up-to-date concerning the latest modifications and procedures

5.4 SDLC Models

5.4.1 Water fall model

It will be executing one by one of the SDLC process. The design Starts after completing the requirements analysis coding begins after design. It is a traditional model It is a sequential design process, often used in SDLC, in which the progress is seen as flowing steadily downwards (like a waterfall), through the different phases.

5.4.2 Prototype model

Developed from the sample after getting good feedback from the customer. This is the Valuable mechanism for gaining better understanding of the customer needs

5.4.3 Rapid application development model(RAD):

This mechanism will develop from already existing one. If The New requirement is matching in already existing requirement, will develop from that.

5.4.4 Spiral model

This mechanism is update the application version by version. All the SDLC process will update version by version.

5.4.5 V-MODELV:

V model is a process where the development and testing phases can do parallely. For every development phase there is a testing phase. Development phases are called as verification whereas testing phases are called as validation

5.5 .STLC (Software Testing Life Cycle): Testing itself has many phases i.e. is called as STLC. STLC is part of SDLC

- Test Plan
- Test Development
- Test Execution
- Analyze Results
- Defect Tracking
- Summaries Report

5.5.1. TEST PLAN

It is a document which describes the testing environment, purpose, scope, objectives, test strategy, schedules, mile stones, testing tool, roles and responsibilities, risks, training, staffing and who is going to test the application, what type of tests should be performed and how it will track the defects.

5.5.2. TEST DEVELOPMENT

Preparing test cases, test data, Preparing test procedure, Preparing test scenario, Writing test script

5.5.3 TEST EXECUTION

In this phase we execute the documents those are prepared in test development phase

5.5.4 ANALYZE RESULT:

Once executed documents will get results either pass or fail. we need to analyze the results during this phase.

5.5.5. DEFECT TRACKING:

Whenever we get defect on the application we need to prepare the bug report file and forwards to Test Team Lead and Dev Team. The Dev Team will fix the bug. Again we have to test the application. This cycle repeats till we get the software without defects.

5.6 .TYPES OF TESTING:

White Box Testing

Black Box Testing

Grey box testing

5.6.1 WHITE BOX TESTING

White box testing as the name suggests gives the internal view of the software. This type of testing is also known as structural testing or glass box testing as well, as the interest lies in what lies inside the box.

5.6.2 BLACK BOX TESTING

Its also called as behavioral testing. It focuses on the functional requirements of the software. Testing either functional or non functional without reference to the internal structure of the component or system is called black box testing.

5.6.3 GREY BOX TESTING

Grey box testing is the combination n of black box and white box testing. Intention of this testing is to find out defects related to bad design or bad implementation of the system.

5.7 LEVEL OF TESTING USED IN PROJECT

5.7.1 Unit testing

Initialization testing is the first level of dynamic testing and is first the responsibility of developers and then that of the test engineers. Unit testing is performed after the expected test results are met or differences are explainable/acceptable.

5.7.2 Integration testing

All module which make application are tested . Integration testing is to make sure that the interaction of two or more components produces results that satisfy functional requirement.

7.3 System testing

to test the complete system in terms of functionality and non functionality. It is black box testing, performed by the Test Team, and at the start of the system testing the complete system is configured in a controlled environment.

5.7.4 Functional testing

The outgoing links from all the pages from specific domain under test. Test all internal links. Test links jumping on the same pages. Check for the default values of fields. Wrong inputs to the fields in the forms.

5.7.5 Alpha testing

Alpha testing is final testing before the software is released to the general public. This testing is conducted at the developer site and in a controlled environment by the end user of the software.

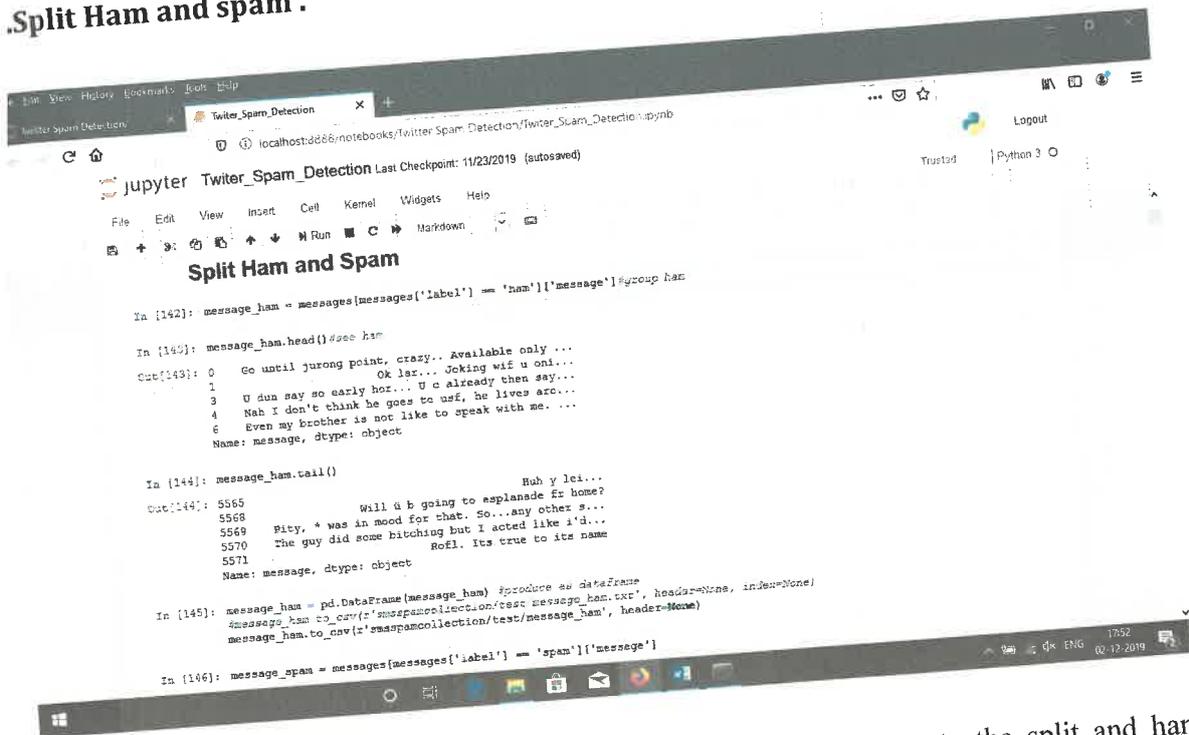
5.7.6 Beta testing

The beta test is conducted at one or more customer sites by the end user of the software. The beta test is conducted at one or more customer sites by the end user of the software.

5.8 unit testing cases

Initialization testing is the first level of dynamic testing and is first the responsibility of developers and then that of the test engineers. Unit testing is performed after the expected test results are met or differences are explainable/acceptable.

Split Ham and spam .



```
In [142]: message_ham = messages[messages['label'] == 'ham']['message'] #group ham

In [143]: message_ham.head() #see ham
Out[143]: 0    Go until jurong point, crazy.. Available only in...
1    Ok lar... Joking wif u oni...
2    U dun say so early hor... U c already then say...
3    Nah I don't think he goes to usf, he lives arc...
4    Even my brother is not like to speak with me. ...
5    Name: message, dtype: object

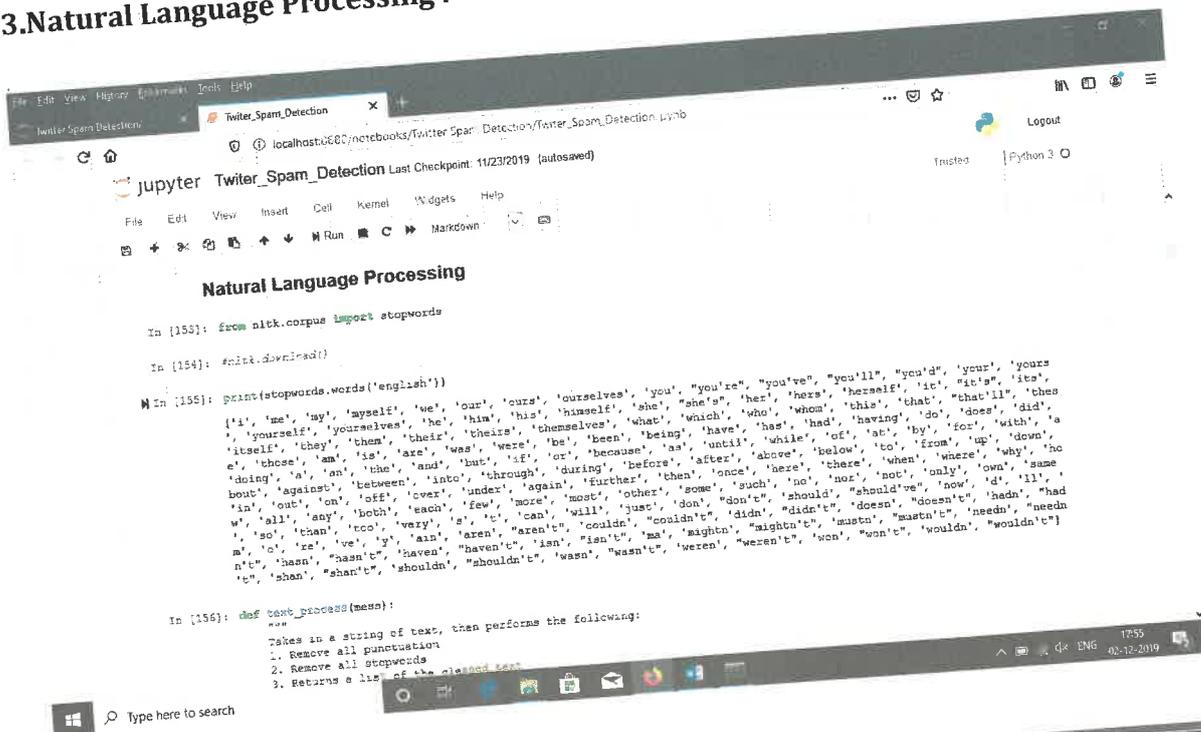
In [144]: message_ham.tail()
Out[144]: 5565    Huh y lei...
5568    Will b going to esplanade fr home?
5569    Pity, * was in mood for that. So...any other s...
5570    The guy did some hitching but I acted like i'd...
5571    RoFl. Its true to its name
5571    Name: message, dtype: object

In [145]: message_ham = pd.DataFrame(message_ham) #produce as dataframe
message_ham.columns = ['message_ham_text', 'header=None', 'index=None']
message_ham.to_csv('spamcollection/test/message_ham', header=None)

In [146]: message_spam = messages[messages['label'] == 'spam']['message']
```

The above figure shows the screenshot of the code written to execute the split and ham module of the code in the jupyter notebook .In this part the string tokens are splitted into ham and spam.

3.Natural Language Processing .



```
In [153]: from nltk.corpus import stopwords

In [154]: #nltk.download()

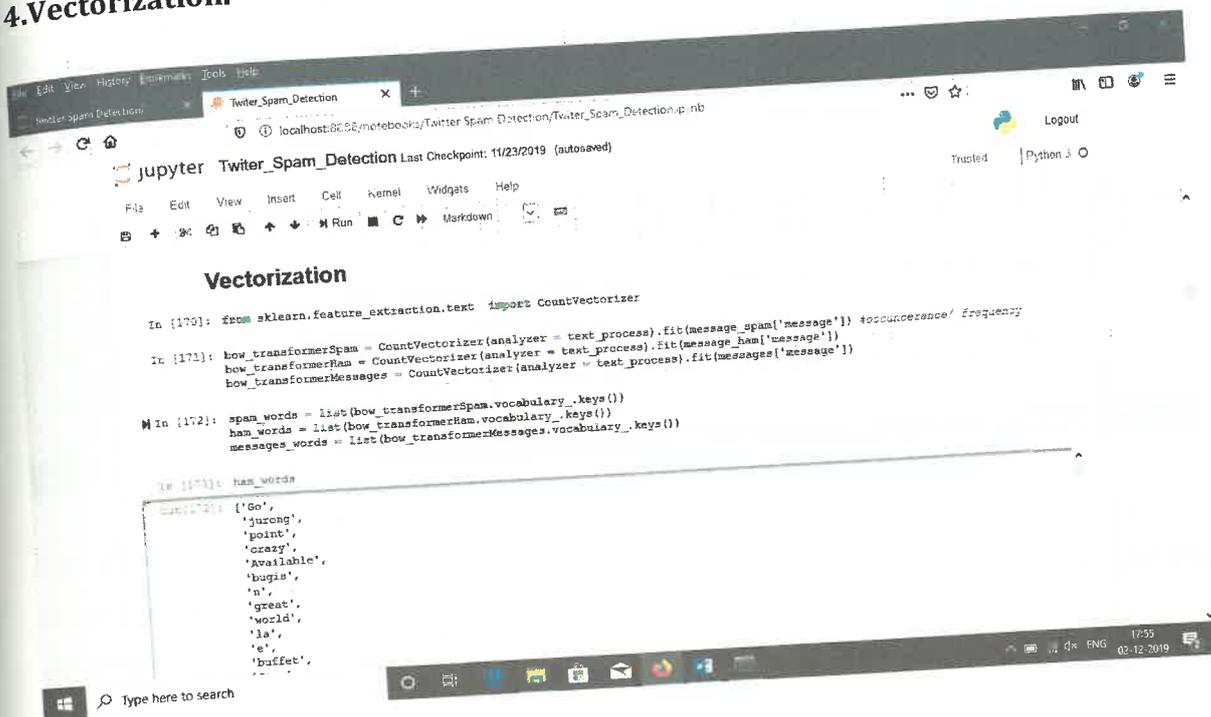
In [155]: print(stopwords.words('english'))
['i', 'me', 'my', 'myself', 'we', 'our', 'ours', 'ourselves', 'you', 'you're', 'you've', 'you'll', 'you'd', 'your', 'yours', 'yourself', 'yourselves', 'he', 'him', 'his', 'himself', 'she', 'she's', 'her', 'hers', 'herself', 'it', 'its', 'it's', 'this', 'that', 'that'll', 'these', 'these', 'them', 'their', 'theirs', 'themselves', 'what', 'which', 'who', 'whom', 'this', 'that', 'that'll', 'then', 'itself', 'they', 'them', 'theirs', 'was', 'were', 'is', 'are', 'be', 'been', 'being', 'have', 'has', 'had', 'having', 'do', 'does', 'did', 'e', 'those', 'am', 'is', 'are', 'was', 'were', 'is', 'are', 'be', 'been', 'being', 'while', 'of', 'at', 'by', 'for', 'with', 'a', 'doing', 'a', 'an', 'the', 'and', 'but', 'if', 'or', 'because', 'as', 'until', 'while', 'above', 'below', 'to', 'from', 'up', 'down', 'about', 'against', 'between', 'into', 'through', 'during', 'before', 'after', 'above', 'below', 'to', 'from', 'up', 'down', 'in', 'out', 'on', 'off', 'over', 'under', 'again', 'further', 'then', 'once', 'such', 'no', 'nor', 'not', 'only', 'own', 'same', 'w', 'all', 'any', 'both', 'each', 'few', 'more', 'most', 'other', 'some', 'such', 'no', 'nor', 'not', 'only', 'own', 'same', 'w', 'so', 'than', 'too', 'very', 's', 't', 'can', 'will', 'just', 'don', 'don't', 'should', 'should've', 'now', 'd', 'll', 'm', 'o', 're', 've', 'y', 'ain', 'aren', 'aren't', 'couldn', 'couldn't', 'didn', 'didn't', 'doesn', 'doesn't', 'hadn', 'hadn't', 'hasn', 'hasn't', 'haven', 'haven't', 'isn', 'isn't', 'ma', 'mightn', 'mightn't', 'mustn', 'mustn't', 'needn', 'needn't', 'shan', 'shan't', 'shouldn', 'shouldn't', 'wasn', 'wasn't', 'weren', 'weren't', 'won', 'won't', 'wouldn', 'wouldn't']

In [156]: def text_process(text):
    """
    Takes in a string of text, then performs the following:
    1. Remove all punctuation
    2. Remove all stopwords
    3. Returns a list of the cleaned text
    """
```

Statistical Features-Based Real-Time Detection of Drifted Twitter Spam

The above figure shows the screenshot of the code written to execute the Natural Language processing, here steps like Sentence Segmentation, Word Tokenization, Predicting Parts of Speech for Each Token, Text Lemmatization and Identifying Stop Words.

4. Vectorization.



```
In [170]: from sklearn.feature_extraction.text import CountVectorizer
In [171]: bow_transformerSpam = CountVectorizer(analyzer = text_process).fit(message_spam['message']) #occurrence/ frequency
          bow_transformerHam = CountVectorizer(analyzer = text_process).fit(message_ham['message'])
          bow_transformerMessages = CountVectorizer(analyzer = text_process).fit(messages['message'])
In [172]: spam_words = list(bow_transformerSpam.vocabulary_.keys())
          ham_words = list(bow_transformerHam.vocabulary_.keys())
          messages_words = list(bow_transformerMessages.vocabulary_.keys())

In [173]: ham_words
Out[173]: ['Go',
           'Jurong',
           'point',
           'crazy',
           'Available',
           'bugas',
           'n',
           'great',
           'world',
           'la',
           'e',
           'buffet']
```

The above figure shows the screenshot of the code written to execute vectorization. It is used to speed up the Python code without using loop. Some functions and formulas are used that can help in minimizing the running time of code efficiently.

The above figure shows the screenshot after the whole code is compiled and executed successfully. After the completion it shows a message called Good Job.

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Jnana Sangama, Belagavi – 590 014



Project Report

on

“SIGN LANGUAGE –SPEECH CONVERSION USING VIDEO PROCESSING FOR SPECIAL WORDS AND NUMBERS”

submitted in partial fulfillment of the requirement for the award of degree of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION

Submitted by

KARTHIK.S (1AM16EC051)

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CERTIFICATE

This is to certified that the project work entitled “SIGN LANGUAGE – SPEECH CONVERSION USING VIDEO PROCESSING FOR SPECIAL WORDS AND NUMBERS” is a bonafide work carried out by **KARTHIK.S (1AM16EC051)**, **BESHANTH.M (1AM16EC017)**, and **HARIHARAN.A (1AM16EC033)** in partial fulfilment for the award of **Bachelor of Engineering** in **Electronics and Communication** of the **Visvesvaraya Technological University**, Belagavi during the year 2019 - 20. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report. The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

14/8/2020

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DECLARATION

We, the students of VIII semester B.E in Electronics and Communication Engineering, AMC Engineering College, Bengaluru, hereby declare that the project work entitled “**SIGN LANGUAGE –SPEECH CONVERSION USING VIDEO PROCESSING FOR SPECIAL WORDS AND NUMBERS**” submitted to the **Visvesvaraya Technological University** during the academic year 2019-20, is a record of an original work done by us under the guidance of **Dr.T.Kavitha, Professor**, Department of Electronics and Communication Engineering, AMC Engineering college, Visvesvaraya Technological University(VTU), Bengaluru. This project work is submitted in partial fulfilment of the requirements for the award of the degree of Bachelor of Engineering in **Electronics and Communication Engineering**. The results embodied in this report have not been submitted to any other university or institute for the award of any degree.

Date: 5-08-2020
Place: Bengaluru.

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ABSTRACT

One of the major drawback of our society is the barrier that is created between disabled or handicapped persons and the normal person. Communication is the only medium by which people can share their thoughts or convey the message but for a person with disability (deaf and dumb) face difficulty in communication with normal person. For many deaf and dumb people, sign language is the basic means of communication. Sign Language Recognition (SLR) aims to interpret sign languages automatically by a computer in order to help the deaf communicate with hearing society conveniently. This project's aim is to design a system to help the person who trained the hearing impaired to communicate with the rest of the world using sign language or hand gesture recognition techniques. Disadvantages of existing system, irrelevant object might overlap with the hand. Wrong object extraction appeared if the objects larger than the hand. Performance recognition algorithm decreases when the distance is greater than 1.5 meters between the user and the camera. The proposed method uses HOG algorithm for feature detection and feature extraction of hand gestures, many algorithms for classification using image processing. The advantages of using the proposed system, there are no restrictions in this application such as the arm must be vertical, the palm must be facing the camera and the finger color must be basic color such as either red or green or blue. Ambient light doesn't affect the color detection threshold.

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CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

Image processing is a rapidly growing area in diverse applications, such as multimedia computing, secured data communication, biomedical, biometrics, remote sensing, texture understanding, pattern recognition, content-based retrieval, compression, and many more. This is all about how a computer can sense pictorial data after processing an image. Among the set of gestures intuitively performed by humans when communicating with each other, pointing gestures are especially interesting for communication and is perhaps the most intuitive interface for selection. They open up the possibility of intuitively indicating objects and locations, e.g., to make a robot change moving direction or simply mark some object. This is particularly useful in combination with speech recognition as pointing gestures can be used to specify parameters of location in verbal statements.

This technology can be a boon for disable people who are not able to speak hence can't communicate. Also if the person has different language than receiver, then also, it can be used to as translator. There has been always considered a challenge the development of a natural interaction interface, where people interact with technology as they are used to interact with the real world. A hand free interface, based only on human gestures, where no devices are attached to the user, will naturally immerse the user from the real world to the virtual environment. Hands are human organs which are used to manipulate physical objects. For this very reason hands are used most frequently by human beings to communicate and interact with machines. Mouse and Keyboard are the basic input/output to computers and the use of both of these devices require the use of hands. Most important and immediate information. Exchange between man and machine is through visual and actual aid, but this communication is one sided. Computers of this age provide humans with 1024*768 pixels at the rate of 15 frames per second and compared to it a good typist can write 60 words per minute with each word on the average containing 6 letters. To help somewhat mouse remedies this problem, but there are limitations in this as well. Although hands are most commonly used for day to day physical manipulation related tasks, but in some cases they are also used for communication. Hand gestures support

us in our daily communication to convey out-messages clearly. Hands are most important for mute and deaf people, who depend on their hands and gestures which are vital for communication in sign language, if computer had the ability to translate and understand hand gestures, it would be a leap forward in the field of human computer interaction. The dilemma, faced with this is that the images these days are information tick and in-order to achieve this task extensive processing is required.

1.2 HISTORY

To more accurately segment hand regions and track the positions of fingers, many hand recognition works have been developed based on aided sensors. For example, Akmeliawatil et al. used color-coded gloves to more accurately detect hand regions. Brashear et al. built a wearable system with a head-mounted cameras and many accelerometers to capture and recognize hand gestures. Geetha et al. proposed to integrate the local features extracted from seven 3-D points identified by the Kinect sensor and the global trajectory features extracted by Axis of Least Inertia (ALI). Then, the similarity between frames was learned by multi instance learning (MIL), and a strong gesture classifier was developed based on the exemplar-based learning and the AdaBoost classifier. Purely using a RGB cameras, several methods have been proposed hand gesture detection and recognition. Tariq et al. proposed a feature set extracted after applying skin based on thresholding, contouring and convexity defect calculation. Madhuri et al. utilized the combinations of fingertip positions for classification. Both Tariq and Madhuri applied simple features which can be extracted in real time, but their methods can only be adopted when the hand is captured in front of a wall with mono colour. In most of works, they use the contour which gives the shape of the hand to recognize gestures. Thus, the environment with complex background is a problem when the contour is extracted by using an edge detector. Fernando et al. applied template matching to classify sign language. Quan et al. combined spatial and temporal features to construct a video sequence appearance model for sign language recognition. Wang proposed 61 kinds of Chinese hand shape models and the corresponding shape codes to improve the motion smoothness of the hand when synthesizing Chinese sign videos. These models and codes were used to choose transferring hand shapes by judging the fingers bending degrees and relationship between the joined sign gestures with obvious motion changes. Among these vision-based approaches, none of them can deal with recognizing multiple similar hand gestures in complex background.

1.3 MOTIVATION

Most hearing people do not know sign language and know very little about deafness in general. For example, most hearing people do not know how to communicate in spoken language with a deaf or hard-of-hearing person who can speak and read lips (e.g. that they should turn their head or not to cover their mouth.). So, here this project is built on a real-time vision-based gesture recognition system which can be used in environment with complex background.

1.4 PROBLEM DEFINITION

It is well known fact that communication is very essential in day to day life. Humans with disabilities often experience issues in this area. [Deaf and Dumb]. In the world of sign language, and gestures, a lot of research work has been done over past few years. Sign Language Recognition is one of the most growing fields of research area. In present scenario, it is impossible for humans to understand the sign language without any practice. This project facilitate a human machine interactive system that would be very helpful for communication between deaf and dumb people and humans in real world situation.

1.5 OBJECTIVES

The main objective of the proposed system is to work as a medium of communication among deaf and dumb people to convey the message with normal person. A person who can talk and hear properly (normal person) cannot communicate with deaf & dumb person unless he/she is familiar with sign language. The proposed method uses HOG algorithm for feature detection and feature extraction of hand gestures, many algorithms for classification using image processing.

1.6 SUMMARY

Image processing is the process of extracting pictorial data after processing an image. This technology can be used for the deaf and dumb for sign conversion by processing hand signs and interpreting message. In the recent years many techniques have been developed for sign conversion, due to some of the disadvantages of these techniques and with the

development of image processing, many new techniques have been developed. Many hearing people don't have the knowledge of sign language, with this method communication becomes easy. The proposed method uses HOG algorithm for hand gestures recognition, many algorithms for classification using image processing.

CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

Sign language conversion techniques have been developed and updated down the lane. So many techniques are available for sign language conversion. First they used sensors for recognizing hand signs and with the emergence of 3D cameras, they were used for accurately sensing hand signs. Now Image processing is the recent trend, so many techniques have been developed based on image processing for sign language conversion.

2.2 RELATED WORK AND ITS EXPLANATION

With referring to the different styles and techniques adapted for sign language conversion. Each technique has its own advantage and each technique has its own disadvantage. So this project can make use of the advantage and try some new techniques or methods to overcome the disadvantage so that there is more accuracy.

[1] Title: Using Multiple Sensors for Mobile Sign Language Recognition

Author: *Helene Brashear, Thad Starner, Paul Lukowicz & Holger Junker*

The authors built a constrained, lab-based Sign Language recognition system with the goal of making it a mobile assistive technology. They examine using multiple sensors for disambiguation of noisy data to improve recognition accuracy. The experiment compares the results of training a small gesture vocabulary using noisy vision data, accelerometer data and both data sets combined. The authors chose to use a rule-based grammar for sentence structure in the training and testing process. Speech recognition often uses statistical grammars for increased accuracy. These grammars are built by tying together phonemes (the simplest unit of speech) and training on the transition between the phonemes. The sets are usually done with bigrams (two phonemes tied together) or trigrams (three phonemes). Training using bigrams or trigrams requires considerably more data because representations of each transition of each word are now needed. In our case, the bigrams and trigrams would be built by tying together

gestures. The current data set is too small to effectively train using bigrams or trigrams, but we intend to continue collecting data with the goal of implementing these techniques.

Advantage:

- Benefit of the proposed design is that the user can monitor the camera's view via the head mounted display.
- Provides accuracy.

Disadvantage:

- Data set is too small to effectively train using bigrams or trigrams.
- The current system has only been trained on a very small vocabulary.

[2] Title: A Vision Based Dynamic Gesture Recognition of Indian Sign Language on Kinect based Depth Images

Author: Geetha M, Manjusha C, Unnikrishnan P and Harikrishnan R

Indian Sign Language (ISL) is a visual-spatial language which provides linguistic information using hands, arms, facial expressions, and head/body postures. The proposed work aims at recognizing 3D dynamic signs corresponding to ISL words. With the advent of 3D sensors like Microsoft Kinect Cameras, 3D geometric processing of images has received much attention in recent researches. The authors have captured 3D dynamic gestures of ISL words using Kinect camera and has proposed a novel method for feature extraction of dynamic gestures of ISL words. While languages like the American Sign Language (ASL) are of huge popularity in the field of research and development, Indian Sign Language on the other hand has been standardized recently and hence its (ISLs) recognition is less explored. The method extracts features from the signs and converts it to the intended textual form. The proposed method integrates both local as well as global information of the dynamic sign. A new trajectory based feature extraction method using the concept of Axis of Least Inertia(ALI) is proposed for global feature extraction. An Eigen distance based method using the seven 3D key points- (five corresponding to each finger tips, one corresponding to centre of the palm and another corresponding to lower part of palm), extracted using Kinect is proposed for local feature extraction. Integrating 3D local feature has improved the performance of the system as shown in the result. Apart from serving as an aid to the disabled people, other applications of the system also include serving as a sign language tutor, interpreter and also be of use in electronic systems that take gesture input from the users.

Advantage:

- Improve the accuracy of recognition.
- The proposed method integrates both local as well as global information of the dynamic sign.
- Can handle different types of words in a common vision based platform.

Disadvantage:

- These methods are not user friendly and are more expensive.

[3] Title: A Colour Hand Gesture Database for Evaluating and Improving Algorithms on Hand Gesture and Posture Recognition

Author: Farhad Dadgostar, Andre L. C. Barczak, Abdolhossein Sarrafzadeh

With the increase of research activities in vision-based hand posture and gesture recognition, new methods and algorithms are being developed. Although less attention is being paid to developing a standard platform for this purpose. Developing a database of hand gesture images is a necessary first step for standardizing the research on hand gesture recognition. For this purpose, we have developed an image database of hand posture and gesture images. The database contains hand images in different lighting conditions and collected using a digital camera. Details of the automatic segmentation and clipping of the hands are also discussed in this paper.

Advantage:

- Automatically vary the lighting fairly in all directions and even produce very complex patterns of lighting by introducing more than one source of light.
- Enable researchers to add their own backgrounds to the image or to use it as an object with known boundaries.

Disadvantage:

- Unless some special gadgets are used to control the lighting, it is very difficult to vary the positions of the light fairly along the three axis.

[4] Title: Low cost approach for Real Time Sign Language Recognition

Author: Matheesha Fernando, Janaka Wijayanayaka

Sign Language is the language of people who suffer from speech and hearing defects. Still the rest of the world doesn't have a clear idea of sign language. The communication

between speech impaired people and other people is very inefficient. To overcome this problem technology can act as an intermediate flexible medium for speech impaired people to communicate amongst themselves and with other individuals as well as to enhance their level of learning / education. The suggested solutions in the literature for sign language recognition are very expensive for day to day use. Therefore, the main objective of this research is to find out a low cost affordable method of sign language interpretation. This paper discusses the possible ways to deal with the sign language postures to identify the signs and convert them into text and speech using appearance based approach with a low cost web camera. Further this approach will be very useful to the sign language learners to practice sign language. During the research available human computer interaction approaches in posture recognition were tested and evaluated. A series of image processing techniques with Hub-moment classification was identified as the best approach. The system is able to recognize selected Sign Language signs with the accuracy of 76% without a controlled background with small light adjustments.

Advantage:

- Helps in identifying a low cost, affordable method that can facilitate hearing and speech impaired people to communicate with the world in more comfortable way where they can easily get what they need from the society and also can contribute to the well-being of the society.
- Can be used as a learning tool for sign language where hearing and speech impaired people can practice sign language using the application.

Disadvantage:

- This project only looks at the hand postures not on hand gestures.

[5] Title: MILES: Multiple-Instance Learning via Embedded Instance Selection

Author: Yixin Chen, Jinbo Bi and James Z. Wang

Multiple-instance problems arise from the situations where training class labels are attached to sets of samples (named bags), instead of individual samples within each bag (called instances). Most previous multiple-instance learning (MIL) algorithms are developed based on the assumption that a bag is positive if and only if at least one of its instances is positive.

Although the assumption works well in a drug activity prediction problem, it is rather restrictive for other applications, especially those in the computer vision area. The authors proposed a learning method, MILES (Multiple-Instance Learning via Embedded instance Selection), which converts the multiple-instance learning problem to a standard supervised learning problem that does not impose the assumption relating instance labels to bag labels. MILES maps each bag into a feature space defined by the instances in the training bags via an instance similarity measure. This feature mapping often provides a large number of redundant or irrelevant features. Hence 1-norm SVM is applied to select important features as well as construct classifiers simultaneously.

Advantage:

- Broad adaptability: It provides a learning framework that converts a multiple-instance problem to a supervised learning problem.
- Low complexity: It is efficient in computational complexity, therefore, can potentially be tailored to tasks that have stringent time or resource limits.
- Prediction capability: In some multiple-instance problems, classification of instances is at least as important as the classification of bags.

Disadvantage:

- The performance of MILES depends on whether there are “useful” features among those defined by the instances in the training bags.
- In some applications, for example 3D object recognition, geometric constraints on the image patches are extremely useful in reducing the search space and improving the recognition accuracy. However, MILES is not designed to take advantage of this type of prior knowledge.
- The feature vectors generated by the mapping are not sparse.

2.3 COMPARISON

Table 2.1: comparison table

SL	TITLE	AUTHOR	ADVANTAGE	DISADVANTAGE
.				

N O				
1.	Using Multiple Sensors for Mobile Sign Language Recognition	Helene Brashear, Thad Starner, Paul Lukowicz & Holger Junker	<ul style="list-style-type: none"> • The user can monitor the camera's view via the head mounted display. • Provides accuracy. 	<ul style="list-style-type: none"> • Data set is too small to effectively train using bigrams or trigrams. • The current system has only been trained on a very small vocabulary.
2.	A Vision Based Dynamic Gesture Recognition of Indian Sign Language on Kinect based Depth Images	Geetha M, Manjusha C, Unnikrishnan P and Harikrishnan R	<ul style="list-style-type: none"> • Improve the accuracy of recognition. • The proposed method integrates both local as well as global information of the dynamic sign. • Can handle different types of words in a common vision based platform. 	<ul style="list-style-type: none"> • These methods are not user friendly and are more expensive.
3.	A Colour Hand Gesture Database for Evaluating and Improving Algorithms on Hand Gesture and Posture Recognition	Farhad Dadgostar, Andre L. C. Barczak, Abdolhosse in Sarrafzadeh	<ul style="list-style-type: none"> • Automatically vary the lighting fairly in all directions and even produce very complex patterns of lighting by introducing more than one source of light. • Enable researchers to add their own backgrounds to the image or to use it as an object with known boundaries. 	<ul style="list-style-type: none"> • Unless some special gadgets are used to control the lighting, it is very difficult to vary the positions of the light fairly along the three axis.
4.	Low cost approach for Real Time Sign Language Recognition	Matheesha Fernando, Janaka Wijayanayaka	<ul style="list-style-type: none"> • Helps in identifying a low cost, affordable method that can facilitate hearing and speech impaired people to communicate with the world in more comfortable way where they can easily get what 	<ul style="list-style-type: none"> • This project only looks at the hand postures not on hand gestures.

			<p>they need from the society and also can contribute to the well-being of the society.</p> <ul style="list-style-type: none"> • Can be used as a learning tool for sign language where hearing and speech impaired people can practice sign language using the application. 	
5.	Multiple-Instance Learning via Embedded Instance Selection	Yixin Chen, Jinbo Bi and James Z. Wang	<ul style="list-style-type: none"> • Broad adaptability: It provides a learning framework that converts a multiple-instance problem to a supervised learning problem. • Low complexity: It is efficient in computational complexity, therefore, can potentially be tailored to tasks that have stringent time or resource limits. • Prediction capability: In some multiple-instance problems, classification of instances is at least as important as the classification of bags. 	<ul style="list-style-type: none"> • The performance of MILES depends on whether there are “useful” features among those defined by the instances in the training bags. • In some applications, for example 3D object recognition, geometric constraints on the image patches are extremely useful in reducing the search space and improving the recognition accuracy. However, MILES is not designed to take advantage of this type of prior knowledge. • The feature vectors generated by the mapping are not sparse.

2.4 OBJECTIVE OF THE PROJECT

The main objective of the proposed system is to make communication easy for the deaf and dumb people to communicate with normal people. This is achieved by converting the Indian sign language to normal text and speech with available technology.

Proposed System:

The first step for the proposed system is the capturing of the video using webcam where different alphabets were taken into consideration. Skin Filtering was performed to the input video frames for detection of hand gestures. It was done so that the required hand could be extracted from the background. Skin Filtering is a technique used for separating the skin coloured regions from the non-skin coloured regions. In our proposed system there are 5 modules: real time Input image from webcam, pre-processing and segmentation, feature extraction, classification and Results analysis (gesture recognition). For gesture recognition is real time recognized in live camera. The proposed system are used in SVM (Support Vector Machine), K Neighbours-Classifier, Logistic Regression, MLP Classifier, Naive Bayes, Random Forest Classifier algorithms. We propose an easy-to-use and inexpensive approach to recognize single handed as well as double handed gestures accurately. This system can definitely help millions of deaf people to communicate with other normal people. A fast, novel and robust system was proposed for recognition of different alphabets of Indian Sign Language for video sequences. The proposed system is a real time video processing that is based on a real time application system.

Advantages

- There are no moving parts, so device wear is not an issue.
- We have proposed a system which is able to recognize the various alphabets of Indian Sign Language for Human-Computer interaction giving more accurate results at least possible time.
- Accuracy rate obtained was 98% but it lacks proper Skin filtering with changes in illumination.
- Proper classifier were used to recognize the gestures.

SVM (Support Vector Machine), K Neighbours-Classifier, Logistic Regression, MLP Classifier, Naive Bayes, and Random Forest Classifier Algorithms is used and after the training then output is achieved, thus giving the proper recognized gesture.

2.5 SUMMARY

Image processing is the process of extracting pictorial data after processing an image. This technology can be used for the deaf and dumb for sign conversion by processing hand signs and interpreting message. In the recent years many techniques have been developed for sign

conversion, due to some of the disadvantages of these techniques and with the development of image processing, many new techniques have been developed. Many hearing people don't have the knowledge of sign language, with this method communication becomes easy.

CHAPTER 3

DESIGN AND METHODOLOGY

3.1 INTRODUCTION

Sign language conversion is used for making communication easy for deaf and dumb people to communicate with normal people. This is achieved using latest available technology like image processing for extracting features from hand sign and using suitable algorithm for feature extraction and with a nominal method converting it to text and speech.

3.2 BLOCK DIAGRAM

The proposed system consists of five modules of following steps assigned in fig 3.1 to interpret the gesture from the input image:

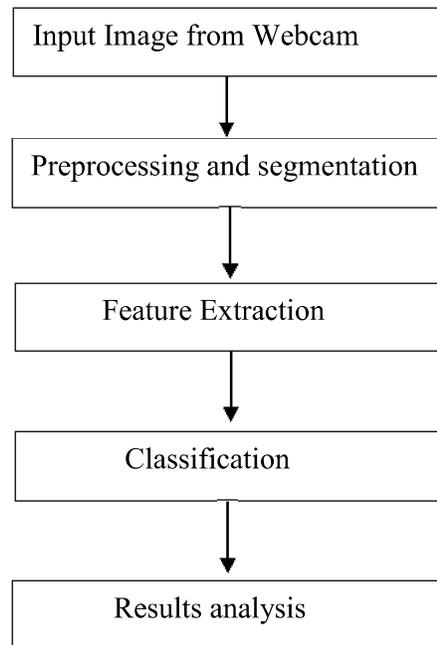


Fig 3.1: Overview of the proposed system in five modules

3.2.1 Input Image from Webcam:

The image (gesture or sign) is captured using the laptop camera or the external device webcam to get better image clarity.

3.2.2 Pre-processing and segmentation:

Image processing is necessary for image enhancement. During Pre-processing RGB image to convert into HSV colour space. This step was taken because HSV colour space was less sensitive to illumination changes compared to RGB. Then it was filtered, smoothed and finally the biggest binary linked object was being considered so as to avoid consideration of skin colored objects other than hand. To obtain the good result smoothing and filtering is done. Image segmentation is basically performed to locate the hand object in image.

3.2.3 Feature Extraction:

Feature Extraction stage is necessary because certain features have to be extracted so that they are unique for each gesture or sign. After the decision is made that a sign is present, then the last frame is taken into consideration and features. The Feature Extraction is to extract the features in all images (gesture or sign) dataset are stored in 'svm.pkl' and finally extract the labels stored in 'labels.pkl' best on train data and test data.

3.2.4 Classification:

Classification of hand is done with the help of various features calculated previously. The five bit binary sequence is thus generated to uniquely recognize and utilize these recognized hand gesture for supporting human computer interaction. By the feature extraction significant peak is encoded as 1 while insignificant peak is encoded as 0 based on intersection to the threshold line.

3.2.5 Results analysis:

Different images are tested and found that the new technique of classification was found to show 97% accuracy. Some images tested with other database images are given in the results analysis. In Results analysis are real time detect the sign language and sign recognize when live camera is started then capture the test images (gesture or sign) that time compare the features 'svm.pkl' and 'labels.pkl' if it matches the dataset after the process in display the result.

3.3 FLOW CHART

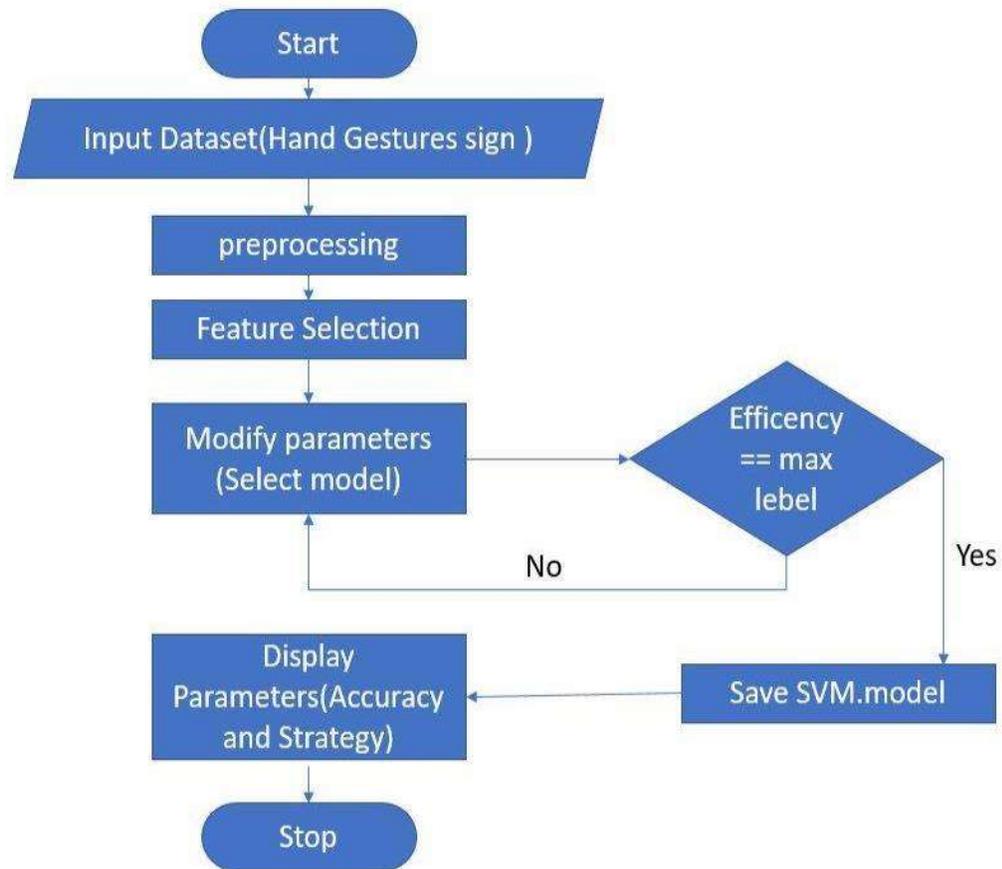


Fig 3.2: Flow chart

3.4 SYSTEM ARCHITECTURE

The architectural configuration procedure is concerned with building up a fundamental basic system for a framework. It includes recognizing the real parts of the framework and interchanges between these segments. The beginning configuration procedure of recognizing these subsystems and building up a structure for subsystem control and correspondence is called construction modeling outline and the yield of this outline procedure is a portrayal of the product structural planning. The proposed architecture for this system is given below. It shows the way this system is designed and brief working of the system.

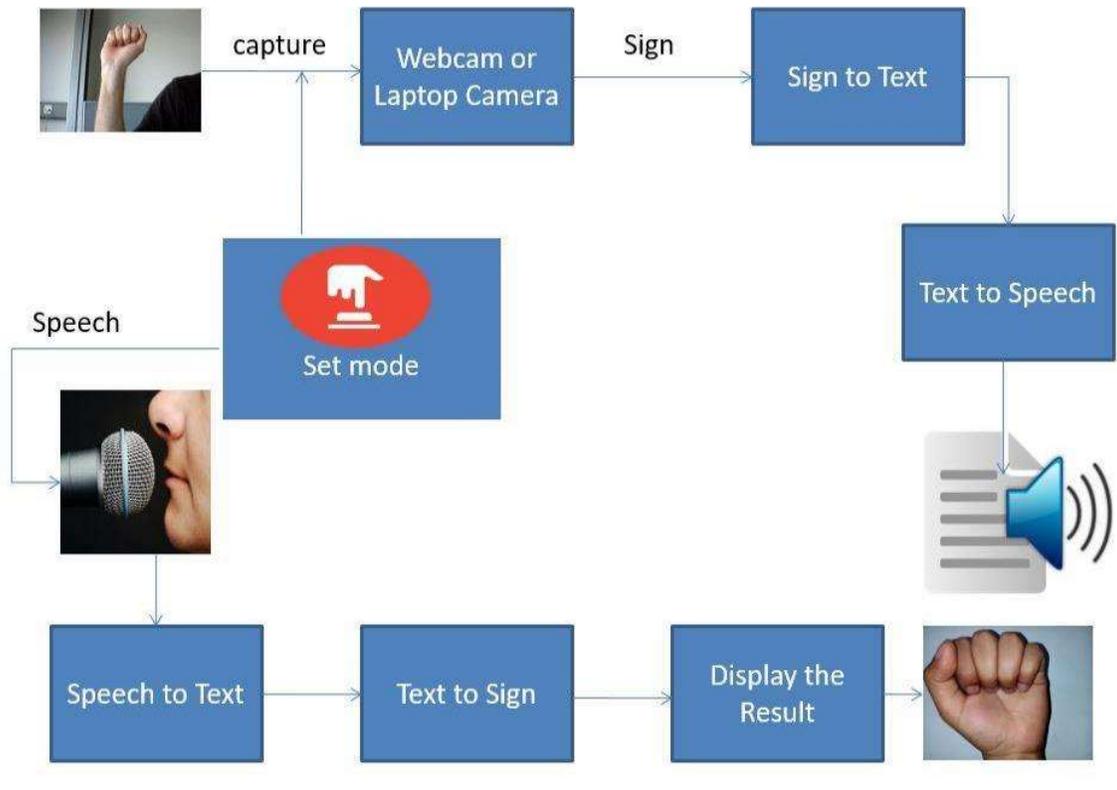


Fig 3.3: System architecture

3.5 METHODOLOGIES

A methodology is a repeatable process with project-specific methods. This methodology consists of the following phases such as:

1. Requirement of the data collection will be performed using two dataset are Train data and Test data.
2. During Technology adaptation, will be undertaken with three process such as:

3.5.1 Feature Extraction

Feature Extraction is extract the all Images data using Hog algorithm can provides all dataset features.

3.5.1.1 HOG Algorithm:

The HOG feature descriptor is used in extract the feature and labels for images sign or gesture. Such as:-

Process-A:

This process applies an optional global image normalization equalization that is designed to reduce the influence of illumination effects. In practice this project uses gamma (power law) compression, either computing the square root or the log of each color channel. Image texture strength is typically proportional to the local surface illumination so this compression helps to reduce the effects of local shadowing and illumination variations.

Process-B:

This process computes first order image gradients. These capture contour, silhouette and some texture information, while providing further resistance to illumination variations. The locally dominant color channel is used, which provides color invariance to a large extent. Variant methods may also include second order image derivatives, which act as primitive bar detectors - a useful feature for capturing, e.g. bar like structures in alphabet of sign.

Process-C

This process aims to produce an encoding that is sensitive to local image content while remaining resistant to small changes in pose or appearance. The adopted method pools gradient orientation information locally in the same way as the SIFT ₂ feature. The image window is divided into small spatial regions, called “cells”. For each cell we accumulate a local 1-D histogram of gradient or edge orientations over all the pixels in the cell. This combined cell-level 1-D histogram forms the basic “orientation histogram” representation. Each orientation histogram divides the gradient angle range into a fixed number of predetermined bins. The gradient magnitudes of the pixels in the cell are used to vote into the orientation histogram

3.5.2 Pre-processing

Pre-processing is processed the dataset apply six best algorithms in pre-processed the SVM, K Neighbours Classifier, Logistic Regression, MLP Classifier, Naïve Bayes, Random Forest Classifier all are create more score such as accuracy score, precision score, f1 score, recall score of the test and train dataset after SVM algorithm create the dataset features store in 'svm.pkl' and finally extract the labels store in 'labels.pkl' best on train data and test data.

3.4.2.1 Machine Learning Method:

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves. The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples. The primary aim is to allow the computers learn automatically without human intervention or assistance and adjust actions accordingly.

Supervised machine learning algorithm can apply what has been learned in the past to new data using labelled examples to predict future events. Starting from the analysis of a known training dataset, the learning algorithm produces an inferred function to make predictions about the output values. The system is able to provide targets for any new input after sufficient training. The learning algorithm can also compare its output with the correct, intended output and find errors in order to modify the model accordingly.

3.5.2.2 SVM (Support Vector Machine):

A Support Vector Machine (SVM) is a supervised machine learning algorithm that can be employed for both classification and regression purposes. SVMs are more commonly used in classification problems and as such, this is what we will focus on in this post. SVMs are based on the idea of finding a hyper plane that best divides a dataset into two classes. Support vectors are the data points nearest to the hyper plane, the points of a data set that, if removed, would alter the position of the dividing hyper plane. Because of this, they can be considered the critical elements of a data set. It is also commonly used for image recognition challenges, performing particularly well in aspect-based recognition and colour-based classification. It provides better accuracy and works well on smaller cleaner datasets. It can be more efficient because it uses a subset of training points. In SVC (Support Vector Classification) used in extract the features in all Images (gesture or sign) dataset are store in 'svm.pkl'. In this algorithm provide best performance such as Accuracy, Precision, f1 score and Recall score.

3.5.2.3 Random Forest:

The random forest algorithm helps to grow many such decision trees and provide the average of the different classification trees (or the mode). This reduces the variance. The

different Classification trees are trained on the basis of different parts of the training dataset. In order to classify a new object from an input vector, put the input vector down, with each of the trees in the forest. Each tree gives a classification, the forest then chooses the classification of having the most votes or the average of all the trees in the forest. In Random Forest Classification used in extract the features in all Images (gesture or sign) dataset are store in 'RF.pkl'.

3.5.2.4 Naive Bayes:

This is a classification technique based on Bayes' theorem with an assumption of independence between predictors. In simple terms, a Naive Bayes classifier assumes that the presence of a particular feature in a class is unrelated to the presence of any other feature. Naive Bayes model isn't difficult to build and is really useful for very large datasets. Along with simplicity, Naive Bayes is also considered to have outperformed all the highly sophisticated classification methods. This algorithm used in clf(classification) best on sign or gesture and it also provides better Accuracy, Precision, f1 score, Recall score.

3.5.2.5 Logistic regression:

It is a classification, and not a regression algorithm. It is used to estimate discrete values (Binary values like 0/1, yes/no, true/false) based on a given set of independent variable(s). In simple words, it predicts the probability of occurrence of an event by fitting data to a *logistic function*. Hence, it is also known as logistic regression. A logistic regression model is termed as a probabilistic model. It helps in finding the probability that a new instance belongs to a certain class. Since it is probability, the output lies between 0 and 1. Whenever using the logistic regression as a binary classifier (classification done into two classes), it can consider the classes to be a positive class and a negative class. Then find the probability. Higher the probability (greater than 0.5), it is likelier that it falls into the positive class. Similarly, if the probability is low (less than 0.5), it can be classified into the negative class. In this algorithm used in train data and test data(x_train,y_train). It also provide best performance such as accuracy and score.

3.5.2.6 MLP (Multi-Layer Perceptron):

In the Multilayer perceptron, there can more than one linear layer (combinations of neurons). If taken a simple example of three-layer network, first layer will be the input layer and last will be output layer and middle layer will be called hidden layer. It can feed input data into the input layer and take the output from the output layer. It can increase the number of the hidden layer as much as it want, to make the model more complex. In a supervised classification system, each input vector is associated with a label, or ground truth, defining its class or class label is given with the data. The output of the network gives a class score, or prediction, for each input. To measure the performance of the classifier, the loss function is defined. The loss will be high if the predicted class does not correspond to the true class, it will be low otherwise. Sometimes the problem of over fitting and under fitting occurs at the time of training the model. In this case, our model performs very well on training data. In order to train the network, an optimization procedure is required for the need of loss function and an optimizer. This procedure will find the values for the set of weights that minimizes the loss function. In this algorithm used in train data and test data(x_{train}, y_{train}). It also provide best performance such as Accuracy, Precision, f1 score, Recall score.

3.5.2.7 K Nearest Neighbours (KNN):

K Nearest Neighbour (KNN) is a very simple, easy to understand, versatile and one of the topmost machine learning algorithms. KNN used in the variety of applications such as finance, healthcare, political science, handwriting detection, image recognition and video recognition. In Credit ratings, financial institutes will predict the credit rating of customers. In loan disbursement, banking institutes will predict whether the loan is safe or risky. In political science, classifying potential voters in two classes will vote or won't vote. KNN algorithm used for both classification and regression problems. KNN is a non-parametric and lazy learning algorithm. Non-parametric means there is no assumption for underlying data distribution. In other words, the model structure determined from the dataset. This will be very helpful in practice where most of the real world datasets do not follow mathematical theoretical assumptions. Lazy algorithm means it does not need any training data points for model generation. All training data used in the testing phase. This makes training faster and testing phase slower and costlier. Costly testing phase means time and memory. In the worst case, KNN needs more time to scan all data points and scanning all data points will require more

memory for storing training data. In this algorithm used in both training dataset and testing dataset (x_{train}, y_{train}). It also provide best performance such as Accuracy, Precision, f1 score, Recall score.

3.5.2.8 K- means clustering:

K-means, it is one of the simplest unsupervised learning algorithms that will solve the most well-known clustering problem. The procedure can be grouped as the one which follows a simple and very easy way to classify a given data set with the help of a certain number of clusters (assume k clusters) fixed Apriority. The main idea here is to define k centers, which takes one for each cluster. These centers should now be planned and placed in an absolute cunning way because it has got various locations leading or causing a different result. So, there is a better choice, which is to place them very far away from each other. As far as possible. Then comes the next step which is to take each point that is belonging to a given data set and can be associated with the nearest center. When there is no point pending, the first step is already completed and a complete early group age is done. This is the point, where it all need to do the re-calculation. Here, 'k' is the complete new centroids as barycenter of the clusters which actually results from the previous or the earlier step. Also, after we have got these k new centroids, a new binding has to be done. This will need to be in between the same data set points and the nearest new center. A loop has to be generated. As a result of this loop, everyone may notice that the k centers will be changing the location step by step. This will continue until no more changes are to be done or in other words, can say the centers do not move anymore. Finally, this algorithm is always aiming at minimizing an objective function which is known to be as squared error function. It used in preprocess the data when the dataset are training (train data).

3.5.3 Classification

Classification can classified the both test data and train data predict in sign language using 'svm.pkl' and 'labels.pkl'.

3. Results analysis are provide real time detect the sign and sign recognize when live camera start capture the test images that time compare the features 'svm.pkl' and

'labels.pkl' if it is match the dataset after that display the result.

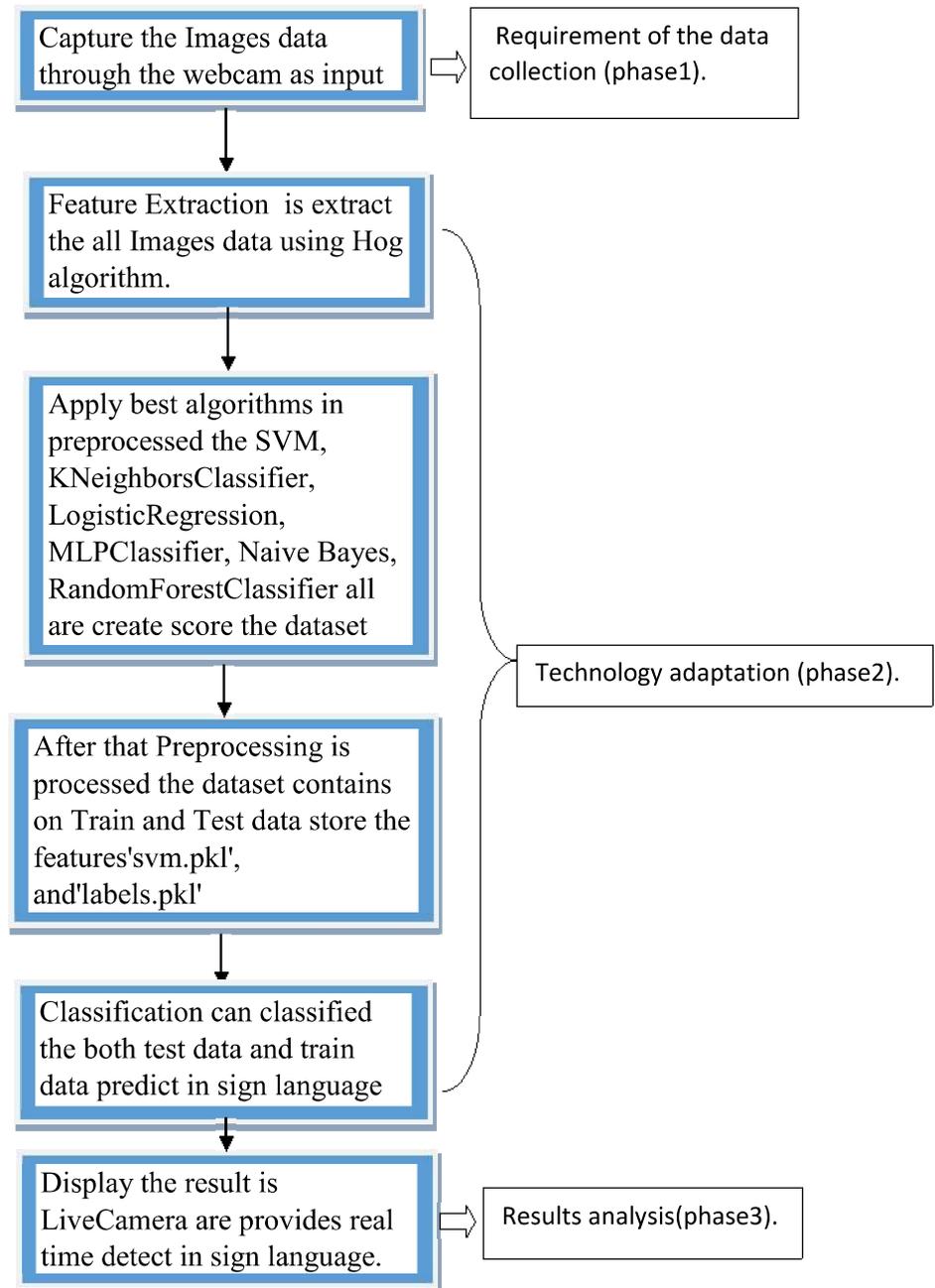


Fig 3.4: Three phases of the methodology

3.6 SUMMARY

Image processing is the process of extracting pictorial data after processing an image. This technology can be used for the deaf and dumb for sign conversion by processing hand

signs and interpreting message. In the recent years many techniques have been developed for sign conversion, due to some of the disadvantages of these techniques and with the development of image processing, many new techniques have been developed. Many hearing people don't have the knowledge of sign language, with this method communication becomes easy.

CHAPTER 4

IMPLEMENTATION AND RESULTS

4.1 INTRODUCTION

This project uses a laptop which consists of webcam for capturing image, and there are 5 modules involved in implementing it, they are capturing of image, pre-processing, feature extraction, classification and result analysis. It uses python language for coding and anaconda simulator on windows operating system. There are multiple libraries used in this project such as cv2, numpy, matplotlib, joblib, sklearn, skimage, os, math, time and some others and also it uses multiple algorithms in this project such as hog, support vector machine, random forest, naïve bayes, logistic regression, multi-layer perceptron, k nearest neighbours and PYEESX3 algorithm for getting accurate results for the above mentioned 5 modules.

4.2 HARDWARE AND SOFTWARE REQUIREMENTS

4.2.1 Hardware Requirements

- Laptop or computer.
- Webcam.
- Speaker.

4.2.2 Software Requirements

- Anaconda Navigator.
- Python IDE.

4.2.3 Language

- Python

4.3 SPECIFICATION OF HARDWARE

4.3.1 Processor

In this project Intel i5 core processor is used, which can be used in both computers and laptops, and they are part of one of three types of processors in the “i” series which is also

called the Intel core family of processors. They are available in multiple speeds, ranging from 1.90 GHz up to 3.80 GHz, and it features 3 MB, 4 MB or 6 MB of cache. It utilizes either the LGA 1150 or LGA 1155 socket on a motherboard. The core is often found to be quad core, having 4 cores. However, a selected few high-end core i5 processors feature 6 cores. They are used in laptops where low battery usage for lower speeds and high battery usage for higher speeds is observed.

4.3.2 RAM

RAM can be expanded as Random access memory which is a form of computer memory that can be read and changed in any order, they are mostly used in storing data and machine code which are temporary code. It allows data to read and write in almost the same amount of time irrespective of the physical location of data inside the memory. In today's technology RAM take the form of integrated circuit chips with metal-oxide-semiconductor memory cells. They are associated normally with volatile types such as DRAM modules, where the stored information is lost if power is removed. They are two types of volatile random access semiconductor memory which are Static random access memory (SRAM) and Dynamic random access memory (DRAM). Usually we use 4GB and above for this project.

4.3.3 System type

In this project we use 64 bit operating system, it is known that in computer architecture, 64-bit integers, memory addresses, or other data units are those that are 64 bits (8 octets) wide. Also, 64-bit CPU and ALU architectures are those that are based on registers, address buses, or data buses of that size. 64-bit microcomputers are computers in which 64 bit microprocessors are the norm. From the software perspective, 64-bit computing means the use of code with 64-bit virtual memory addresses. However, not all 64-bit instruction sets support full 64-bit virtual memory addresses; x86-64 and ARMv8, for example, support only 48 bits of virtual address, with the remaining 16 bits of the virtual address required to be all 0's or all 1's, and several 64-bit instruction sets support fewer than 64 bits of physical memory address.

4.3.4 Hard disk

This project uses a laptop which gives about 500 GB to 600 GB hard disk. It is a non-volatile storage, retaining stored data even when powered off. All the permanent data is stored in hard disk.

4.4 SOFTWARE SPECIFICATION

4.4.1 Language

Python is an interpreted, high-level, general-purpose programming language. Created by Guido van Rossum and first released in 1991, Python's design philosophy emphasizes code readability with its notable use of significant whitespace. Its language constructs and object-oriented approach aim to help programmers write clear, logical code for small and large-scale projects. Python is dynamically typed and garbage-collected. It supports multiple programming paradigms, including procedural, object-oriented, and functional programming. Python is often described as "batteries included" language due to its comprehensive standard library. Python was conceived in the late 1980s as a successor to the ABC language. Python 2.0, released in 2000, introduced features like list comprehensions and a garbage collection system capable of collecting reference cycles. Python 3.0, released in 2008, was a major revision of the language that is not completely backward-compatible, and much Python 2 code does not run unmodified on Python 3. The Python 2 language, i.e. Python 2.7.x, was officially discontinued on 1 January 2020 (first planned for 2015) after which security patches and other improvements will not be released for it. With Python 2's end-of-life, only Python 3.5 and later are supported. Python interpreters are available for many operating systems. A global community of programmers develops and maintains CPython, an open source reference implementation. A non-profit organization, the Python Software Foundation, manages and directs resources for Python and CPython development.

4.4.2 Simulation tool

This project uses Anaconda navigator 3.7.4 as the simulation tool, Anaconda Navigator is a desktop graphical user interface (GUI) included in Anaconda® distribution that allows you to launch applications and easily manage conda packages, environments, and channels without using command-line commands. Navigator can search for packages on Anaconda Cloud or in a local Anaconda Repository. It is available for Windows, macOS, and Linux. In order to run, many scientific packages depend on specific versions of other packages. Data scientists often use multiple versions of many packages and use multiple environments to separate these

different versions. The command-line program conda is both a package manager and an environment manager. This helps data scientists ensure that each version of each package has all the dependencies it requires and works correctly. Navigator is an easy, point-and-click way to work with packages and environments without needing to type conda commands in a terminal window. You can use it to find the packages you want, install them in an environment, run the packages, and update them – all inside Navigator.

4.4.3 Libraries

4.4.3.1 Opencv library

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code. The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch images together to produce a high resolution image of an entire scene, find similar images from an image database, remove red eyes from images taken using flash, follow eye movements, recognize scenery and establish markers to overlay it with augmented reality, etc. OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 18 million. The library is used extensively in companies, research groups and by governmental bodies. It has C++, Python, Java and MATLAB interfaces and supports Windows, Linux, Android and Mac OS. OpenCV leans mostly towards real-time vision applications.

4.4.3.2 Numpy Library

NumPy is the fundamental package for scientific computing with Python. It contains among other things a powerful N-dimensional array object, sophisticated (broadcasting) functions, tools for integrating C/C++ and Fortran code, and useful linear algebra, Fourier transform, and random number capabilities Besides its obvious scientific uses, NumPy can also be used as an efficient multi-dimensional container of generic data. Arbitrary data-types can

be defined. This allows NumPy to seamlessly and speedily integrate with a wide variety of databases.

4.4.3.3 Matplotlib library

Matplotlib is a plotting library for the Python programming language and its numerical mathematics extension NumPy. It provides an object-oriented API for embedding plots into applications using general-purpose GUI toolkits like Tkinter, wxPython, Qt, or GTK+. There is also a procedural "pylab" interface based on a state machine (like OpenGL), designed to closely resemble that of MATLAB, though its use is discouraged.^[3] SciPy makes use of Matplotlib.

4.4.3.4 Scikit-Learn Library

Scikit-learn is an open source Python library for machine learning. The library supports state-of-the-art algorithms such as KNN, XGBoost, random forest, SVM among others. It is built on top of Numpy. Scikit-learn is widely used in kaggle competition as well as prominent tech companies. Scikit-learn helps in preprocessing, dimensionality reduction (parameter selection), classification, regression, clustering, and model selection.

4.4.3.5 Scikit-Image Library

Scikit-image is an open-source image processing library for the Python programming language. It includes algorithms for segmentation, geometric transformations, color space manipulation, analysis, filtering, morphology, feature detection, and more. It is designed to interoperate with the Python numerical and scientific libraries NumPy and SciPy.

4.4.3.6 Pyttsx3 Library

Pyttsx3 is a text to speech conversion library in python. Unlike alternative libraries, it works offline and is computable with both python 2 and 3. An application invokes the pyttsx3. The pyttsx3 module supports two voices first is female and the second is male which is provided by "sapi5" for windows.

4.5 SYSTEM STUDY

4.5.1 Feasibility study

The feasibility of the project is analyzed in this phase and business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis the feasibility study of the proposed system is to be carried out. This is to ensure that the proposed system is not a burden to the company. For feasibility analysis, some understanding of the major requirements for the system is essential.

4.5.1.1 Economical feasibility

This study is carried out to check the economic impact that the system will have on the organization. The amount of fund that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system as well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

4.5.1.2 Technical feasibility

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands on the available technical resources. This will lead to high demands being placed on the client. The developed system must have a modest requirement, as only minimal or null changes are required for implementing this system.

4.5.1.3 Social feasibility

The aspect of study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final user of the system.

4.5.2 Functional requirement

- Laptop can capture live video using the web camera
- The captured video is processed and features are extracted
- Can detect the signs

- Application can send the instruction to the machine learning model
- can process the instruction model
- The laptop's current screen image is captured
- The sign status is displayed in the Indian sign Language

4.5.3 Non-Functional Requirement

- **Usability**

The client acknowledge be typical nearly the buyer interfaces and committed to ask for ambush pressure in relocating to a unique framework with another condition.

- **Reliability**

The progressions made by the Programmer ought to be obvious both to the Project pioneer and in addition the Test design.

- **Security**

Counting bug following the framework must give important security and must secure the entire procedure from slamming.

- **Performance**

The framework will be facilitated on a solitary web server with a solitary database server out of sight, consequently execution turns into a noteworthy concern.

- **Portability**

This is required when the web server, which is facilitating the framework stalls out because of a few issues, which requires their framework to be taken to another framework.

- **Reusability**

The framework ought to be separated into such modules that it could be utilized as a piece of another framework without requiring a lot of work.

4.6 TYPE OF TESTING

4.6.1 Unit testing

Individual component are tested to ensure that they operate correctly. Each component is tested independently, without other system component. This system was tested with the set of proper test data for each module and the results were checked with the expected output. Unit

testing focuses on verification effort on the smallest unit of the software design module. This is also known as MODULE TESTING. This testing is carried out during phases, each module is found to be working satisfactory as regards to the expected output from the module.

4.6.2 Integration testing

Integration testing is another aspect of testing that is generally done in order to uncover errors associated with flow of data across interfaces. The unit-tested modules are grouped together and tested in small segment, which make it easier to isolate and correct errors. This approach is continued until I have integrated all modules to form the system as a whole.

4.6.3 System Testing

System testing is actually a series of different tests whose primary purpose is to fully exercise the computer-based system. System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration oriented system integration testing. System testing is based on process description and flows, emphasizing pre-driver process and integration points

4.6.4 Performance Testing

The performance testing ensure that the output being produced within the time limits and time taken for the system compiling, giving response to the users and request being send to the system in order to retrieve the results.

4.6.5 Validation Testing

The validation testing can be defined in many ways, but a simple definition is that. Validation succeeds when the software functions in a manner that can be reasonably expected by the end user.

4.6.6 Black Box testing

Black box testing is done to find the following

- Incorrect or missing functions
- Interface errors
- Errors on external database access
- Performance error
- Initialization and termination error

4.6.7 White Box Testing

This allows the tests to

- Check whether all independent paths within a module have been exercised at least once
- Exercise all logical decisions on their false sides
- Execute all loops and their boundaries and within their boundaries
- Exercise the internal data structure to ensure their validity
- Ensure whether all possible validity checks and validity lookups have been provided to validate data entry.

4.6.8 Acceptance Testing

This is the final stage of testing process before the system is accepted for operational use.

The system is tested within the data supplied from the system procurer rather than simulated data

Table 2.2 Unit Test Case 1

Sl # Test Case	UTC- 1
Name of Test	Pre-processing the image.
Expected Result	Input RGB image. Convert to greyscale. Apply gaussian/weighted filter.
Actual output	Same as expected.
Remarks	Successful

Table 2.3 Unit Test Case 2

Sl # Test Case	UTC- 2
Name of Test	Segmentation.
Expected Result	Filtered image as input. Grey to binary image. Image morphological operation.

	Removing noise. Binary image properties. Mask of segment image. Segmented image.
Actual output	Same as expected.
Remarks	Successful

Table 2.4 Unit Test Case 3

SI# Test Case	UTC- 3
Name of Test	Feature extraction.
Expected Result	Segmented image. GLCM Feature extraction. Feature matrix (GLCM fit with labels).
Actual output	Same as expected.
Remarks	Successful

Table 2.5 Unit Test Case 4

SI# Test Case	UTC- 4
Name of Test	Training.
Expected Result	Train ML model with feature matrix. Saved trained model with pickle.
Actual output	Same as expected.
Remarks	Successful

Table 2.6 Unit Test Case 5

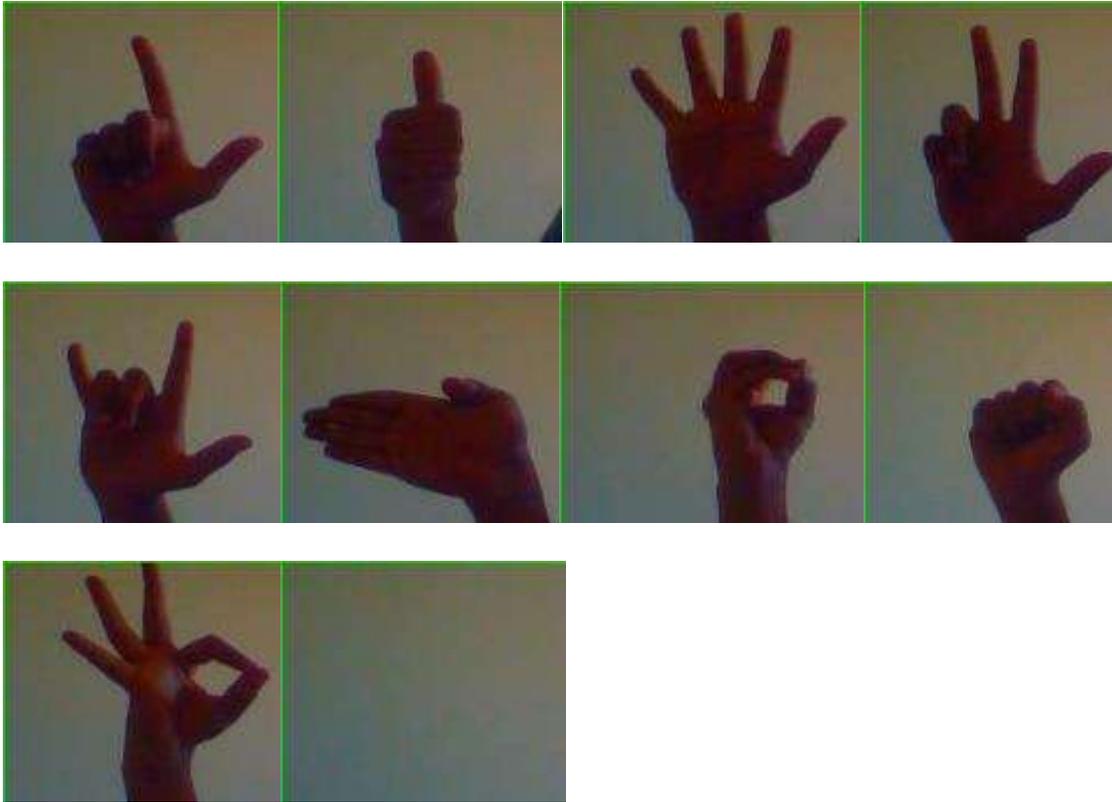
Sl # Test Case	UTC- 5
Name of Test	Classification.
Expected Result	Input rgb image 1. Pre-processing 2. Segmentation 3. Feature extraction Pass features to trained ml model
Actual output	Same as expected.
Remarks	Successful

Table 2.7 Unit Test Case 6

Sl # Test Case	UTC- 5
Name of Test	Sign Recognition.
Expected Result	In Results analysis are real time detect the sign and sign recognize when live camera is start after the process in display the result.
Actual output	Same as expected.
Remarks	Successful

4.7 INPUT





4.8 SUMMARY

This chapter gives the final step of conversion, the components, coding language, software components required for the project to successfully convert the input gestures to the words representing it in 5 steps of image extraction, feature extraction, pre-processing, classification and finally result analysis which gives the outcome the project expected.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

In this project, the proposed system for recognizing a dynamic hand words gesture of Indian sign language and conversion of recognized gesture into text and speech and viceversa i.e. dual way communication. In this system, skin color filtering technique has used for segmentation. Eigen vectors and Eigen values technique has used for feature extraction. For classification, Eigen value weighted Euclidean Distance based classifier has used. Prediction of words sign using one or both hand, working with Indian Sign language dynamic hand gesture words dataset and dual way communication has proposed in this system. This project concludes that from using the above mentioned open source libraries in the given codes the images are captured and it is stored for training and testing folders. Which are then accessed in feature extraction where the images from train folders are taken and the process of masking, blurring, and edge detection and finally HOG image as output using HOG algorithm. This features are accessed in the next step of pre-processing where it uses the all the libraries and it reads through all the images in the train and test folders which are then applied to machine learning algorithms support vector machine (SVM), K nearest neighbour (KNN), Naïve Bayes and Multi-layer perceptron (MLP) which calculates accuracy, precision, f1 value and recall values. In which accuracy is taken for viewing, in the next step of classification we select an image in the dataset and the result is classified accordingly if the errors are seen then they can be rectified at this moment of process. In the final step the live image is recorded through camera and based on the training and testing data the result of speech is achieved.

5.2 FUTURE SCOPE

The future work for this project has lot of potential to improve its popularity amongst people as a viable gadget which can be used in day to day life and as the technology is blooming there are lot of changes and improvements which can be made for the betterment of this project and for the helpfulness to the people, there is possibility of improvement in noise reduction, dataset collection, better feature extraction, time reduction in conversion. It can be changed to have multiple languages and signs included in its future work.

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APPENDIX A: DATA SHEET

Computer

- Processor : Intel i5 3.0 GHz
- RAM : 4 GB and above
- System type : 64-bit Operating system
- Hard disk : 500 GB

Webcam

- Camera with 3P Lens.
- Built-in Microphone.
- Auto White Balance.
- Night Vision.
- Manual Switch for LED.

APPENDIX B: SOURCE CODE

[1] Input Image from Webcam

```
import os
import time
import cv2
import numpy as np
vc = cv2.VideoCapture(0)
pic_no = 0
total_pic = 250
flag_capturing = False
path = 'Train/Good MORNING'
while(vc.isOpened()):
    rval, frame = vc.read()
    frame = cv2.flip(frame, 1)
    cv2.rectangle(frame, (300,300), (100,100), (0,255,0),0)
    cv2.imshow("image", frame)
    crop_img = frame[100:300, 100:300]
    if flag_capturing:
        pic_no += 1
        #save_img = cv2.resize( crop_img, (128,128) )
        save_img = cv2.resize( crop_img, (640,480) )
        save_img = np.array(save_img)
        cv2.imwrite(path + "/" + str(pic_no) + ".jpg", save_img)
    keypress = cv2.waitKey(1)
    if pic_no == total_pic:
        flag_capturing = False
    break
    if keypress == ord('q'):
        break
```

```
elif keypress == ord('c'):
    flag_capturing = True
    vc.release()
    cv2.destroyAllWindows()
    cv2.waitKey(1)
```

[2] Feature extraction

```
import numpy as np
import cv2
from matplotlib import pyplot as plt
from skimage.feature import hog
def func(frame):
    frame = cv2.resize(frame,(128,128))
    converted2 = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
    converted = cv2.cvtColor(frame, cv2.COLOR_BGR2HSV)
    lowerBoundary = np.array([0,40,30],dtype="uint8")
    upperBoundary = np.array([43,255,254],dtype="uint8")
    skinMask = cv2.inRange(converted, lowerBoundary, upperBoundary)
    skinMask = cv2.addWeighted(skinMask,0.5,skinMask,0.5,0.0)
    skinMask = cv2.medianBlur(skinMask, 5)
    skin = cv2.bitwise_and(converted2, converted2, mask = skinMask)
    img2 = cv2.Canny(skin,60,60)
    surf = cv2.xfeatures2d.SURF_create()
    img2 = cv2.resize(img2,(256,256))
    kp, des = surf.detectAndCompute(img2,None)
    return des
def Hog(frame):
    frame = cv2.resize(frame,(128,128))
    converted2 = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
    converted = cv2.cvtColor(frame, cv2.COLOR_BGR2HSV)
```

```

lowerBoundary = np.array([0,40,30],dtype="uint8")
upperBoundary = np.array([43,255,254],dtype="uint8")
skinMask = cv2.inRange(converted, lowerBoundary, upperBoundary)
skinMask = cv2.addWeighted(skinMask,0.5,skinMask,0.5,0.0)
skinMask = cv2.medianBlur(skinMask, 5)
skin = cv2.bitwise_and(converted2, converted2, mask = skinMask)
fdb,hog_image = hog(skin, orientations=8, pixels_per_cell=(16,16),cells_per_block=(4,
4),block_norm= 'L2',visualize=True)
fdi=[]
for i in range(0,3200):
fdi.append(fdb[i])
return fdi
path = "1.jpg"
#print(Hog(cv2.imread(path)))

```

[3] pre-processing

```

import numpy as np
import cv2
import os
import sklearn.metrics as sm
from featureExtraction import func,Hog
from sklearn.cluster import MiniBatchKMeans
from sklearn.svm import SVC
from sklearn.model_selection import GridSearchCV
import random
import warnings
import pickle
#from joblib import dump,load
from sklearn.naive_bayes import GaussianNB as nb
from sklearn.neighbors import KNeighborsClassifier as knn
from sklearn.linear_model import LogisticRegression as lr

```

```

from sklearn.neural_network import MLPClassifier as mlp
import numpy as np
import sklearn.metrics as sm
from sklearn.ensemble import RandomForestClassifier
from sklearn.model_selection import train_test_split
import matplotlib.pyplot as plt
def perform_data_split(X, y, training_idx, test_idx, val_idx):
X_train = X[training_idx]
X_test = X[test_idx]
X_val = X[val_idx]
y_train = y[training_idx]
y_test = y[test_idx]
y_val = y[val_idx]
return X_train, X_test, X_val, y_train, y_test, y_val
def train_test_val_split_idx(total_rows, percent_test, percent_val):
if percent_test + percent_val >= 1.0:
raise ValueError('percent_test and percent_val must sum to less than 1.0')
row_range = range(total_rows)
no_test_rows = int(total_rows*(percent_test))
test_idx = np.random.choice(row_range, size=no_test_rows, replace=False)
# remove test indexes
row_range = [idx for idx in row_range if idx not in test_idx]
no_val_rows = int(total_rows*(percent_val))
val_idx = np.random.choice(row_range, size=no_val_rows, replace=False)
# remove validation indexes
training_idx = [idx for idx in row_range if idx not in val_idx]
print('Train-test-val split: %i training rows, %i test rows, %i validation rows' %
(len(training_idx), len(test_idx), len(val_idx)))
return training_idx, test_idx, val_idx
def cluster_features(img_descs, training_idx, cluster_model):
n_clusters = cluster_model.n_clusters

```

```

training_descs = [img_descs[i] for i in training_idx]
all_train_descriptors = [desc for desc_list in training_descs for desc in desc_list]
all_train_descriptors = np.array(all_train_descriptors)
print ("%i descriptors before clustering" % all_train_descriptors.shape[0])
print ('Using clustering model %s...' % repr(cluster_model))
print ('Clustering on training set to get codebook of %i words' % n_clusters)
cluster_model.fit(all_train_descriptors)
print ('done clustering. Using clustering model to generate BoW histograms for each image.')
img_clustered_words = [cluster_model.predict(raw_words) for raw_words in img_descs]
img_bow_hist = np.array(
[ np.bincount(clustered_words, minlength=n_clusters) for clustered_words in
img_clustered_words ])
X = img_bow_hist
print ('done generating BoW histograms.')
return X, cluster_model

def calc_accuracy(method,label_test,pred):
print("accuracy score for ",method,sm.accuracy_score(label_test,pred))
print("precision_score for ",method,sm.precision_score(label_test,pred,average='micro'))
print("f1 score for ",method,sm.f1_score(label_test,pred,average='micro'))
print("recall score for ",method,sm.recall_score(label_test,pred,average='micro'))
return(sm.accuracy_score(label_test,pred),
sm.precision_score(label_test,pred,average='micro'),sm.f1_score(label_test,pred,average='micro'),sm.recall_score(label_test,pred,average='micro'))

def predict_svm(X_train, X_test, y_train, y_test):
svc=SVC(kernel='linear')
print("svm started")
svc.fit(X_train,y_train)
pickle.dump(svc, open('svm.pkl', 'wb'))
y_pred=svc.predict(X_test)
return calc_accuracy("SVM",y_test,y_pred)

def predict_RF(X_train, X_test, y_train, y_test):

```

```
RFC=RandomForestClassifier(n_estimators=100, max_depth=2,random_state=0)
print("RF started")
RFC.fit(X_train,y_train)
pickle.dump(RFC, open('RF.pkl', 'wb'))
y_pred=RFC.predict(X_test)
return calc_accuracy("RF",y_test,y_pred)
def predict_lr(X_train, X_test, y_train, y_test):
clf = lr()
print("lr started")
clf.fit(X_train,y_train)
y_pred=clf.predict(X_test)
return calc_accuracy("Logistic regression",y_test,y_pred)
def predict_nb(X_train, X_test, y_train, y_test):
clf = nb()
print("nb started")
clf.fit(X_train,y_train)
y_pred=clf.predict(X_test)
return calc_accuracy("Naive Bayes",y_test,y_pred)
def predict_knn(X_train, X_test, y_train, y_test):
clf=knn(n_neighbors=3)
print("knn started")
clf.fit(X_train,y_train)
y_pred=clf.predict(X_test)
return calc_accuracy("K nearest neighbours",y_test,y_pred)
def predict_mlp(X_train, X_test, y_train, y_test):
clf=mlp()
print("mlp started")
clf.fit(X_train,y_train)
y_pred=clf.predict(X_test)
return calc_accuracy("MLP classifier",y_test,y_pred)
```

```

path="Train"
label=0
img_descs=[]
y=[]
ltr = {}
for (dirpath,dirnames,filenames) in os.walk(path):
for dirname in dirnames:
print(dirname)
for(direcpath,direcnames,files) in os.walk(path+"\\\\"+dirname):
for file in files:
if 'jpg' in file.lower():
actual_path=path+"\\\\"+dirname+"\\\\"+file
print(actual_path)
frame = cv2.imread(actual_path)
des=Hog(frame)
img_descs.append(des)
y.append(label)
ltr[label] = dirname
label=label+1
y=np.array(y)
X_train = img_descs
y_train = y
pickle.dump(ltr, open('labels.pkl', 'wb'))
path="Test"
label=0
img_descs=[]
y=[]
ltr = {}
for (dirpath,dirnames,filenames) in os.walk(path):
for dirname in dirnames:

```

```

print(dirname)
for(direcpath,direcnames,files) in os.walk(path+"\\\\"+dirname):
for file in files:
if 'jpg' in file.lower():
actual_path=path+"\\\\"+dirname+"\\\\"+file
print(actual_path)
frame = cv2.imread(actual_path)
des=Hog(frame)
img_descs.append(des)
y.append(label)
ltr[label] = dirname
label=label+1
y=np.array(y)
X_test = img_descs
y_test = y
(a_rf,p_rf,f_rf,r_rf) = predict_nb(X_train, X_test,y_train, y_test)
(a_svm,p_svm,f_svm,r_svm) = predict_svm(X_train, X_test,y_train, y_test)
(a_lr,p_lr,f_lr,r_lr) = predict_knn(X_train, X_test,y_train, y_test)
(a_ml,p_ml,f_ml,r_ml) = predict_mlp(X_train, X_test,y_train, y_test)
objects = ['Naive Bayes' , 'SVM', 'KNN','MLP']
y_pos = np.arange(len(objects))\
performance = []
performance.append(a_rf)
performance.append(a_svm)
performance.append(a_lr)
performance.append(a_ml)
plt.bar(y_pos, performance, align='center', alpha=0.5)
plt.xticks(y_pos, objects)
plt.ylabel('Accuracy in %')
plt.title('Accuracy')

```

```
plt.figure()
```

```
performance = []
```

```
performance.append(p_rf)
```

```
performance.append(p_svm)
```

```
performance.append(p_lr)
```

```
performance.append(p_ml)
```

```
plt.bar(y_pos, performance, align='center', alpha=0.5)
```

```
plt.xticks(y_pos, objects)
```

```
plt.ylabel('Precision in %')
```

```
plt.title('Precision')
```

```
plt.figure()
```

```
performance = []
```

```
performance.append(f_rf)
```

```
performance.append(f_svm)
```

```
performance.append(f_lr)
```

```
performance.append(f_ml)
```

```
plt.bar(y_pos, performance, align='center', alpha=0.5)
```

```
plt.xticks(y_pos, objects)
```

```
plt.ylabel('f1 score in %')
```

```
plt.title('f1 score')
```

```
plt.figure()
```

```
performance = []
```

```
performance.append(r_rf)
```

```
performance.append(r_svm)
```

```
performance.append(r_lr)
```

```
performance.append(r_ml)
```

```
plt.bar(y_pos, performance, align='center', alpha=0.5)
```

```
plt.xticks(y_pos, objects)
```

```
plt.ylabel('Recall in %')
```

```
plt.title('Recall score')
plt.figure()
plt.show()
```

[4] Classification

```
from tkinter import filedialog
from tkinter import *
import numpy as np
import cv2
import os
import csv
import sklearn.metrics as sm
from featureExtraction import func,Hog
from sklearn.cluster import MiniBatchKMeans
from sklearn.svm import SVC
from sklearn.model_selection import GridSearchCV
import random
import warnings
import pickle
import numpy as np
import sklearn.metrics as sm
def cluster_features(img_descs, training_idx, cluster_model):
    n_clusters = cluster_model.n_clusters
    training_descs = [img_descs[i] for i in training_idx]
    all_train_descriptors = [desc for desc_list in training_descs for desc in desc_list]
    all_train_descriptors = np.array(all_train_descriptors)
    cluster_model.fit(all_train_descriptors)
    img_clustered_words = [cluster_model.predict(raw_words) for raw_words in img_descs]
    img_bow_hist = np.array(
        [np.bincount(clustered_words,      minlength=n_clusters)      for      clustered_words      in
         img_clustered_words])
```

```

X = img_bow_hist
return X, cluster_model

path = 'C:/Users/Prakruthi/Desktop/FinalProject_SignLang(ML)/Train'

filename = filedialog.askopenfilename(initialdir = path,title = "Select file",filetypes =
(("Image files", "*.jpg"),("all files", "*.*")))

img_descs=[]

training_idx=[0]

frame = cv2.imread(filename)

des=Hog(frame)

img_descs.append(des)

svc= pickle.load(open('svm.pkl', 'rb'))

y_pred=svc.predict(img_descs)

print(y_pred)

labels = pickle.load(open('labels.pkl', 'rb'))

predicted_label = labels[y_pred[0]]

print(predicted_label)

```

[5] Speech2sign

```

import os

import cv2

import time

import pyttsx3

def Say(SayThis):

t2engine = pyttsx3.init()

t2engine.setProperty('rate', 130)

t2engine.say(SayThis)

t2engine.runAndWait()

def main(letter):

path="Train"

folder_path = path+'/' +letter.upper()

folder_path=folder_path.strip()

```

```

print("=====",folder_path)
#folder_path = path+'\\'+letter
for(direcpath,direcnames,files) in os.walk(folder_path):
#for files in range(str(folder_path)):
print(">>>>")
#files = os.walk(folder_path)
print("*****",files)
frame =folder_path + '/' + files[0]
print("---frame:",frame)
frame = cv2.imread(frame)
frame=cv2.resize(frame,(256,256))
cv2.imshow(letter,frame)
Say(letter)
cv2.waitKey(10)
cv2.destroyAllWindows()
if __name__ == '__main__':
TestData="speech"
while True:
for(direcpath,direcnames,files) in os.walk(TestData):
for file in files:
if 'txt' in file:
print(file)
time.sleep(2)
filename= TestData +'/' + file
with open(filename,"r") as myfile:
text = myfile.read()
print("Speech to text:", text)
clf = main(text)
print('Filename:',filename)
os.remove(filename)

```

[6] Speech

```
import speech_recognition as sr
import pyaudio
# Initialize the recognizer
r = sr.Recognizer()
# use the microphone as source for input.
with sr.Microphone() as source:
    print("Say something")
    audio = r.listen(source)
    print("Time Over..")
    try:
        print("Text:"+r.recognize_google(audio))
        f = open("speech/speech.txt","w")
        print(r.recognize_google(audio), file = f)
        f.close()
    except:
        pass
```

[7] Reverse

```
import os
import cv2
import pyttsx3
def reverse(letter):
    path="train"
    #path="test2"
    folder_path = path+'\\'+letter.upper()
    for(direcpath,direcnames,files) in os.walk(folder_path):
        frame =folder_path + '\\ + files[0]
        frame = cv2.imread(frame)
```

```
frame=cv2.resize(frame,(256,256))
return frame
def Say(SayThis):
t2engine = pyttsx3.init()
t2engine.setProperty('rate', 130)
t2engine.say(SayThis)
t2engine.runAndWait()
def main(letter):
for i in letter:
cv2.imshow(i,reverse(i))
Say(i)
cv2.waitKey(10)
cv2.destroyAllWindows()
#main('ABCD')
```

[8] Result analysis

```
from tkinter import filedialog
from tkinter import *
import numpy as np
import cv2
import os
import csv
import sklearn.metrics as sm
from featureExtraction import func,Hog
from sklearn.cluster import MiniBatchKMeans
from sklearn.svm import SVC
from sklearn.model_selection import GridSearchCV
import random
import warnings
import pickle
```

```

import numpy as np
import sklearn.metrics as sm
from Reverse import Say
def cluster_features(img_descs, training_idx, cluster_model):
    n_clusters = cluster_model.n_clusters
    training_descs = [img_descs[i] for i in training_idx]
    all_train_descriptors = [desc for desc_list in training_descs for desc in desc_list]
    all_train_descriptors = np.array(all_train_descriptors)
    cluster_model.fit(all_train_descriptors)
    img_clustered_words = [cluster_model.predict(raw_words) for raw_words in img_descs]
    img_bow_hist = np.array(
        [np.bincount(clustered_words, minlength=n_clusters) for clustered_words in
         img_clustered_words])
    X = img_bow_hist
    return X, cluster_model
training_idx=[0]
cap = cv2.VideoCapture(0)
while True:
    ret, frame = cap.read()
    if (ret == False):
        break
    try:
        cv2.rectangle(frame, (300,300), (100,100), (0,255,0), 2)
        crop_img = frame[100:300, 100:300]
        des=Hog(crop_img)
        img_descs=[]
        img_descs.append(des)
        svc= pickle.load(open('svm.pkl', 'rb'))
        y_pred=svc.predict(img_descs)
        print(y_pred)
        labels = pickle.load(open('labels.pkl', 'rb'))

```

```
predicted_label = labels[y_pred[0]]
Say(predicted_label)
print(predicted_label)
cv2.imshow('Frame',frame)
f = open("output.txt","a")
print(predicted_label,file = f)
f.close()
k = cv2.waitKey(5) & 0xFF
if k == 27:
    break
except Exception as e:
    print(e)
cap.release()
cv2.destroyAllWindows()
```

APPENDIX C: PUBLICATION DETAILS

Publication title: Sign language-Speech conversion using video processing for special words and numbers.

Conference: 6th National conference on “VLSI, Communication and Computer Networks VCCN6”.

Participants: KARTHIK.S (1AM16EC051)

BESHANTH.M (1AM16EC017)

HARIHARAN.A (1AM16EC033)

Date: 17th and 18th October, 2019.

Place: AMC Engineering College, Bangalore.

Organized: Department of Electronics and Communication Engineering.

Co-ordinator: Dr .T. Kavitha, Professor

Convener: Dr .N. V. Uma Reddy, HOD-ECE

Patron: Dr .A .G. Nataraj, Principal

SIGN LANGUAGE –SPEECH CONVERSION USING VIDEO PROCESSING FOR SPECIAL WORDS AND NUMBERS

1 Karthik S, 2 Beshanth M, 3 Hariharan A Prof DR.T.Kavitha

Department of ECE, AMC Engineering college, Affiliated to VTU, Belagavi

ABSTRACT - One of the major drawback of our society is the barrier that is created between disabled or handicapped persons and the normal person. Communication is the only medium by which we can share our thoughts or convey the message but for a person with disability (deaf and dumb) faces difficulty in communication with normal person. For many deaf and dumb people, sign language is the basic means of communication. Sign language recognition (SLR) aims to interpret sign languages automatically by a computer in order to help the deaf communicate with hearing society conveniently. Our aim is to design a system to help the person who trained the hearing impaired to communicate with the rest of the world using sign language or hand gesture recognition techniques. In this system, feature detection and feature extraction of hand gesture is done with the help of Support Vector Machine (SVM), K Neighbours-Classifer, Logistic Regression, MLP Classifier,

Naive Bayes, Random Forest Classifier algorithms are using image processing.

Keywords- Indian sign language(ISL), Hand gestures, speech conversion, special signs, numbers, image extraction, feature detection, real time application system.

I.INTRODUCTION

Image processing is a rapidly growing area in diverse applications, such as multimedia computing, secured data communication, biomedical, biometrics, remote sensing, texture understanding, pattern recognition, content-based retrieval, compression, and many more. This is all about how a computer can sense pictorial data after processing an image. Among the set of gestures intuitively performed by humans when communicating with each other, pointing gestures are especially interesting for communication and is

perhaps the most intuitive interface for selection. They open up the possibility of intuitively indicating objects and locations, e.g., to make a robot change moving direction or simply mark some object. This is particularly useful in combination with speech recognition as pointing gestures can be used to specify parameters of location in verbal statements.

This technology can be a boon for disabled people who are not able to speak hence can't communicate. Also if the person has different language than receiver, then also, it can be used to as translator. There has been always considered a challenge the development of a natural interaction interface, where people interact with technology as they are used to interact with the real world. A hand free interface, based only on human gestures, where no devices are attached to the user, will naturally immerse the user from the real world to the virtual environment.

Hands are human organs which are used to manipulate physical objects. For this very reason hands are used most frequently by human beings to communicate and interact with machines. Mouse and Keyboard are the basic input/output to computers and the use of both of these devices require the use of hands. Most important and immediate information exchange between man and

machine is through visual and actual aid, but this communication is one sided. Computers of this age provide humans with 1024 * 768 pixels at a rate of 15 frames per second and compared to it a good typist can write 60 words per minute with each word on average containing 6 letters. To help somewhat mouse remedies this problem, but there are limitations in this as well. Although hands are most commonly used for day to day physical manipulation related tasks, but in some cases they are also used for communication. Hand gestures support us in our daily communications to convey out- messages clearly. Hands are most important for mute and deaf people, who depends their hands and gestures to communicate, so hand gestures are vital for communication in sign language. If computer had the ability to translate and understand hand gestures, it would be a leap forward in the field of human computer interaction. The dilemma, faced with this is that the images these days are information tick and in-order to achieve this task extensive processing is required.

II.LITERATURE SURVEY

[1] Title: Using Multiple Sensors for Mobile Sign Language Recognition

Author: Helene Brashear, Thad Starner, Paul Lukowicz & Holger Junker

The authors built a constrained, lab-based Sign Language recognition system with the goal of making it a mobile assistive technology. They examine using multiple sensors for disambiguation of noisy data to improve recognition accuracy. The experiment compares the results of training a small gesture vocabulary using noisy vision data, accelerometer data and both data sets combined. The authors chose to use a rule-based grammar for sentence structure in the training and testing process. Speech recognition often uses statistical grammars for increased accuracy. These grammars are built by tying together phonemes (the simplest unit of speech) and training on the transition between the phonemes. The sets are usually done with bigrams (two phonemes tied together) or trigrams (three phonemes). Training using bigrams or trigrams requires considerably more data because representations of each transition of each word are now needed. In our case, the bigrams and trigrams would be built by

tying together gestures. The current data set is too small to effectively train using bigrams or trigrams, but we intend to continue collecting data with the goal of implementing these techniques.

Advantage:

- Benefit of the proposed design is that the user can monitor the camera's view via the head mounted display.
- Provides accuracy.

Disadvantage:

- Data set is too small to effectively train using bigrams or trigrams.
- The current system has only been trained on a very small vocabulary.

[2] Title: A Vision Based Dynamic Gesture Recognition of Indian Sign Language on Kinect based Depth Images

Author: Geetha M, Manjusha C, Unnikrishnan P and Harikrishnan R

Indian Sign Language (ISL) is a visual-spatial language which provides linguistic information using hands, arms, facial expressions, and head/body postures. The proposed work aims at recognizing 3D dynamic signs corresponding to ISL words. With the advent of 3D sensors like

Microsoft Kinect Cameras, 3D geometric processing of images has received much attention in recent researches. The authors have captured 3D dynamic gestures of ISL words using Kinect camera and has proposed a novel method for feature extraction of dynamic gestures of ISL words. While languages like the American Sign Language (ASL) are of huge popularity in the field of research and development, Indian Sign Language on the other hand has been standardized recently and hence its (ISLs) recognition is less explored. The method extracts features from the signs and converts it to the intended textual form. The proposed method integrates both local as well as global information of the dynamic sign. A new trajectory based feature extraction method using the concept of Axis of Least Inertia (ALI) is proposed for global feature extraction. An Eigen distance based method using the seven 3D key points- (five corresponding to each finger tips, one corresponding to centre of the palm and another corresponding to lower part of palm), extracted using Kinect is proposed for local feature extraction. Integrating 3D local feature has improved the performance of the system as shown in the result. Apart from serving as an aid to the disabled people, other applications of the system also include serving as a sign language tutor, interpreter and also be of

use in electronic systems that take gesture input from the users.

Advantage:

- Improve the accuracy of recognition.
- The proposed method integrates both local as well as global information of the dynamic sign.
- Can handle different types of words in a common vision based platform.

Disadvantage:

- These methods are not user friendly and are more expensive.

[3] Title: A Colour Hand Gesture Database for Evaluating and Improving Algorithms on Hand Gesture and Posture Recognition

Author: Farhad Dadgostar, Andre L. C. Barczak, Abdolhossein Sarrafzadeh

With the increase of research activities in vision-based hand posture and gesture recognition, new methods and algorithms are being developed. Although less attention is being paid to developing a standard platform for this purpose. Developing a database of hand gesture images is a necessary first step for standardizing the research on hand gesture

recognition. For this purpose, we have developed an image database of hand posture and gesture images. The database contains hand images in different lighting conditions and collected using a digital camera. Details of the automatic segmentation and clipping of the hands are also discussed in this paper.

Advantage:

- Automatically vary the lighting fairly in all directions and even produce very complex patterns of lighting by introducing more than one source of light.
- Enable researchers to add their own backgrounds to the image or to use it as an object with known boundaries.

Disadvantage:

- Unless some special gadgets are used to control the lighting, it is very difficult to vary the positions of the light fairly along the three axis.

[4] Title: Low cost approach for Real Time Sign Language Recognition

Author: Matheesha Fernando, Janaka Wijayanayaka

Sign Language is the language of people who suffer from speech and hearing defects. Still the rest of the world doesn't have a clear idea of sign language. The communication between speech impaired people and other people is very inefficient. To overcome this problem technology can act as an intermediate flexible medium for speech impaired people to communicate amongst themselves and with other individuals as well as to enhance their level of learning / education. The suggested solutions in the literature for sign language recognition are very expensive for day to day use. Therefore, the main objective of this research is to find out a low cost affordable method of sign language interpretation. This paper discusses the possible ways to deal with the sign language postures to identify the signs and convert them into text and speech using appearance based approach with a low cost web camera. Further this approach will be very useful to the sign language learners to practice sign language. During the research available human computer interaction approaches in posture recognition were tested and evaluated. A series of image processing techniques with Hub-moment classification was identified as the best approach. The system is able to recognize selected Sign Language signs with the

accuracy of 76% without a controlled background with small light adjustments.

Advantage:

- Helps in identifying a low cost, affordable method that can facilitate hearing and speech impaired people to communicate with the world in more comfortable way where they can easily get what they need from the society and also can contribute to the well-being of the society.
- Can be used as a learning tool for sign language where hearing and speech impaired people can practice sign language using the application.

Disadvantage:

- This project only looks at the hand postures not on hand gestures.

[5] Title: MILES: Multiple-Instance Learning via Embedded Instance Selection

Author: Yixin Chen, Jinbo Bi and James Z. Wang

Multiple-instance problems arise from the situations where training class

labels are attached to sets of samples (named bags), instead of individual samples within each bag (called instances). Most previous multiple-instance learning (MIL) algorithms are developed based on the assumption that a bag is positive if and only if at least one of its instances is positive. Although the assumption works well in a drug activity prediction problem, it is rather restrictive for other applications, especially those in the computer vision area. The authors proposed a learning method, MILES (Multiple-Instance Learning via Embedded instance Selection), which converts the multiple-instance learning problem to a standard supervised learning problem that does not impose the assumption relating instance labels to bag labels. MILES maps each bag into a feature space defined by the instances in the training bags via an instance similarity measure. This feature mapping often provides a large number of redundant or irrelevant features. Hence 1-norm SVM is applied to select important features as well as construct classifiers simultaneously.

Advantage:

- **Broad adaptability:** It provides a learning framework that converts a multiple-instance problem to a supervised learning problem.

- **Low complexity:** It is efficient in computational complexity, therefore, can potentially be tailored to tasks that have stringent time or resource limits.
- **Prediction capability:** In some multiple-instance problems, classification of instances is at least as important as the classification of bags.
- In some applications, for example 3D object recognition, geometric constraints on the image patches are extremely useful in reducing the search space and improving the recognition accuracy. However, MILES is not designed to take advantage of this type of prior knowledge.
- The feature vectors generated by the mapping are not sparse.

Disadvantage:

- The performance of MILES depends on whether there are “useful” features among those defined by the instances in the training bags.

III.PROBLEM DEFINITION

It is well known fact that communication is very essential in day to day life. Humans with disabilities often experience issues in this area. [Deaf and Dumb].In the world of sign language, and gestures, a lot of research work has been done over past few years. Sign Language Recognition is one of the most growing fields of research area. Language is mainly used for communication of deaf-dumb people. In present scenario, it is impossible for humans to understand the sign language without any practice. We hereby

facilitate a human machine interactive system that would be very helpful for communication between deaf and dumb people and humans in real world situation.

IV.OBJECTIVE OF THE PROJECT

Proposed System:

The first step for our proposed system is the capturing of the video using webcam where different alphabets were taken into consideration. Skin Filtering was performed to the input video frames for detection of hand gestures. It was done so that the required hand could be

extracted from the background. Skin Filtering is a technique used for separating the skin coloured regions from the non-skin coloured regions. In our proposed system there are 5 modules: real time Input image from webcam, pre-processing and segmentation, feature extraction, classification and Results analysis (gesture recognition). For gesture recognition is real time recognized in live camera .The proposed system are used in SVM (Support Vector Machine), K Neighbours-Classifer, Logistic Regression, MLP Classifier, Naive Bayes, Random Forest Classifier algorithms. We propose an easy-to-use and inexpensive approach to recognize single handed as well as double handed gestures accurately. This system can definitely help millions of deaf people to communicate with other normal people. A fast, novel and robust system was proposed for recognition of different alphabets of Indian Sign Language for video sequences. The proposed system is a real time video processing that is based on a real time application system.

Advantages

- There are no moving parts, so device wear is not an issue.
- We have proposed a system which is able to recognize the various alphabets of Indian Sign Language for Human-Computer interaction

giving more accurate results at least possible time.

- Accuracy rate obtained was 98% but it lacks proper Skin filtering with changes in illumination.
- Proper classifier were used to recognize the gestures.
- SVM (Support Vector Machine), K Neighbours-Classifer, Logistic Regression, MLP Classifier, Naive Bayes, and Random Forest Classifier Algorithms is used and after the training then output is achieved, thus giving the proper recognized gesture.

Modules:

The proposed system consists are five modules of following steps to interpret the gesture from the input image such as:

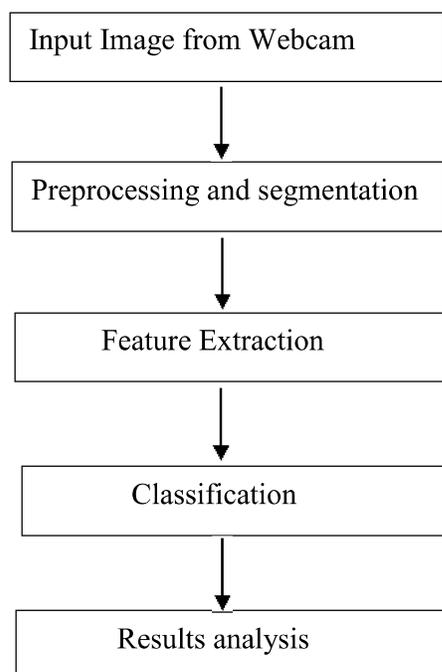


Fig : Overview of the proposed system in five modules

- **Input Image from Webcam:**

The image (gesture or sign) is captured using the laptop camera or the external device webcam to get better image clarity.

- **Pre-processing and segmentation:**

Image processing is necessary for image enhancement. During Pre-processing RGB image to convert into HSV colour space. This step was taken because HSV colour space was less sensitive to illumination changes compared to RGB. Then it was filtered, smoothened and finally the biggest binary linked object was being considered so as to avoid consideration of skin coloured objects other than hand. To obtain the good result smoothing and filtering is done. Image segmentation is basically performed to locate the hand object in image.

- **Feature Extraction:**

Feature Extraction stage is necessary because certain features has to be extracted so that they are unique for each gesture or sign. After the decision is made that a sign is present, then the last frame is taken into consideration and features. The Feature Extraction is extract the features in all

Images (gesture or sign) dataset are store in 'svm.pkl' and finally extract the labels store in 'labels.pkl' best on train data and test data.

- **Classification:**

Classification of hand is done with the help of various features calculated previously. The five bit binary sequence is thus generated to uniquely recognize and utilize these recognized the recognized hand gesture for supporting human computer interaction. By the feature extraction significant peak is encoded as 1 while insignificant peak is encoded as 0 based on intersection to the threshold line.

- **Results analysis:**

Different images were tested and found that the new technique of classification was found to show 97% accuracy. Some images tested with other database images are given in the results analysis. In **Results analysis** are real time detect the sign language and sign recognize when live camera is start then capture the test images (gesture or sign)that time compare the features 'svm.pkl' and 'labels.pkl' if it is match the dataset after the process in display the result.

V. System requirements

□ Hardware specification:

Processor : Intel i7 3.0 GHz
RAM : 16 GB and above
System type : 64-bit Operating system
Hard disk : 500 GB

□ Software specification:

Coding Language : Python
Operating system : Windows 10
Library : OpenCV,
Matplotlib, Numpy, Scikit-learn, Scikit-
Image, Joblib.
Simulation tool : Anaconda
Navigator IDE 3.7.4 , (jupyter Notebook).

VI. CONCLUSION

Image processing is the process of extracting pictorial data after processing an image. This technology can be used for the deaf and dumb for sign conversion by processing hand signs and interpreting message. In the recent years many techniques have been developed for sign conversion, due to some of the disadvantages of these techniques and with the development of image processing,

many new techniques have been developed. Many hearing people don't have the knowledge of sign language, with this method communication becomes easy.

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Department of Electronics and Communication Engineering Certificate

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.....*AMC Engineering College Bangalore*.....

has presented a paper in the 6th National Conference On "VLSI, Communication & Computer Networks VCCN6"
on 17th & 18th Oct, 2019 at AMC Campus organized by the Department of Electronics and Communication
Engineering, AMC Engineering College, Bengaluru, Karnataka in Collaboration with The Institution of
Engineers (India).

Paper Title: *Sign language - speech conversion using video processing for special words
and numbers.*

Dr T. Kavitha
Co-ordinator

Dr N. V. Uma Reddy
Convener, HOD - ECE

Dr. A. G. Nataraj
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APPENDIX D: PROJECT SELF EVALUATION FORM

	AMC ENGINEERING COLLEGE DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING					
PROJECT WORK SELF EVALUATION FORM						
Name of the Student	Hariharan. A	USN	1AM16EC033			
Academic year	2019-2020	Project Batch	10			
Project Title	Sign language-speech conversion using video processing For special words and numbers					
S.No	To what extent did each of the following you contribute to your project	To a very great extent	To a great extent	To a moderate extent	To some extent	Not at all
1.	Have you applied the knowledge of mathematics, science and engineering concepts(PO1,PSO1)	<input checked="" type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
2.	Have you analyzed the system of hardware, software and its interaction (PO2,PSO1)	<input type="checkbox"/> 5	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
3.	Design the systems, components or processes to meet needs(PO3,PSO1)	<input checked="" type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
4.	Have you used the modern tools of engineering to design the system or components of your project (PO5,PSO1)	<input type="checkbox"/> 5	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
5.	Identification of impact in societal and environmental contexts of your project developed in interdisciplinary domain (PO7,PSO2)	<input type="checkbox"/> 5	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1

6.	Are you responsible, diligent, and ethical on your project (core and interdisciplinary) development period with your team members? (PO8)	<input type="checkbox"/> 5	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
7.	Have you functioned effectively as a member in a team with your project members? (PO9):	<input type="checkbox"/> 5	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
8.	Have you assessed any societal, health, safety, legal and cultural issues in your project? (PO6)	<input type="checkbox"/> 5	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
9.	Have you presented your project confidently and prepared effective reports? (PO10)	<input checked="" type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
10.	Have you completed the project within a time frame and estimated budget? (PO11)	<input checked="" type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
11.	Is your project leads you to recognize the need for lifelong learning in the context of technological change? (PO12)	<input checked="" type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
12.	Have you conducted the experiments/ analysis to provide valid conclusion? (PO4,PSO1)	<input type="checkbox"/> 5	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
13.	Is your project leads to learn any programming languages? (PO5, PSO2)	<input type="checkbox"/> 5	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
14.	Identify the domain of your project (Embedded / Communication/ Network/ Signal Processing/ VLSI and etc)	Embedded and image processing				

Classify the relevance of your project (Research oriented/application) with proper justification:

15.

This project is for social purpose, for the help of deaf and dumb people for better and easy communication between them and the society, where the people can communicate in an easy and effective way and it is a step towards future where the technology is improving, this aspect also needs to be evolved from the early discoveries.

Signature of the Student:

Harishan

Date: 5-08-2020



AMC ENGINEERING COLLEGE

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROJECT WORK SELF EVALUATION FORM

Name of the Student	Beshanth.M	USN	1AM16EC017
Academic year	2019-2020	Project Batch	10
Project Title	Sign language-speech conversion using video processing For special words and numbers		

S.No	To what extent did each of the following you contribute to your project	To a very great extent	To a great extent	To a moderate extent	To some extent	Not at all
1.	Have you applied the knowledge of mathematics, science and engineering concepts(PO1,PSO1)	<input type="checkbox"/> 5	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
2.	Have you analyzed the system of hardware, software and its interaction (PO2,PSO1)	<input checked="" type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
3.	Design the systems, components or processes to meet needs(PO3,PSO1)	<input checked="" type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
4.	Have you used the modern tools of engineering to design the system or components of your project (PO5,PSO1)	<input type="checkbox"/> 5	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
5.	Identification of impact in societal and environmental contexts of your project developed in interdisciplinary domain (PO7,PSO2)	<input checked="" type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1

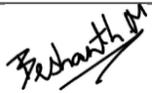
.	Are you responsible, diligent, and ethical on your project (core and interdisciplinary) development period with your team members? (PO)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5		4	3	2	1	
7.	Have you functioned effectively as a member in a team with your project members? (PO9) :	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5		4	3	2	1	
.	Have you assessed any societal, health, safety, legal and cultural issues in your project? (PO)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5		4	3	2	1	
9.	Have you presented your project confidently and prepared effective reports? (PO10)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5		4	3	2	1	
10.	Have you completed the project within a time frame and estimated budget? (PO11)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5		4	3	2	1	
11.	Is your project leads you to recognize the need for lifelong learning in the context of technological change? (PO12)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5		4	3	2	1	
12.	Have you conducted the experiments/ analysis to provide valid conclusion? (PO4,PSO1)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5		4	3	2	1	
13.	Is your project leads to learn any programming languages? (PO5, PSO2)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5		4	3	2	1	
14.	Identify the domain of your project (Embedded / Communication/ Network/ Signal Processing/ VLSI and etc)	Embedded and image processing				

Classify the relevance of your project (Research oriented/application) with proper justification:

15.

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Signature of the Student:



Date: 5-08-2020



AMC ENGINEERING COLLEGE
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PROJECT WORK SELF EVALUATION FORM

Name of the Student	Karthik. S	USN	1AM16EC051
Academic year	2019-2020	Project Batch	10
Project Title	Sign language-speech conversion using video processing For special words and numbers		

S.No	To what extent did each of the following you contribute to your project	To a very great extent	To a great extent	To a moderate extent	To some extent	Not at all
1.	Have you applied the knowledge of mathematics, science and engineering concepts(PO1,PSO1)	<input checked="" type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
2.	Have you analyzed the system of hardware, software and its interaction (PO2,PSO1)	<input type="checkbox"/> 5	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
3.	Design the systems, components or processes to meet needs(PO3,PSO1)	<input checked="" type="checkbox"/> 5	<input type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1
4.	Have you used the modern tools of engineering to design the system or components of your project (PO5,PSO1)	<input type="checkbox"/> 5	<input checked="" type="checkbox"/> 4	<input type="checkbox"/> 3	<input type="checkbox"/> 2	<input type="checkbox"/> 1

5.	Identification of impact in societal and environmental contexts of your project developed in interdisciplinary domain (PO7,PSO2)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		5	4	3	2	1
.	Are you responsible, diligent, and ethical on your project (core and interdisciplinary) development period with your team members? (PO)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		5	4	3	2	1
7.	Have you functioned effectively as a member in a team with your project members? (PO9) :	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		5	4	3	2	1
.	Have you assessed any societal, health, safety, legal and cultural issues in your project? (PO)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		5	4	3	2	1
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		5	4	3	2	1
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		5	4	3	2	1
13.	Is your project leads to learn any programming languages? (PO5, PSO2)	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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15.

Signature of the Student:

A handwritten signature in black ink that reads "Karthik". The signature is written in a cursive style with a horizontal line underneath the name.

Date: 5-08-2020

VISVESVARAYA TECHNOLOGICAL UNIVERSITY

“Jnana Sangama”, Belagavi – 590 018, Karnataka.



PROJECT PHASE II

ON

**“NUMERICAL AND EXPERIMENTAL RESONANT MODAL
ANALYSIS OF CANTILEVER BEAM VIA ELECTROMAGNETIC
VIBRATION EXCITER”**

Submitted in partial fulfilment of the requirement for the award of

BACHELOR OF ENGINEERING

in

MECHANICAL ENGINEERING

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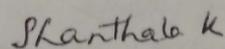
2019 - 2020

AMC ENGINEERING COLLEGE
DEPARTMENT OF MECHANICAL ENGINEERING



CERTIFICATE

This is to certify that the project work (Phase - II) entitled “**NUMERICAL AND EXPERIMENTAL RESONANT MODAL ANALYSIS OF CANTILEVER BEAM VIA ELECTROMAGNETIC VIBRATION EXCITER**” carried by **Mr. JEEVAN KUMAR C K (1AM16ME058), Mr. AKSHAY P (1AM16ME017), Mr. V AKHIL (1AM15ME199) and Mr. JNANESHWAR M P (1AM16ME059)**, bonafide student of **AMC ENGINEERING COLLEGE**, in partial fulfilment for the award of **Bachelor of Engineering in Mechanical Engineering** of the **Visvesvaraya Technology University, Belagavi** during the year 2019-2020. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the department library. This Project Phase II report has been approved as it satisfies the academic requirement in respect of project work prescribed for the said degree.



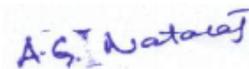
Signature of the Guide

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Dr. A. G. Nataraj

ACKNOWLEDGEMENT

We are profoundly honoured to acknowledge the *Management of AMC Engineering College*, Bangalore for providing us an opportunity to study and support towards the completion of our project work.

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Thanks also to our co- guide *Prof. Shivaprasad D.* for all the help extended to us in completing Project Phase-1.

We would like to thank our *parents* and *friends* for their support, encouragement during the course of our project. Finally, we offer our regards to all the faculty members of ME department and all those who supported us in any respect during the project.

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ABSTRACT

Parts of aerospace, construction, agricultural, automobile, etc. suffer from undesirable vibrations when the system is in its working condition and it is essential to study the effect of vibration. Condition of resonance is always disastrous. To avoid resonant condition vibration analysis is very essential. Mechanical vibration exciter in general are of contact type and have its own limitations like low frequency range.

A vibration exciter is a machine which produces mechanical vibratory motion to provide forced vibration to a specimen on which modal analysis and testing is to be performed. The vibration exciters or shakers can be used in several applications such as determination of the dynamic characteristics of machines and structures and fatigue testing of materials.

Project report presents dynamic modal analysis of cantilever beam both by analytical and finite element method. It is found that both theoretical and finite element frequencies for different mode shapes are almost in agreement with each other. Development of vibration exciter and vibration analysis of cantilever structures /turbine blades is detailed in the project. Vibration signature signals related to speed, load, defective working related to cantilever structure-turbine motor is analyzed in this project.

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CHAPTER 1

INTRODUCTION

Vibration is mechanical phenomenon where oscillations occur at an equilibrium point. Vibration in a mechanical system is most undesirable under resonant condition and it is very essential to study the resonant effect of vibration.

To study the dynamic characteristics, cyclic excitation force produced by the exciter, can be applied to the machine. Vibration exciters are used to produce the required cyclic excitation at a required frequency. The exciters are designed to produce a given range of harmonic or time dependent excitation force and displacement through a given range of frequencies. Vibration exciters are used for development, simulation, production, studying the effects of vibration, and simulate the shock or vibration conditions found in components of aerospace, construction, agricultural, automobile.

During the past decade a wide variety of vibration exciters have been developed, their fields of application ranging from fatigue testing of automobile, missile and aircraft components, to the calibration of vibration pick-ups. The special field of application for which a particular vibration exciter is suitable, is normally determined by its frequency range, maximum stroke and force ratings. Vibration exciters are commonly used are a) Mechanical Exciters b) Electromagnetic Exciters.

Although different transducing principles can be employed in the design of vibrators, most modern vibration exciters are based on the electro-dynamic principle, where an a. c. signal is applied to a coil placed within a strong magnetic field.

With dynamic factors such as displacement, velocity, acceleration, and force, electrodynamic vibration accurately simulates a wide range of conditions that can help improve the quality and reliability of many products. As a closed loop vibration control system, electrodynamic shakers can accurately reproduce real world vibrations on electronic, automotive, aerospace, and military products like automotive parts and systems qualification testing Electronic assembly, Computer equipment testing, Avionics and Military hardware testing, Satellite component testing, Product and package testing. In our present project electromagnetic vibration exciter is developed for the dynamic modal analysis of the cantilever structure.

1.1 ELECTROMAGNETIC EXCITER

An electromagnetic vibration exciter (shaker) is an electro-mechanical device which transforms electrical a. c. signals into mechanical vibrations and works on the principles of electromagnetism.

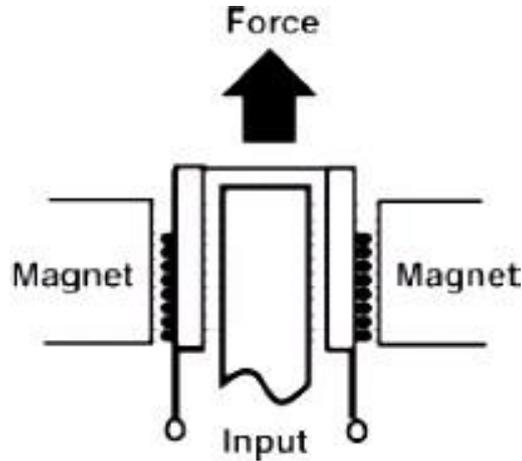


Figure 1.1 Working principle of electromagnetic exciter

Electric current in a wire will establish a magnetic field. When the wire is wound in a coil the effect of the magnetic field is multiplied because of the multiple windings of the coil. The change of current flow in the coil will produce a varying magnetic field. Figure 1.1 illustrates a suspended coil with a permanent magnet surrounding the windings. This results in a system that can generate electric currents when the coil is moved within the magnetic field of the permanent magnet. Conversely, if the permanent magnet is held still and alternating electric currents are allowed to flow in the coil, then the suspended coil will develop vibratory motion. This is the principle of the electromagnetic shaker.

1.2 VIBRATION ANALYSIS OF THE STRUCTURAL BEAM

Structure used in the analysis is a beam. Beam is an inclined or horizontal structural member casing a distance among one or additional supports, and carrying vertical loads across (transverse to) its longitudinal axis, as a purlin, girder or rafter. Three basic types of beams are:

- (1) Simple span, supported at both ends.
- (2) Continuous, supported at more than two points.
- (3) Cantilever, supported at one end with the other end overhanging and free.

There exist two kinds of beams namely Euler-Bernoulli's beam and Timoshenko beam. By the theory of Euler-Bernoulli's beam it is assumed that

- Cross-sectional plane perpendicular to the axis of the beam remain plane after deformation.
- The deformed cross-sectional plane is still perpendicular to the axis after deformation.
- The theory of beam neglects the transverse shearing deformation and the transverse shear is determined by the equation of equilibrium.

In Euler – Bernoulli beam theory, shear deformations and rotation effects are neglected, and plane sections remain plane and normal to the longitudinal axis. In the Timoshenko beam theory, plane sections still remain plane but are no longer normal to the longitudinal axis.

Free vibration takes place when a system oscillates under the action of forces integral in the system itself due to initial deflection, and under the absence of externally applied forces. The system will vibrate at one or more of its natural frequencies, which are properties of the system dynamics, established by its stiffness and mass distribution. In case of continuous system, the system properties are functions of spatial coordinates. The system possesses infinite number of degrees of freedom and infinite number of natural frequencies.

In actual practice there exists some damping (e.g., the internal molecular friction, viscous damping, aero dynamical damping, etc.) inherent in the system which causes the gradual dissipation of vibration energy, and it results in decay of amplitude of the free vibration. Damping has very little influence on natural frequency of the system, and hence, the observations for natural frequencies are generally made on the basis of no damping. Damping is of great significance in restraining the amplitude of oscillation at resonance.

The comparative displacement alignment of the vibrating system for a particular natural frequency is known as the Eigen function in continuous system. The mode shape of the lowest natural frequency (i.e. the fundamental natural frequency) is termed as the fundamental (or the first) mode frequency. The displacements at some points may be zero which are called the nodal points. Generally n th mode has $(n-1)$ nodes excluding the end points. The mode shape varies for different boundary conditions of a beam.

1.3 ELECTROMAGNET

Electromagnets are made out of a coil of wire (wire curled in series). This is more effective in producing a magnetic field than just a wire running straight. This effect can be strengthened by winding a wire tightly around a powerful core, made of magnetic material, such as iron. The picture above shows a coil wound around an iron nail. On its own, the iron nail is not magnetic.

Properties of Magnet

A few properties of the magnet are as follows:

- **Attractive Property** – Ferromagnetic materials like iron, nickel and cobalt are attracted by magnets
- **Repulsive Property** – Like poles repel each other while unlike poles attract each other
- **Directive Property** – A freely suspended magnet always points in the north-south direction

Electromagnets are distinguished from permanent magnets because they only show a magnetic attraction to other metallic objects when a current pass through them. This has numerous advantages, as the power of their magnetic attraction can be controlled, and turned on and off at will. It is for this reason that they are widely used in research and industry, wherever magnetic interactions are required.

1.4 TYPES OF ELECTROMAGNETS

There are three basic types of electromagnets: the robust ones, the superconductors and finally the hybrids.

- **Resistant:** A resistive magnet produces a magnetic field with copper wires, this executes electricity through the wire and electrons produce a weak magnetic field. In this sense, if a wire is twisted around a piece of metal such as iron, it helps to concentrate that magnetic field around the plate, so the more the wire twists, the stronger the field.
- **Superconductors:** Superconducting electromagnets operate by reducing electrical resistance: when a current pass through a copper plate, atoms in the copper interfere with electrons in the current. Therefore, superconducting magnets use liquid nitrogen or liquid helium to produce very cold temperatures. The cold keeps the copper atoms out of the way, and these electromagnets keep working, even when the power is disconnected.
- **Hybrid:** Hybrid electromagnets combine resistive electromagnets with superconductors. The design of hybrid electromagnets varies, but, for example, at the University of Florida there is one that weighs 35 tons, represents more than 20 feet in height, and contains enough copper wire for an average of 80 homes. Deionized water, or water without an electrical charge, keeps this hybrid magnet running along more than 200 degrees C below freezing point.

CHAPTER 2

LITERATURE SURVEY

[1] Cornel Hațiegan et al., “Vibration study for a subassembly – part of hydraulic turbines”

The paper presents an analysis of vibrations measured on a subassembly found at hydraulic turbines which are subjected to rupture caused by excessive bearing wear, vibration caused by instability of lubricant film from bearings, gripping, decrease of bearing stiffness due to fatigue of supporting structures. For the experimental subassembly was used as straight-lined shaft, having variable cross-section, and a sliding type bearing.

[2] Michael Reiterer et al., “Experimental modal testing of Railway Bridges”

In this paper the potential application of experimental modal testing of railway bridges by application of the forced vibration excitation method is proposed to identify reliable and reproducible values of the natural frequencies and damping coefficients. The measuring results of a framed concrete bridge with 16.1 m span length were presented and the dependence of dynamic parameters to seasonable temperature changes and to the size of bridge vibration amplitude were discussed in detail.

[3] Aditya Pawar et al. “Design and fabrication of mechanical vibration exciter”

The paper discusses Design and Fabrication of Mechanical Vibration Exciter. The exciter indicated rpm value of the motor up to 1000 rpm. Paper discusses variation in the amplitude and the damping effects of external weights.

[4] Nitin Kumar Anekar, et al. “Design and Testing of unbalanced mass mechanical vibration exciter”

This article presents design, construction, performance and testing of mechanical vibrations exciter, which have unbalanced mass to generate uniaxial vibrations. The mechanical vibration exciter produces vibrations due to centrifugal force of rotating eccentric mass. The vibrations

produced lie in the low frequency range. Exciter has unbalanced mass at one end of disc, base frame, top plate as platform, springs and motor.

5] A.P. Parameswaran et al. “Active Vibration Control of a Smart Cantilever Beam on General Purpose Operating System”

In this paper, direct output feedback based active vibration control has been implemented on a cantilever beam using Lead Zirconate-Titanate (PZT) sensors and actuators. Three PZT patches were used, one as the sensor, one as the exciter providing the forced vibrations and the third acting as the actuator that provides an equal but opposite phase vibration/force signal to that of sensed so as to damp out the vibrations. The literature indicated that experimental control of the vibrating smart beam needed to be performed on a real time operating system platform wherein deterministic and reliable control could be achieved.

CHAPTER 3

OBJECTIVES AND METHODOLOGY

Based on the literature survey objectives and methodology are framed for our project.

3.1 OBJECTIVES

- Non-contact type vibration exciter to be built for the dynamic modal analysis for a cantilever beam/turbine blade.
- Natural frequency of cantilever beam system to be found out using FEM-ANSYS 15.0.
- The FEM results are compared using numerical results for free vibration of a cantilever beam.
- Analysis of vibration signature signals in cantilever-based structures (turbine motors).

3.2 METHODOLOGY

Flow chart of the methodology is represented in the figure 3.1

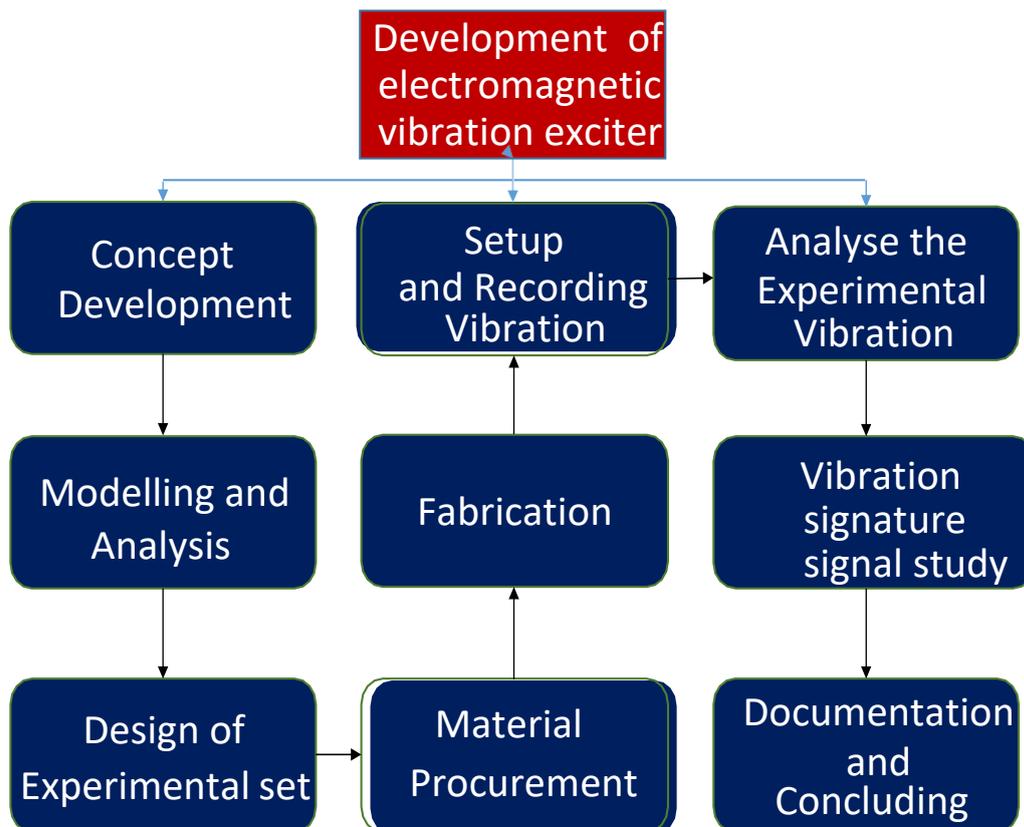


Figure 3.1 Flow chart of the Methodology

- After building the vibration exciter, excitation will be fed to the cantilever beam to study the vibration characteristics of cantilever beam when subjected to dynamic excitation force.
- At certain frequency the mode shapes are obtained, the frequencies are noted for different mode shapes.
- Frequencies are compared with the practical applications where the objects are under the vibration.

CHAPTER 4

ANALYTICAL MODAL ANALYSIS

4.1 MATHEMATICAL EQUATIONS FOR CANTILEVER BEAM UNDER FREE VIBRATION

For a cantilever beam exposed to free vibration, and the system is considered as continuous system considering the beam mass as distributed along with the stiffness of the shaft, the equation of motion can be written as given by the following equations.

$$\frac{d^2}{dx^2} \left\{ EI(x) \frac{d^2 Y(x)}{dx^2} \right\} = \omega^2 m(x) Y(x)$$

Where, E is the modulus of rigidity of beam material, I is the moment of inertia of the cross section of the beam, $Y(x)$ is displacement in y direction at distance x from fixed end, ω is the circular natural frequency, m is the mass per unit length, $m = \rho A(x)$, ρ is the density of the material, x is the distance measured from the fixed end.

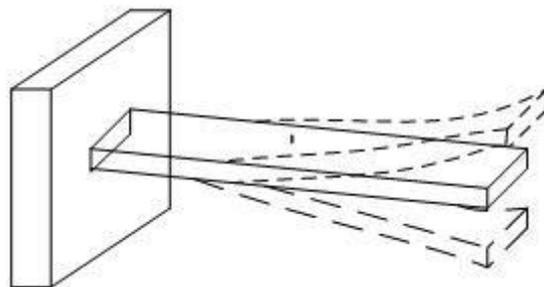


Figure 4.1 The beam under free vibration for cantilever case

Figure 4.1 shows a cantilever beam having rectangular cross section, which is subjected to bending vibration by giving a small initial displacement at the free end and figure 4.2 depicts a cantilever beam under the free vibration under different modal conditions. Modal shapes represented are based on Euler-Bernoulli Beam Theory.

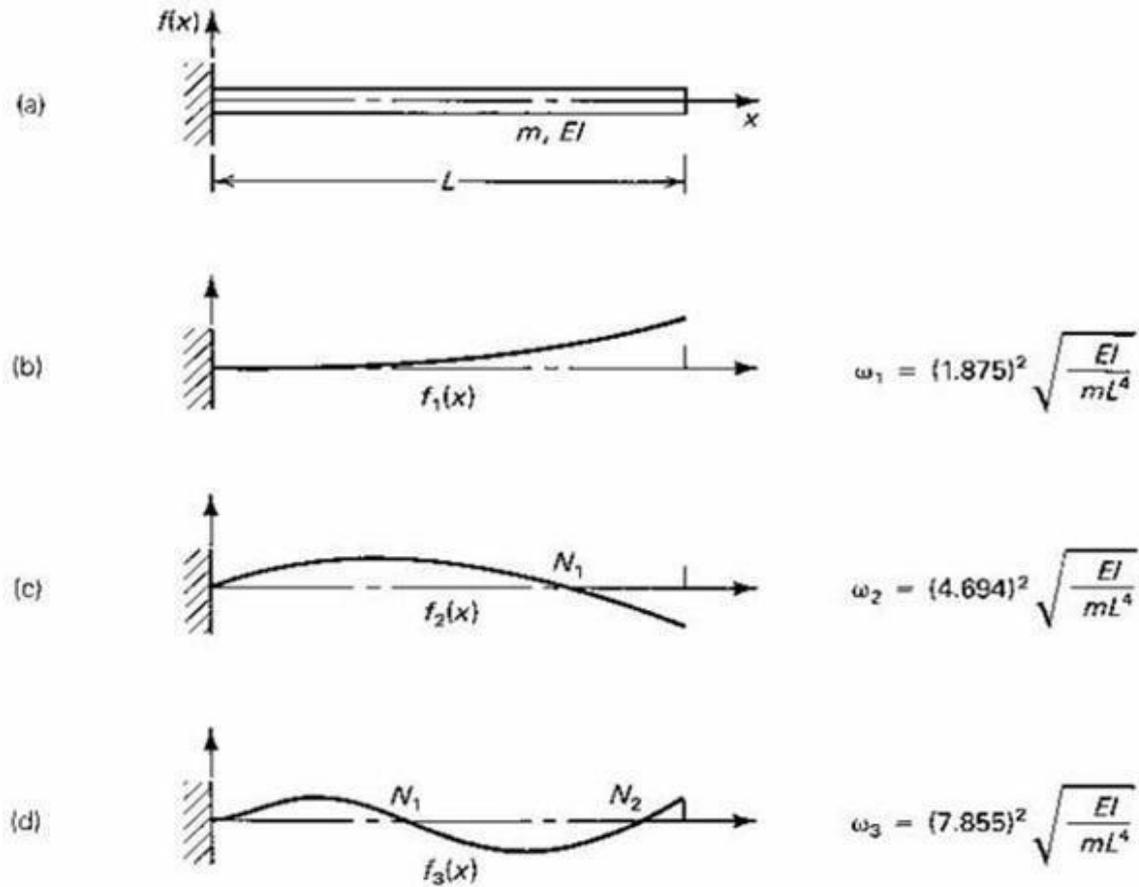


Figure 4.2 Mode shapes of cantilever beam

4.2 ANALYTICAL MODAL ANALYSIS OF CANTILEVER BEAM

Steel cantilever beam with following dimensions are used for analysis

Table 4.1 Beam Dimensions

Length	0.3m
Width	0.03m
Height	0.005m

Table 4.2 Steel Properties

Density	7856 kg/m ³
Young's Modulus	210 x10 ⁹ Pa
Poisson Ratio	0.3

The following given equations have the frequencies of the modes that have been deduced from Euler-Bernoulli Beam Theory.

$$n = 0, 1, 2, 3, \dots$$

$$\alpha_n = 1.875, 4.694, 7.855, 10.947, \dots$$

$$m = \rho V = \rho \cdot l \cdot h \cdot b$$

$$I = \frac{bh^3}{12} = \frac{0.03 \times 0.005^3}{12} = 3.125 \times 10^{-10} \text{ m}^4$$

$$\omega_0 = (1.875)^2 \sqrt{\frac{EI}{\rho AL^4}} = 291.50 \text{ rad/s} = 46.39 \text{ Hz}$$

$$\omega_1 = (4.694)^2 \sqrt{\frac{EI}{\rho AL^4}} = 1826.97 \text{ rad/s} = 290.77 \text{ Hz}$$

$$\omega_2 = (7.858)^2 \sqrt{\frac{EI}{\rho AL^4}} = 5119.99 \text{ rad/s} = 814.87 \text{ Hz}$$

$$\omega_3 = (10.947)^2 \sqrt{\frac{EI}{\rho AL^4}} = 9936.55 \text{ rad/s} = 1581.45 \text{ Hz}$$

Analytical natural frequencies obtained indicated that mode I has natural frequency of 46.39 Hz, mode II has natural frequency of 290.77 Hz, mode III has natural frequency of 814.87 Hz, mode IV has natural frequency of 1581.45 Hz.

CHAPTER 5

FEM DYNAMIC MODAL ANALYSIS

FEM analysis is done by the simulation software ANSYS 15.0. A finite element method is characterized by formulation, discretization strategy, one or more solution algorithms and post-processing procedures. A discretization strategy is understood to mean a clearly defined set of procedures that cover (a) the creation of finite element meshes, (b) the definition of basis function on reference elements (also called shape functions) and (c) the mapping of reference elements onto the elements of the mesh. A mesh is a group of interconnected finite elements joined together at nodes that represents the shape of continuous geometry, including both the external surface and the interior volume. Finite element mesh of quadrilaterals of a curved domain are used in the present analysis.

Finite element modal analysis is obtained for the cantilever beam with the dimensions taken from the analytical analysis. The beam is fixed at one end and another end is left free. 3 mode shapes are been generated and their corresponding frequency are noted down. The FEM analysis is extended for

- (i) Solid cantilever beam
- (ii) Cantilever beam with crack number – 1
- (iii) Cantilever beam with crack number – 2

The mode shape for solid cantilever beam is represented in the table 5.1. Corresponding number of elements are 966 and the number of nodes are 5926, with quadrilateral element shape.

The mode shape for Cantilever beam with crack number – 1 is represented in the table 5.2. Corresponding number of elements are 70 and the number of nodes are 713, with quadrilateral element shape.

The mode shape for Cantilever beam with crack number – 2 is represented in the table 5.3. Corresponding number of elements are 55 and the number of nodes are 553, with quadrilateral element shape.

Table 5.1 Solid Cantilever Beam

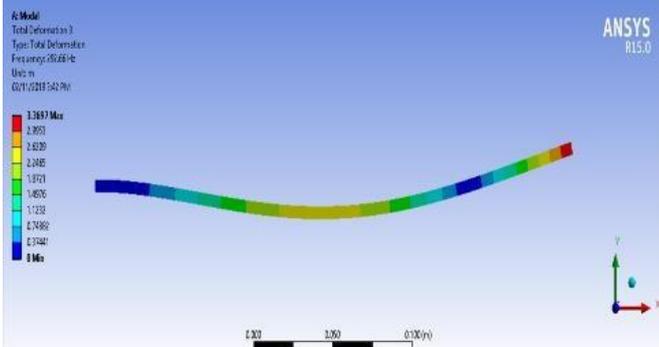
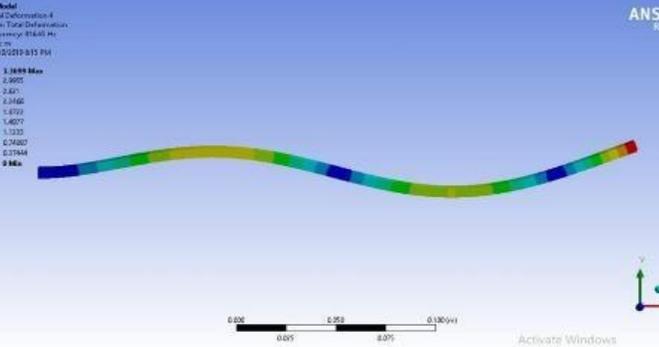
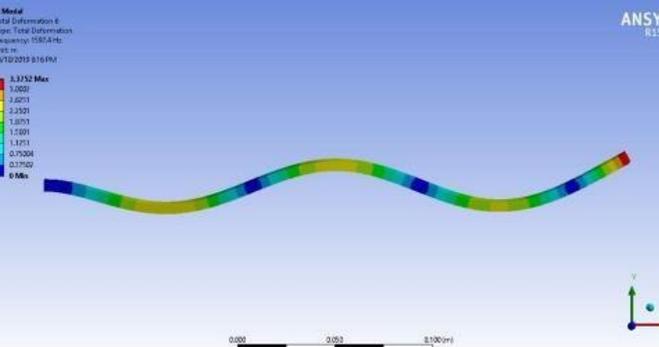
Geometry / Mode	Modal Shape
<p>Geometry</p>	
<p>Mode 1</p>	
<p>Mode 2</p>	
<p>Mode 3</p>	

Table 5.2 Cantilever beam with crack number – 1

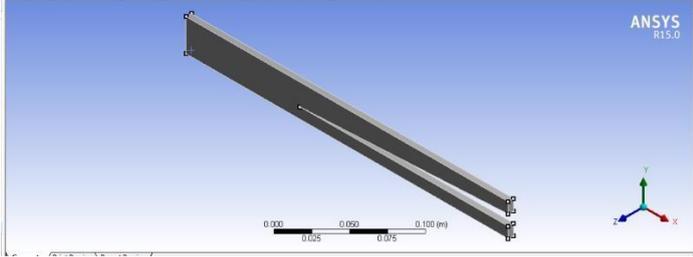
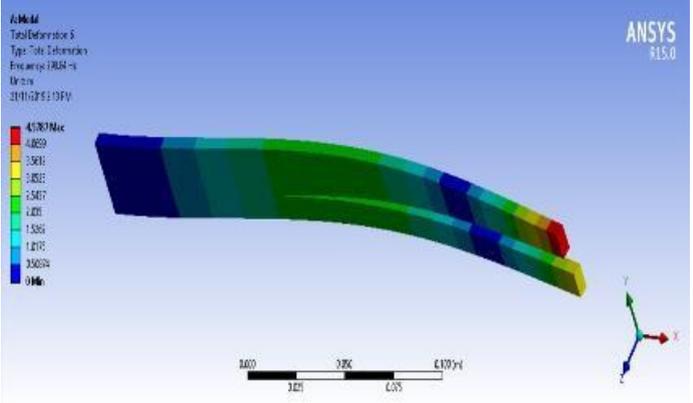
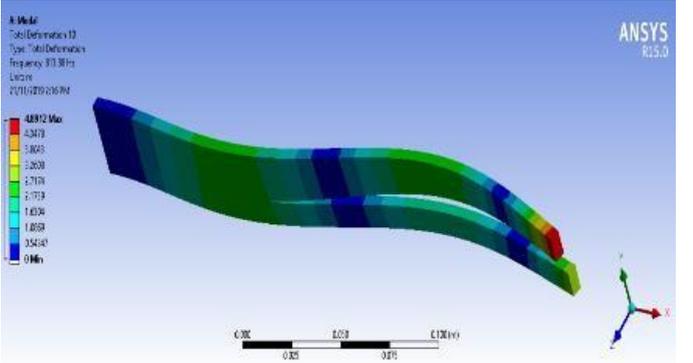
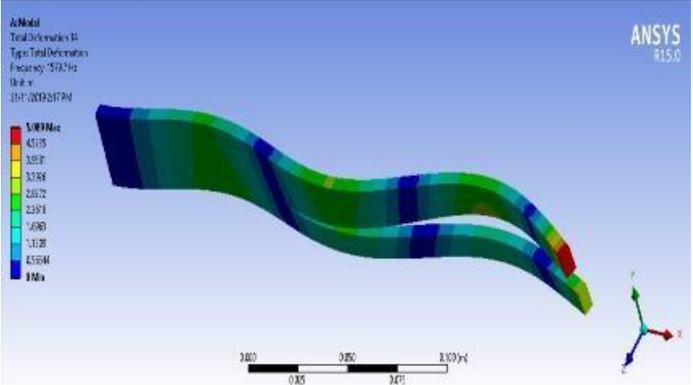
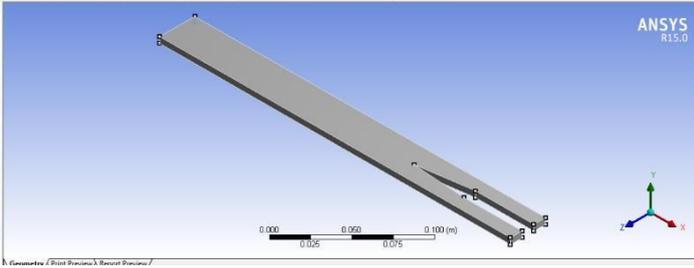
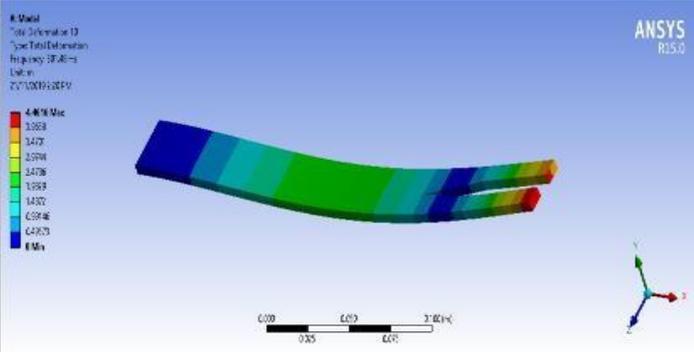
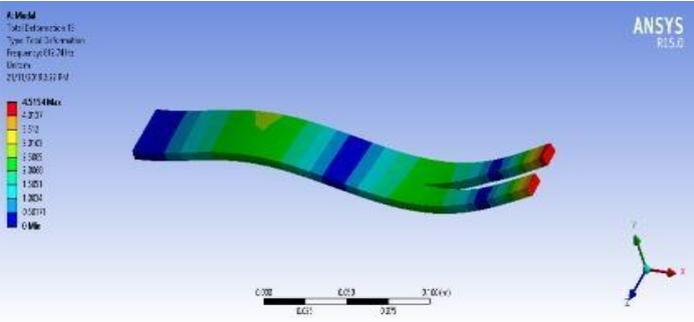
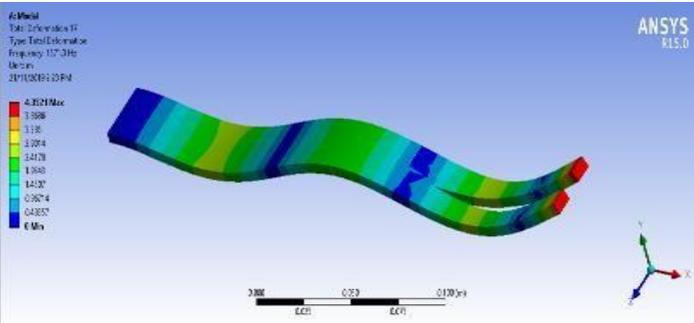
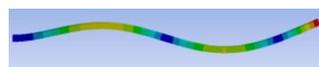
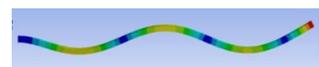
Geometry / Mode	Modal Shape
<p>Geometry</p>	
<p>Mode 1</p>	
<p>Mode 2</p>	
<p>Mode 3</p>	

Table 5.3 Cantilever Beam with crack number – 2

Geometry / Mode	Modal Shape
<p>Geometry</p>	
<p>Mode 1</p>	
<p>Mode 2</p>	
<p>Mode 3</p>	

The analytical and the FEM results are tabulated in the table 5.4. Correspond mode shapes are also represented for all the three cantilever beams which are analyzed.

Table 5.4 Comparison of Analytical and FEM results

Mode no	Frequency (Hz)				MODE SHAPES
	SOLID CANTILEVER BEAM		CRACKED CANTILEVER BEAM - 1	CRACKED CANTILEVER BEAM - 2	
	Theoretical	Ansys			
Mode 1	290.77	292.09	298.8	301.48	
Mode 2	814.87	816.65	813.88	812.74	
Mode 3	1581.45	1597.40	1579.7	1571.3	

The table indicates that theoretical modal frequencies are almost in agreement with FEM analysis.

CHAPTER 6

EXPERIMENTAL VIBRATION SETUP

Free vibration takes place when a system oscillates under the action of forces integral in the system itself due to initial deflection, and under the absence of externally applied forces. The system will vibrate at one or more of its natural frequencies, which are properties of the system dynamics, established by its stiffness and mass distribution.

In case of continuous system the system properties are functions of spatial coordinates. The system possesses infinite number of degrees of freedom and infinite number of natural frequencies. In actual practice there exists some damping (e.g., the internal molecular friction, viscous damping, aero dynamical damping, etc.) inherent in the system which causes the gradual dissipation of vibration energy, and it results in decay of amplitude of the free vibration. Damping has very little influence on natural frequency of the system, and hence, the observations for natural frequencies are generally made on the basis of no damping. Damping is of great significance in restraining the amplitude of oscillation at resonance.

The comparative displacement alignment of the vibrating system for a particular natural frequency is known as the Eigen function in continuous system. The mode shape of the lowest natural frequency (i.e. the fundamental natural frequency) is termed as the fundamental (or the first) mode frequency. The displacements at some points may be zero which are called the nodal points. Generally n th mode has $(n-1)$ nodes excluding the end points. The mode shape varies for different boundary conditions of a beam.

Excitation of the cantilever structure is done by electromagnetic force. Details of building electromagnets are explained in the following sections.

6.1 WORKING PRINCIPLE OF ELECTROMAGNETS



Figure 6.1 Electromagnets

In an electromagnet, an iron nail made into a magnet by passing electric current through a coil surrounding it. Normally, the atoms in the nail are oriented in random directions and individual magnetic fields cancel each other out. Under the influence of electric current, these atoms are reoriented to start pointing in the same direction. All these individual magnetic fields together create a strong magnetic field. As the current flow increases, this degree of reorientation also increases, resulting in a stronger magnetic field. Once all the particles are reoriented perfectly in the same direction, increasing current flow will not affect the magnetic field produced. At this point, the magnet is said to be saturated.

6.2 MAKING OF AN ELECTROMAGNET

Electromagnet is built by wrapping some insulated copper wire around an iron core. Attaching a battery to the wire, an electric current will begin to flow and the iron core will become magnetized. When the battery is disconnected, the iron core will lose its magnetism. Following steps are detailed to build the electromagnet.

Step 1 – Materials needed for electromagnet

One iron core, copper wire, power source.

Step 2 - Removal of Insulation

Some of the copper wire needs to be exposed so that the battery can make a good electrical connection. A pair of wire strippers are used to remove a few centimetres of insulation from each end of the wire.

Step 3 - Wrapping the Wire around the Nail

Wire is wrapped around the nail. The more wire is wrapped around the nail, the stronger the electromagnet will be. Some length of the wire is left unwound so that it can be attached to the battery.



Figure 6.2 Electromagnetic core with wrapped wire

The wire is wrapped around the nail in one direction. This is done to because direction of a magnet field depends on the direction of the electric current creating it. The movement of electric charges creates a magnetic field. Magnetic field around a wire that has electricity flowing through it would look like a series of circles around the wire. If an electric current is flowing directly towards our direction, the magnetic field created by it circles around the wire in a counter-clockwise direction. If the direction of the electric current is reversed, the magnetic field reverses also and circles the wire in a clockwise direction. If some of the wire is wrapped around the nail in one direction and some of the wire in the other direction, the magnetic fields from the different sections fight each other and cancel out, reducing the strength of your magnet.

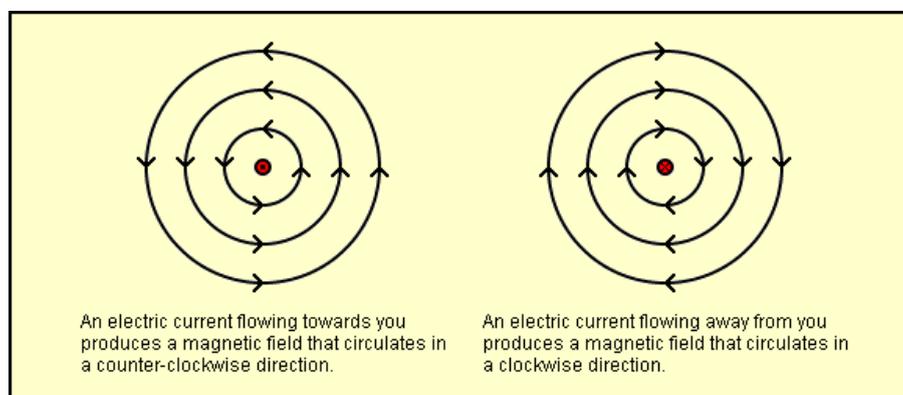


Figure 6.3 Direction of current flow with corresponding magnetic field

Step 4 - Connecting the Battery

One end of the wire is attached to the positive terminal of the battery and the other end of the wire to the negative terminal of the battery. Electromagnet will be working, with any end of the wire attached to the positive terminal of the battery and other end to the negative terminal. Changing the connection of the ends of the wire changes the magnet's polarity. One end of magnet will be its north pole and the other end will be its south pole. Reversing the way, the battery is connected will reverse the poles of the electromagnet.

Number of turns of the wire is very important in design of electromagnet. The more current that passes through the wire, the better, also too much current can be dangerous. Electricity passes through a wire, some of the electrical energy is converted to heat. The more current that flows through a wire, the more heat is generated. If double the current is passing through a wire, the heat generated will increase 4 times. If current passing through a wire increases by triple amount, the heat generated will increase 9 times Things can quickly become too hot to handle.

Electromagnets are designed with different core parameters like core material and thickness to achieve the required force. Electromagnet developed can tested with a permanent magnet. If a permanent magnet is not attracted to the core, it will not make a good electromagnet. An aluminium bar, for example, is not a good core material, whereas iron is regarded as the best core material. Electromagnetic force, flux generated are calculated by using some basic formula based on electromagnetism.

6.3 PROTOTYPE OF THE MODEL

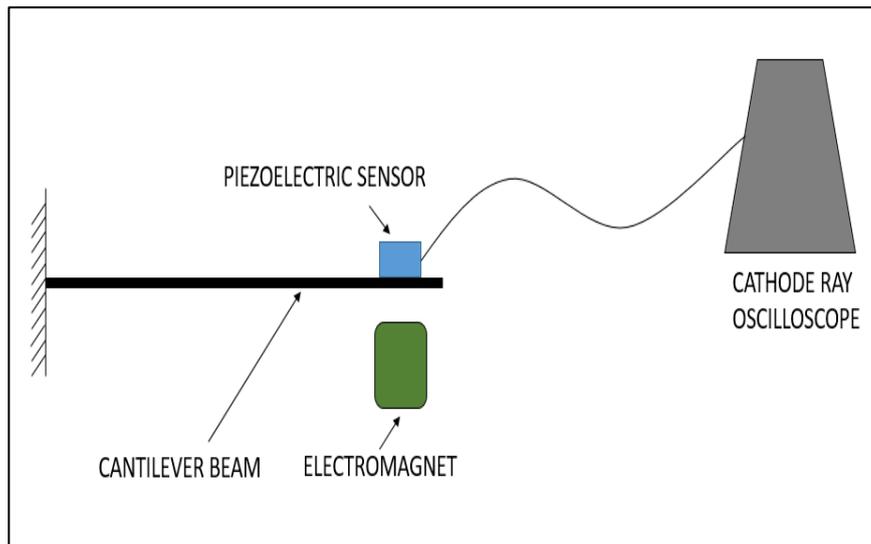


Figure 6.4 Pictorial Representation of the setup

The cantilever beam which will be fixed at one end will be made to vibrate by exciting it with the help of electromagnet, a piezoelectric sensor nothing but a Accelerometer will be placed at free end of the cantilever beam. This sensor will be then connected to oscilloscope where the data will be displayed and stored.

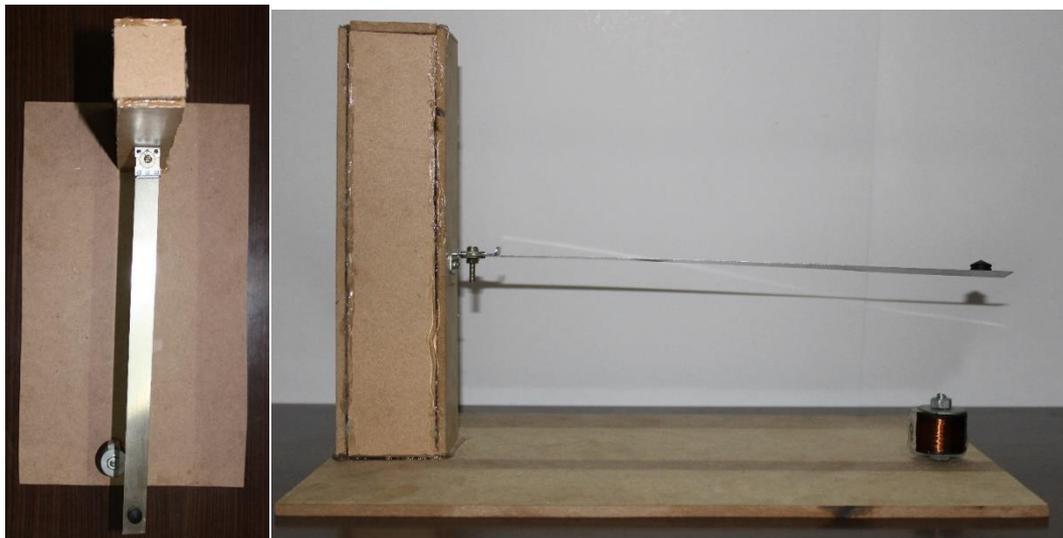


Figure 6.5 Prototype of the model

Table 6.1 Details of the Electromagnets

SL. NO.	STANDARD WIRE GAUGE (SWG)	DIAMETER (mm)	NO. OF TURNS	AREA (mm²)	ELECTOMAGNETS 50 gms
1	26	0.45	425	0.1642	
2	30	0.31	850	0.0779	
3	34	0.23	1625	0.0429	
4	36	0.19	2200	0.0293	
5	40	0.12	5850	0.0117	

The above table shows 5 different types of electromagnets with varying SWG (standard wire gauge) and their corresponding diameter, number of turns and area such that each electromagnet weighs 50grams.

Table 6.2 Details of the Electromagnet strength

SL. NO.	ELECTOMAGNETS	MAGNETIC FLUX (TESLA)	FORCE (NEWTON)
1		1.27	215
2		1.62	270
3		2.04	320
4		2.39	345
5		2.58	360

The above table represents the magnetic flux in tesla and the magnetic force generated by the electromagnet in Newton. This calculation are made with help of following formulae,

- Magnetic field strength, $H = \frac{nl}{l}$ ($\frac{\text{Amp-turns}}{m}$)
- Magnetic flux, $B = \mu H$ (Tesla)
- Force, $F = \frac{B^2 A}{2\mu}$ (N)

Where A = area in m^2

I = current in ampere

l = length in meter

μ = magnetic permeability = 4×10^{-7} henry/m

6.4 EXPERIMENTAL SETUP

In our experiment we will use **oscilloscope** for data acquisition. Accelerometer is a kind of transducer to measure the vibration response (i.e., acceleration, velocity and displacement). Data acquisition system acquires vibration signal from the accelerometer, and encrypts it in digital form. Oscilloscope acts as a data storage device and system analyzer. It takes encrypted data from the data acquisition system and after processing, it displays on the oscilloscope screen by using analysis software.



Figure 6.6 Experimental setup for a cantilever beam

Fig. shows an experimental setup of the cantilever beam. It includes a beam specimen of particular dimensions with a fixed end and at the free end an accelerometer is clamped to measure the free vibration response. The fixed end of the beam is gripped with the help of clamp. For getting defined free vibration cantilever beam data, it is very important to confirm that clamp is tightened properly; otherwise it may not give fixed end conditions in the free vibration data.



Figure 6.7: A Closed View of Accelerometer

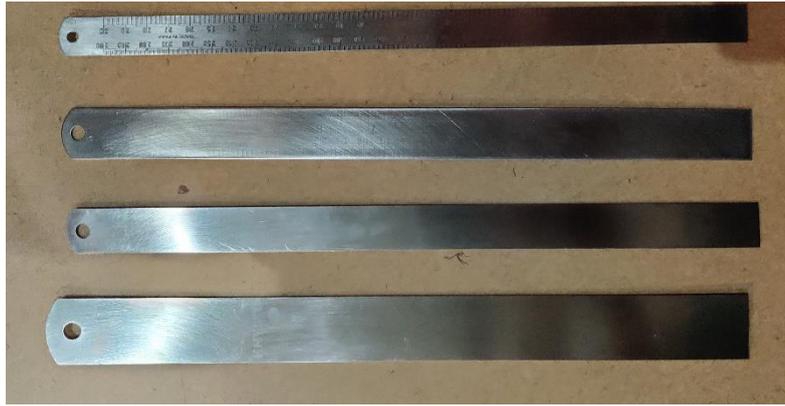


Figure 6.8 Specimen with different dimensions

The figure 6.8 shows the specimen with varying dimensions, so that vibration analysis is done for these specimens. These specimens are considered as cantilever beam.

6.5 EXPERIMENTAL PROCEDURE

1. A beam of a particular material (steel, aluminum or copper), dimensions (L , w , d) and transducer (i.e., measuring device, e.g. strain gauge, accelerometer, laser vibrato meter) was chosen.
2. One end of the beam was clamped as the cantilever beam support.
3. An accelerometer (with magnetic base) was placed at the free end of the cantilever beam , to observe the vibration response (acceleration).
4. Deflection Is given to the cantilever beam with the help of electromagnet and allowed to oscillate on its own.
5. The data obtained from the chosen transducer was recorded in the form of graph (variation of the vibration response with time).
6. The procedure was repeated for 5 to 10 times to check the repeatability of the experimentation.
7. The whole experiment was repeated for different material, dimensions, and measuring devices.
8. The whole set of data was recorded in a data base.

CHAPTER 7

ANALYSIS OF EXPERIMENTAL VIBRATION SIGNALS

Vibration is typically analyzed with measurements of the vibration frequency, displacement, velocity, and acceleration. The latter three — displacement, velocity, and acceleration — are time domain measurements, meaning their amplitudes are plotted versus time. But these vibration signals contain useful information, such as noise and harmonic content, that are difficult or impossible to detect when their amplitudes are plotted in the time domain. It is important to understand these different vibration signatures to extract the behavior of machine parts or turbine blades in our specific project.

There are a variety of different types of signal complexities, corresponding to different vibration phenomena as represented in Figure 7.1 from top to bottom (1-4 in the list below):

1. Some signals have a long-time duration but narrow bandwidth such as rub & buzz noise.
2. Some signals have a short time duration but wide bandwidth such as impacts or transients.
3. Some signals have a short time duration and narrow bandwidth such as decayed resonance.
4. Some signals have a time-varying bandwidth such as an imbalanced shaft generating noise dependent on RPM or machine speed.

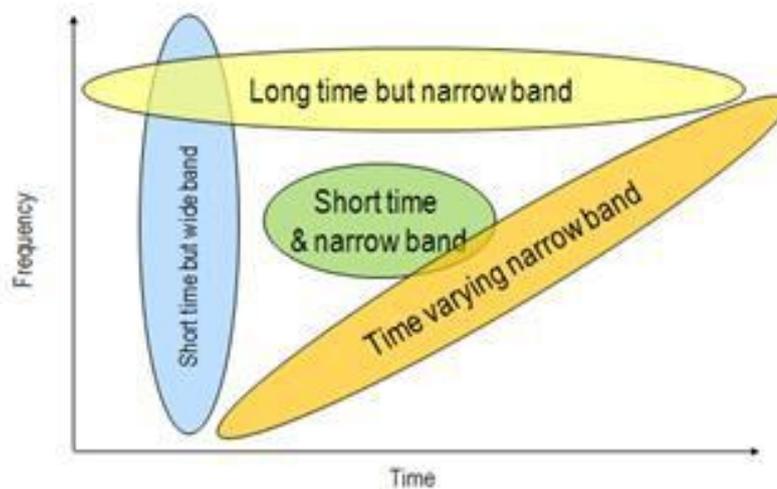


Figure 7.1 Types of vibration signals

A time domain plot is referred to as waveform, and a frequency domain plot is referred to as a spectrum. (Figure 7.2) Every waveform can be expressed as the sum of simple sine waves with varying amplitudes, phases, and frequencies. A Fourier transform is a mathematical process that converts a time domain waveform into these individual sine wave components in the frequency domain — a process often referred to as “spectrum analysis” or “Fourier analysis.”

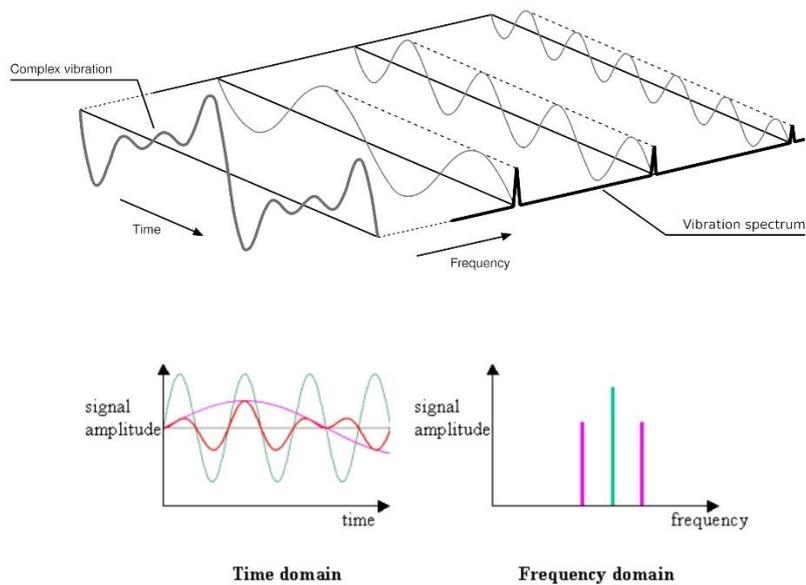


Figure 7.2 Time and Frequency domain signals

The instrument for analyzing signals via fast Fourier transforms is the digital signal analyzer (also referred to as a spectrum analyzer). This device captures the vibration signal, samples it, digitizes it, and performs the FFT analysis. The resulting FFT spectrum helps pinpoint the location, cause, and severity of the vibration, based on the amplitude of the displacement, velocity, and frequency spectra.

Model based analysis compares the vibration signal to a linear model of the signal and returns the error between the two which makes it useful for detecting transients. Autoregressive (AR) modeling analysis is the use of a linear model. Autoregressive Model analysis is useful for detecting transients in a machine vibration signal. Such transients can occur when a machine changes states, experiences variances in load, or begins to develop a fault vibration that is non-periodic. (Figure 7.3)

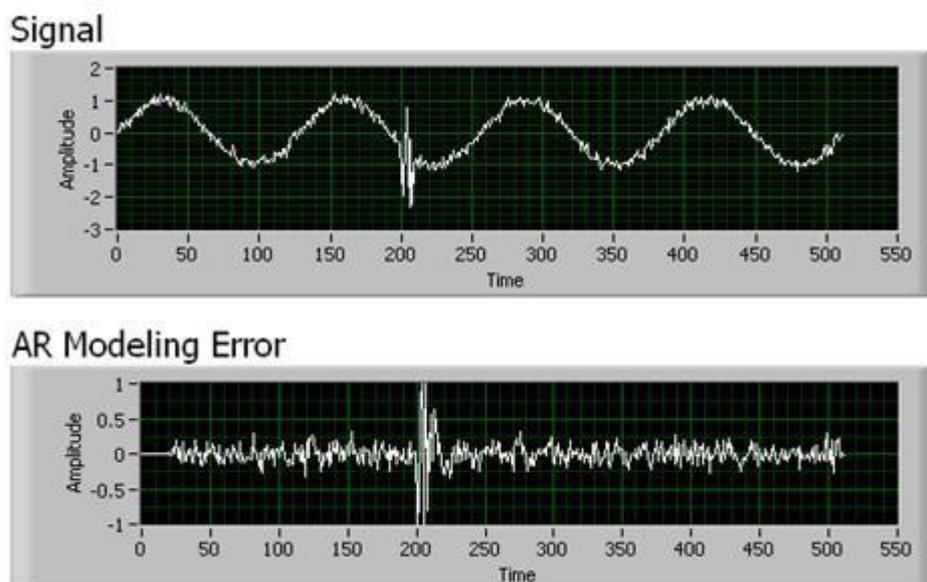


Figure 7.3 Transient vibration in (AR model error) in measured signal

When performing vibration analysis many vibration signal features are directly related to the running speed of a motor or machine such as imbalance, misalignment, gear mesh, and bearing defects. Order analysis is a type of analysis geared specifically towards the analysis of rotating machinery and how frequencies change as the rotational speed of the machine changes. It resamples raw signals from the time domain into the angular domain, aligning the signal with the angular position of the machine. Power spectrum recorded in the oscilloscope to understand the affect of speed is shown in the figure 7.4. There are two large peaks in this power spectrum. The first peak at 60 Hz corresponds to the shaft rotational speed of a machine. The second peak which is the 4th harmonic of the rotational speed, corresponds to the bearings of the machine.

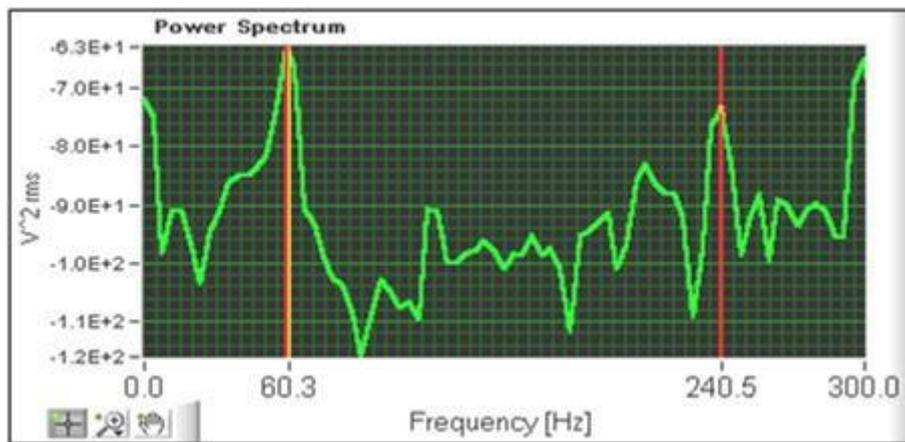


Figure 7.4 Power spectrum of a rotating wind turbine at 60 Hz

However, as the speed changes downward to 50 Hz (Figure 7.5), the 4th harmonic of the power spectrum shifts downward. The peaks in a power spectrum of a rotating device are all related to the fundamental rotational speed of that device.

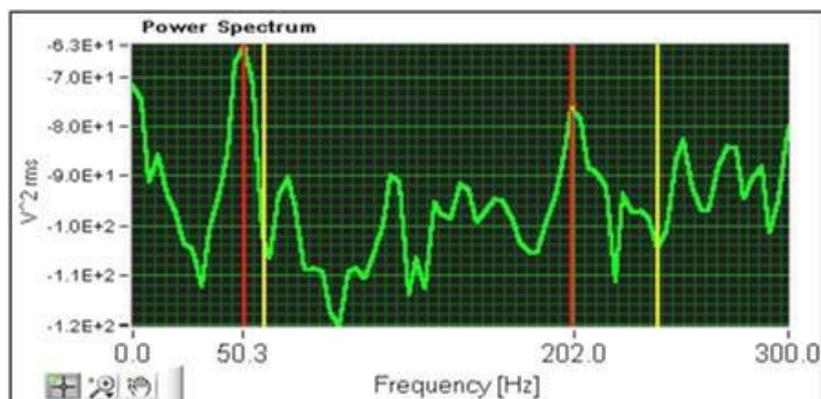


Figure 7.5 Power spectrum a rotating wind turbine at 50 Hz

Wavelets are used in monitoring impact phenomena of cracked, broken, and missing gear teeth. Figure 7.6 represents the wavelets for good and faulty turbine motors. Faultiness related to one the above-mentioned reasons

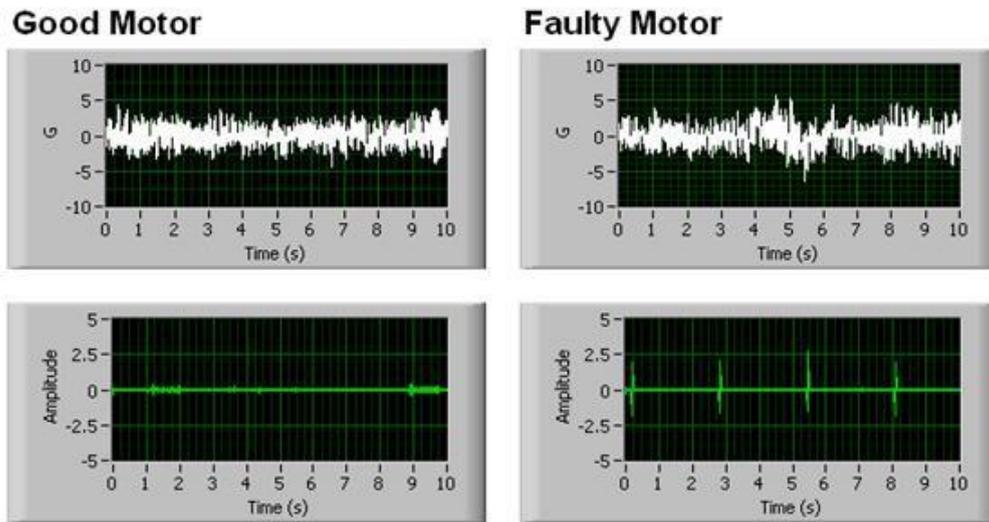


Figure 7.6 Wavelets for good and Faulty motors

CHAPTER 8

CONCLUSION

Dynamic modal analysis is performed for cantilever beam of specific dimension both by analytical method and finite element method and following conclusions are drawn.

- Frequency increases exponentially with increase in the modal.
- Both analytical and finite element method analysis frequencies are almost in agreement.
- Frequency of the cracked cantilever beam has slightly decreased owing to the decrease in the mass of the solid cantilever beam.
- The results obtained for useful in developing the vibration exciter for cantilever beam.
- By capturing dynamic measurements from operating structures, it is possible to extract key component signature features for the smooth working of system. With this signature signal information, it is possible to alter the design of parts or easy maintenance of the system , to avoid breakdown of the system and schedule the operation.

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PROJECT REPORT

ON

**“DESIGN AND SIMULATION OF PV CELL CHARACTERIZATION UNDER
VARYING TEMPERATURE AND IRRADIANCE USING LABVIEW”**

Submitted in partial fulfilment for the award of the degree of

BACHELOR OF ENGINEERING

In

Electrical & Electronics Engineering

Submitted by

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2019-20.



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DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

CERTIFICATE

Certified that the project work entitled **“DESIGN AND SIMULATION OF PV CELL CHARACTERIZATION UNDER VARYING TEMPERATURE AND IRRADIANCE USING LABVIEW”** carried out by MR. **GOPINATH N (1AM16EE0406)** a bonafide student of AMC Engineering College, Bangalore, in partial fulfillment for the award of Bachelor of Engineering in Electrical and Electronics Engineering, of the **Visveswaraiah Technological University, Belagum** during the year **2019-20**. It is certified that all the correction/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the department library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

**Signature of the Guide
Principal**

Prof. Shivalinga swamy G D

Signature of HOD

Dr. K.N Bhanuprakash

Signature of the

Dr. A.G Nataraj

External Viva

Name of the examiners Signature with date

- 1.
- 2.

DECLARATION

I, GOPINATH N, student of Electrical and Electronics Engineering, AMC Engineering college Bengaluru, hereby declare that the project work entitled **“DESIGN AND SIMULATION OF PV CELL CHARACTERIZATION UNDER VARYING TEMPERATURE AND IRRADIANCE USING LABVIEW”** has been carried out at AMC Engineering College, under the guidance of **Prof. SHIVALINGA SWAMY G D**, Assistant Professor, Dept. Of Electrical and Electronics Engineering, AMC Engineering College, Bengaluru and submitted in partial fulfilment of the course requirements for the award of the degree in **Bachelor Engineering in Electrical and Electronics Engineering from the Visvesvaraya Technological University, Belagavi**, during the year **2019-20**.

I also declare that, to the best of my knowledge, work reported here is not a part of any other dissertation on the basis of which a degree or award was conferred on an earlier occasion on this, by any other student.

Date:

Place: Bengaluru

GOPINATH N

(1AM16EE406)

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(1AM16EE406)

ABSTRACT

The development of non-conventional and renewable energy sources is sufficiently appreciated due to the fact that conventional non-renewable energy sources like oil, gas and other fossil fuels are getting increasingly depleted. Thus renewable energy sources are gaining importance and becoming important contributors to total energy consumed in the world. India's incident solar power, only on its land area, is about 5000 Peta-Watt-hours per year (PWh/yr) (i.e. 5000 trillion kWh/yr. or about 600 TW), which is far more than current total energy consumption. In India the grid-interactive solar power generated as of December 2010 was merely 10 MW. By the end of March 2013 the installed grid connected PV systems had increased to 1686.44 MW. Above statistics show the trend in adoption of solar PV technology and its potential in India. A photovoltaic (PV) system converts sunlight directly into electrical power. The basic element of a photovoltaic system is a photovoltaic cell. PV Cells can be grouped to form panels or modules. A single silicon PV cell typically generates 0.5V to 0.8V which is very low for practical use hence they are grouped in series or parallel to form panels or modules. Nevertheless, for all practical purposes the output characteristics of a panel are similar to the PV cell which is its basic element.

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CHAPTER-1

INTRODUCTION

The development of non-conventional and renewable energy sources is sufficiently appreciated due to the fact that conventional non-renewable energy sources like oil, gas and other fossil fuels are getting increasingly depleted. Thus renewable energy sources are gaining importance and becoming important contributors to total energy consumed in the world. India's incident solar power, only on its land area, is about 5000 Peta-Watt- hours per year (PWh/yr) (i.e. 5000 trillion kWh/yr. or about 600 TW), which is far more than current total energy consumption. In India the grid-interactive solar power generated as of December 2010 was merely 10 MW. By the end of March 2013 the installed grid connected PV systems had increased to 1686.44 MW. Above statistics show the trend in adoption of solar PV technology and its potential in India. A photovoltaic (PV) system converts sunlight directly into electrical power. The basic element of a photovoltaic system is a photovoltaic cell. PV Cells can be grouped to form panels or modules. A single silicon PV cell typically generates 0.5V to 0.8V which is very low for practical use hence they are grouped in series or parallel to form panels or modules. Nevertheless, for all practical purposes the output characteristics of a panel are similar to the PV cell which is its basic element. Hence the analysis of the output characteristics of a solar PV cell becomes an essential procedure. The PV cell represents the fundamental power conversion unit of a PV panel. The output characteristics of a PV cell depend largely on the solar insolation or irradiance (G), cell temperature (T_c), series resistance (R_s) and Shunt resistance (R_{sh}). R_s and R_{sh} remain constant after the cell has been manufactured so their effect is not considered in the model and their values are selected so as to have negligible effect on the output characteristics. The maximum power (P_m) derived from the PV cell or its maximum operating power point depends on the load resistance (R). Due to the non-linear output characteristics of the PV cell, a tool for modeling and simulation is proved to be useful for deriving the maximum power from the PV cell by determining the optimal load resistance (R). Several researchers have used different ways to simulate the output characteristics of silicon PV cells, using the MATLAB software. This paper however presents the solar PV cell modeling

and simulation using LabVIEW where the graphical programming has replaced the conventional programming techniques and also it comes with an effective user interface. The developed tool facilitates the prediction of PV cell behavior over a range of temperatures and irradiance levels other than STC which proves resourceful during the design of PV panels and serves as a guide for the selection of PV cells for a panel designer.

The efficiency for mono-crystalline cells is generally between 15% to 20% and between 9% to 12% for polycrystalline. In case of thin film cells, the efficiency is 10% for a-Si, 12% for CuInSe₂ and 9% for CdTe [1]. Since mono-crystalline silicon based PV cells have the highest efficiency and popularity, this paper focuses on them. In the following sections, single-diode solar PV cell circuit model and the equation relating the current and voltage of The cell is presented. Other essential basic relations for modeling are also listed. The design concept is explained and the LabVIEW block diagram and front panel are shown.

The simulation results for varying cell temperatures and irradiance levels on the output characteristics of the PV cell are shown and analyzed. Also the validation of the presented system is demonstrated by comparing simulated results with the datasheet values of existing commercial PV cell. The determination of optimal load resistance (R) using the developed tool for the maximum power point operation for a range of cell temperatures and irradiance levels is demonstrated.

CHAPTER-2

LITERATURE SURVEY

1. LabVIEW based PV Cell Characterization and MPPT under Varying Temperature and Irradiance Conditions:

This paper presents an analysis of variations in the output characteristics of the mono-crystalline silicon PV cell under different temperature and irradiance levels using LabVIEW as the simulation tool. The base of the study is mathematical modeling of PV cell characteristics using the well-known one-diode equivalent model in LabVIEW. The designed tool computes and displays current-voltage (I-V) curves, power-voltage (P-V) curves, maximum power point values (V_m , I_m and P_m), operating power point plot, fill factor (FF), cell efficiency (η), optimal load resistance (R_l) for maximum power, open-circuit voltage (V_{oc}), short-circuit current (I_{sc}) and saturation current (I_0) over a range of cell temperature and irradiation levels.

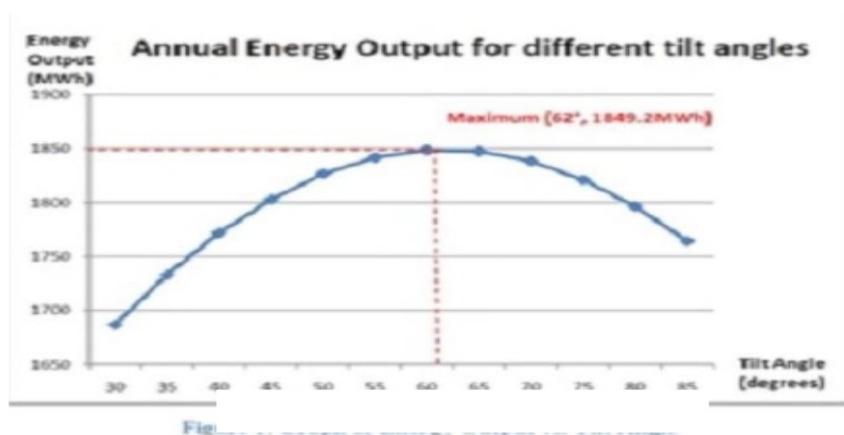
2. Photovoltaic (PV) cell used matlab-simulink environment:

This paper, a mathematical model of a Photovoltaic (PV) cell using matlab-simulink environment, is developed and presented. The model is developed using basic circuit equations of the photovoltaic solar cells including the effects of solar irradiation and temperature changes. The main objective is to find the parameters of the nonlinear I-V equation by adjusting the curve at three points: open circuit, maximum power,

and short circuit. the method finds the best I-V equation for the single-diode photovoltaic (PV) model including the effect of the series and parallel resistances.

3. Design and Simulation of Photovoltaic Cell Using Decrement Resistance Algorithm:

This paper presents a new approach of the Design and simulation of a photovoltaic cell using decrement resistance algorithm for maximum power point tracking (MPPT). The Simulation is done in the MATLAB. The algorithm detects the maximum power point of the photovoltaic (PV) cell. It includes module BP SX 150S for a solar



photovoltaic. This module provides a maximum power of 150 W. The current-voltage (I-V) & power- voltage (P-V) characteristics are obtained for various values of solar Irradiance and Temperatures. The points indicating module voltage V_{mp} and current I_{mp} at maximum Power P_{max} are obtained.

4. Literature Review on Photovoltaic Panels:

Energy from sun can be considered the main source of all types of energies. It can be used by various techniques such as making full use of sunlight to directly generate electricity or by using heat from the sun as a thermal energy. Using Photovoltaic (PV-Cells) is common in solar energy field. The major objective of this review study is to help anyone getting through solar energy field by introducing developments up to date in the field. One can be assisted and will save time. Scientists were again able to increase the electricity return of silicon solar cell using space age materials. By 2007, First-Generation solar cells dominated the market with their low costs and the best commercially available efficiency. The costs of the basic materials are relatively high. It is not clear whether further cost reductions will be sufficient to achieve full economic competitiveness in the wholesale power generation market in areas with modest solar resources. Second-Generation Thin-film PV-Cell technologies are attractive because of their low material and manufacturing costs, but this has to be balanced by lower efficiencies than those obtained from 1st-generation technologies. Thin-film technologies are less mature than first generation PV-Cell and still have a modest market share. Third-generation technologies are yet to be commercialized at any scale. This type of solar panels has the potential to have the highest efficiency of any PV module

CHAPTER-3

THEORY

Solar cell is the basic unit of solar energy generation system where electrical energy is extracted directly from light energy without any intermediate process. The solar cell is a semi-conductor device, which converts the solar energy into electrical energy. The conversion of sunlight (Solar Energy) into electric energy takes place only when the light is falling on the cells of the solar panel. The working of a solar cell primarily depends upon its photovoltaic effect hence a solar cell also known as Photovoltaic cell. A solar panel consists of numbers of solar cells connected in series or parallel. The number of solar cell connected in a series generates the desired output voltage and connected in parallel generates the desired output current. A solar cell operates in somewhat the same manner as other junction photo detectors. A built-in depletion region is generated in that without an applied reverse bias and photons of adequate cell energy create hole-electrons pairs. In the solar cell, as shown in Fig.3.1, the pair must diffuse a considerable distance to reach the narrow depletion region to be drawn out as useful current.

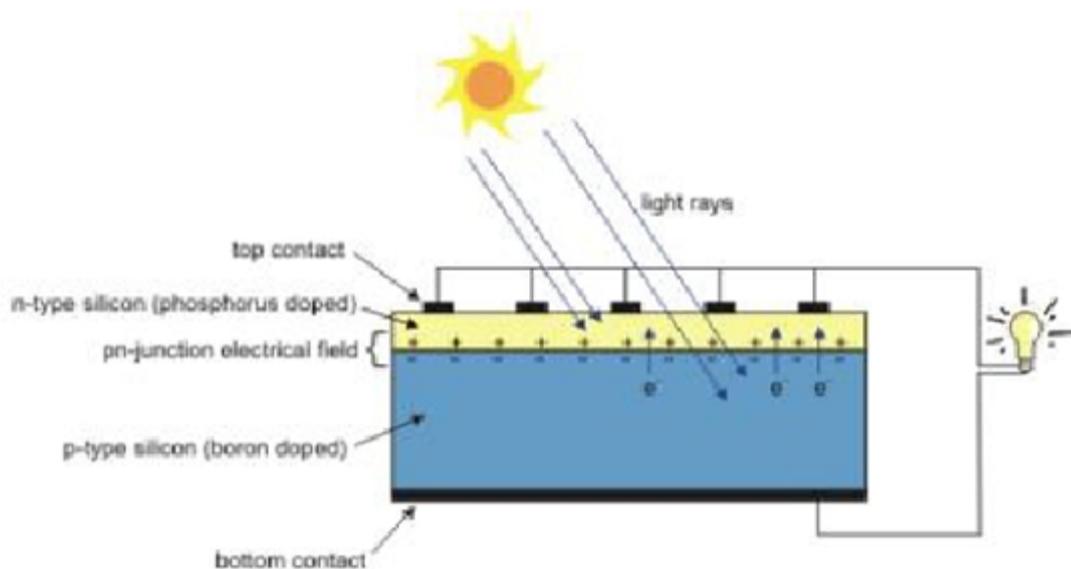
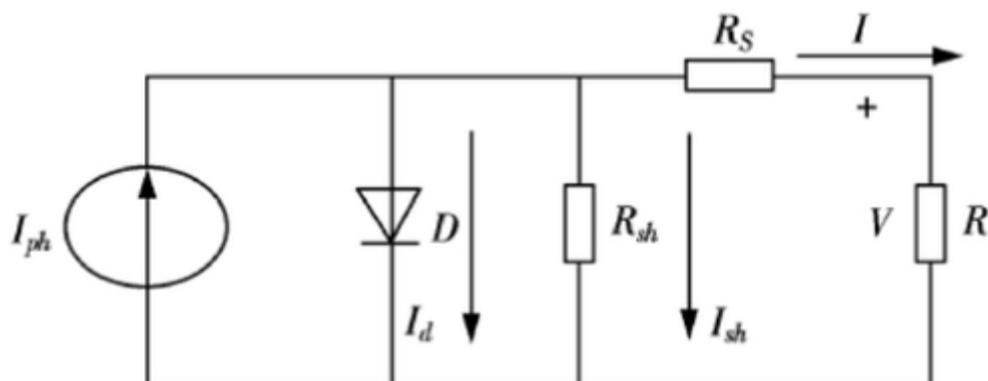


Fig. 3.1 working principle of a solar-cell

The solar cell produce electricity while light strikes on it and the voltage or potential difference established across the terminals of the cell is fixed to 0.5 volt and it is

nearly independent of intensity of incident light whereas the current capacity of cell is nearly proportional to the intensity of incident light as well as the area that exposed to the light. Each of the solar cells has one positive and one negative



terminal like all other type of battery cells. Typically a PV-Cell has negative front contact and positive back contact. A semiconductor p-n junction is in the middle of these two contacts.

Figure 3.2 shows the circuit representation of a PV- Cell using Diode Model. A diode is connected across a load(in this case a Resistor.) and the corresponding Output Voltage(V_{oc}) and Current(I_m) is calculated using Voltage and Current Sensors. While sunlight falling on the cell the some photons of the light are absorbed by solar cell. Some of the absorbed photons will have energy greater than the energy gap between valence band and conduction band in the semiconductor crystal. Hence, one valence electron gets energy from one photon and becomes excited and jumps out from the bond and creates one electron-hole pair. These electrons and holes of e-h pairs are called light- generated electrons and holes. The light-generated electrons near the p-

n junction are migrated to n-type side of the junction due to electrostatic force of the field across the junction. Similarly the light-generated holes created near the junction are migrated to p-type side of the junction due to same electrostatic force. In this way a potential difference is established between two sides of the cell and if these two sides are connected by an external circuit current will start flowing from positive to negative terminal of the solar cell. This was basic working principle of a solar cell now we will discuss about different parameters of a solar or photovoltaic cell upon which the rating of a solar panel depends. During choosing a particular solar cell for specific project

it is essential to know the ratings of a solar panel. These parameters tell us how efficiently

a solar cell can convert the light to electricity.

3.1. Short Circuit Current of Solar Cell:

The maximum current that a solar cell can deliver without harming its own construction is called Short-Circuit Current. It is measured by short circuiting the terminals of the cell at most optimized condition of the cell for producing maximum output. The term optimized condition is used because for fixed exposed cell surface the rate of production of current in a solar cell also depends upon the intensity of light and the angle at which the light falls on the cell. As the current production also depends upon the surface area of the cell exposed to light, it is better to express it as Maximum Current Density (J_{sc}) instead of maximum Current (I_{sc}).

3.2. Open Circuit Voltage of Solar Cell:

It is measured by measuring voltage across the terminals of the cell when no load is connected to the cell. This voltage depends upon the techniques of manufacturing and temperature but not fairly on the intensity of light and area of exposed surface. Normally open circuit voltage of solar cell nearly equal to 0.5 to 0.6 volt. It is normally denoted by V_{oc} .

3.3. Maximum Power Point of Solar Cell:

The maximum electrical power one solar cell can deliver at its standard test condition. If we draw the v-i characteristics of a solar cell maximum power will occur at the bend point of the characteristic curve. It is shown in the v-i characteristics of solar cell by P_m as shown in Fig. 3.3.

3.4. Current at Maximum Power Point:

The current at which maximum power occurs is called Maximum Current and is

represented in the v-i characteristics of solar cell by I_m . (Fig 3.3)

3.5. Voltage at Maximum Power Point:

The voltage at which maximum power occurs is called Maximum Voltage and is shown in the v-i characteristics of solar cell by V_m . (Fig 3.3)

3.6. Efficiency of Solar Cell:

It is defined as the ratio of maximum electrical power output to the radiation power input to the cell and it is expressed in percentage. It is considered that the radiation power on the earth is about 1000 watt/square meter hence if the exposed surface area of the cell is A then total radiation power on the cell will be $1000 A$ watts. Hence the efficiency of a solar cell may be expressed as

CHAPTER 4

INTRODUCTION TO LabVIEW

LabVIEW, short for **L**aboratory **V**irtual **I**nstrument **E**ngineering **W**orkbench, is a programming environment in which you create programs using a graphical notation (connecting functional nodes via wires through which data flows); in this regard, it differs

from traditional programming languages like C, C++, or Java, in which you program with text. However, LabVIEW is much more than a programming language. It is an interactive program development and execution system designed for people, like scientists and engineers, who need to program as part of their jobs. The LabVIEW development environment works on computers running Windows, Mac OS X, or Linux. LabVIEW can create programs that run on those platforms, as well as Microsoft Pocket PC, Microsoft Windows CE, Palm OS, and a variety of embedded platforms, including Field Programmable Gate Arrays (FPGAs), Digital Signal Processors (DSPs), and Micro-Processors.

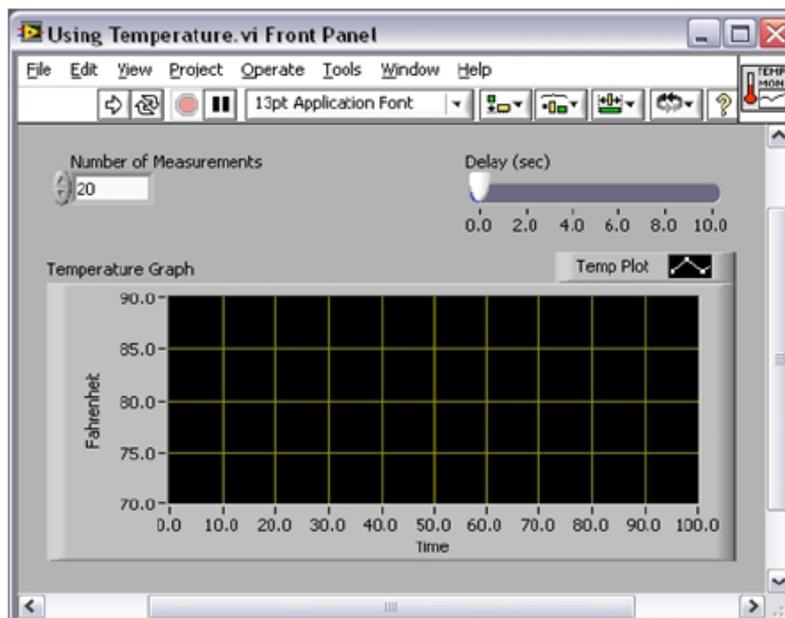
Using the very powerful graphical programming language that many LabVIEW users affectionately call "**G**" (for *graphical*), LabVIEW can increase your productivity by orders of magnitude. Programs that take weeks or months to write using conventional programming languages can be completed in hours using LabVIEW because it is specifically designed to take measurements, analyze data, and present results to the user. And because LabVIEW has such a versatile graphical user interface and is so easy to program with, it is also ideal for simulations, presentation of ideas, general programming, or even teaching basic programming concepts.

LabVIEW offers more flexibility than standard laboratory instruments because it is software-based. You, not the instrument manufacturer, define instrument functionality. Your computer, plug-in hardware, and LabVIEW comprise a completely configurable virtual instrument to accomplish your tasks. Using LabVIEW, you can create exactly the type of virtual instrument you need, when you need it, at a fraction

of the cost of

4.2.1 Front Panel:

The front panel is the interactive user interface of a VI, so because it is the front panel of a physical instrument (Fig. 4.1). The front panel can contain knobs, push buttons, graphs, and other controls that vary from user



is the interface named of a 4.1). The contain buttons, many that may inputs to

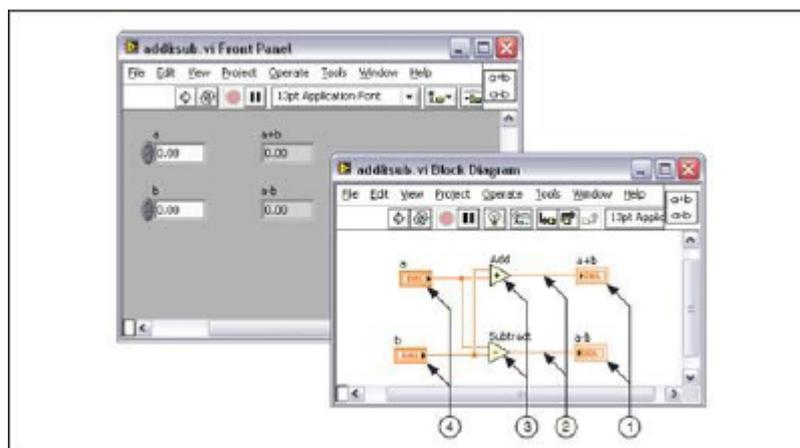
program outputs shown by indicators. You can input data using a mouse and keyboard, and then view the results produced by your program on the screen as shown in Fig. 4.1.

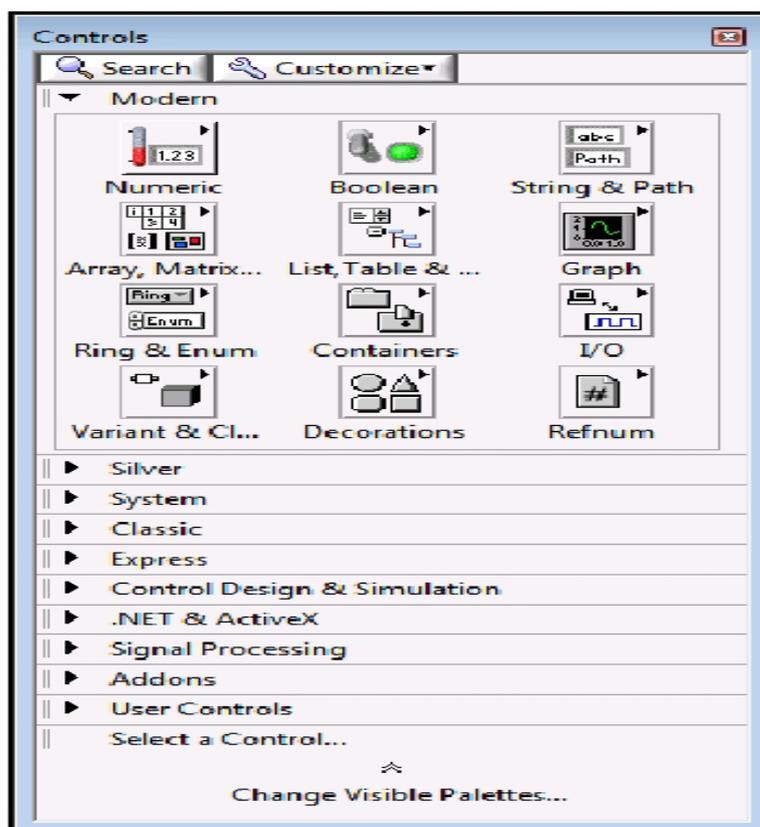
4.2.2 Block Diagram :

Block diagram objects include terminals, subVIs, functions, constants, structures, and wires, which transfer data among other block diagram objects. After you create the front panel window, you add code using graphical representations of functions to control the front panel objects.

The block diagram window contains this graphical source code. Objects on the front panel window appear as terminals on the block diagram. Terminals are entry and exit ports that exchange information between the front panel and block diagram. They are analogous to parameters and constants in text-based programming languages. Types of terminals include control or indicator terminal and node terminals. Control and indicator terminals belong to front panel controls and indicators. Data points you enter into the front panel controls enter the block diagram through the control terminals.

4.2.3 Controls Palette:





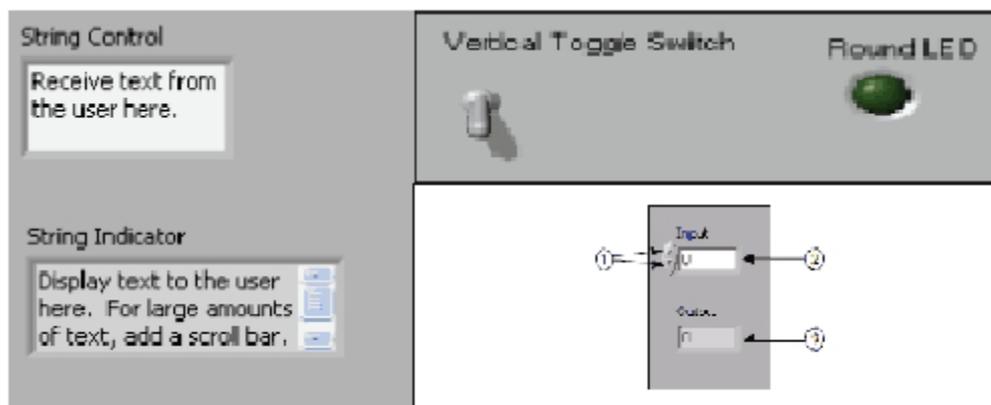
The Controls palette contains the indicators you use to create the front panel. You access the Controls palette from the front window by selecting

palette controls and you use to front panel. the Controls the front window by View»

Controls Palette, or by right clicking on any empty space in the front panel window. The Controls palette is broken into various categories; you can expose some or all of these categories to suit your needs. Fig. 4.3 shows a Controls palette with all of the categories exposed and the Modern category expanded.

4.2.4 Controls and Indicators:

Every VI has a front panel that you can design as a user interface. You also can use front panels as a way to pass inputs and receive outputs when you call the VI from another block diagram. You create the user interface of a VI by placing controls and indicators on the front panel of a VI. When you interact with a front panel as a user interface, you can modify controls to supply inputs and see the results in indicators



The

following Fig. 4.4 demonstrates some of the different types of control available by the user for control of data flow.

Numerical Control:

Numerical Controls and Indicators are also used to Represent Numerical Values. While the Numerical Control is used to get values or to control a Parameter, the Numerical Indicator is use to Produce Outputs or to Display Outputs as shown in fig.4.5.

Sliders:

Sliders are used to represent Numerical Values in LabVIEW. They Can Represent a range of values.(i.e. Integers, Floats, Double, etc.) as shown in fig. 4.5.

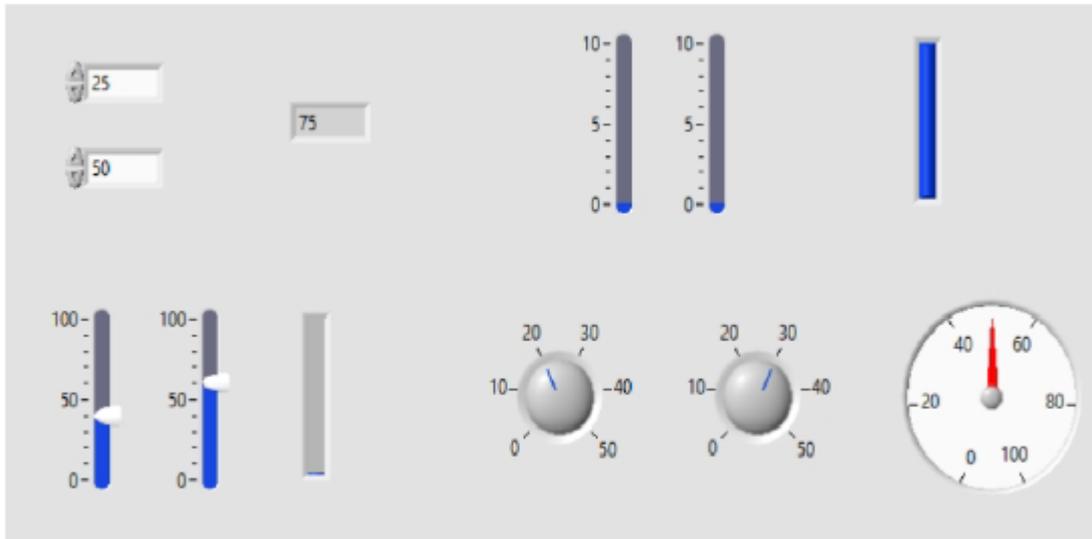
Dials and Gauges:

Dials and Gauges are used to represent a Control where Minute Adjustments are desired by the user, or where there is a need to show the data in a Graphical or more

Design and simulation of PV cell characterization under varying temperature and irradiance using LabVIEW.

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Physical Manner as shown in fig.4.5. Dials and Gauges also provide Numerical

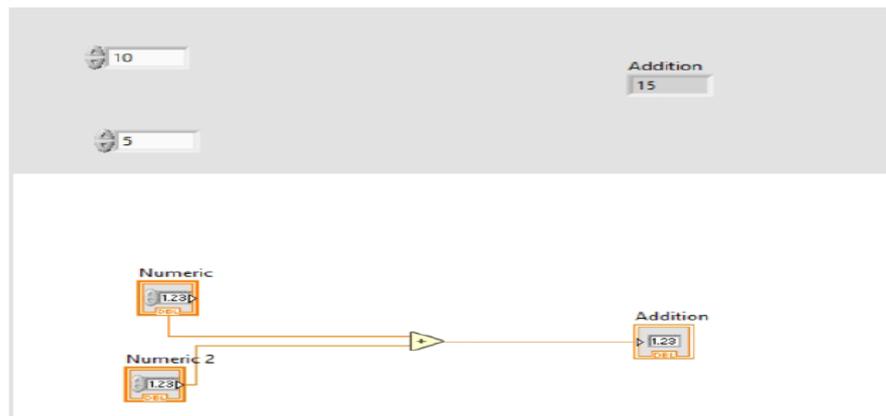


Control of Data.

CHAPTER 5

BASIC SIMULATION IN LabVIEW

5.1 Addition:



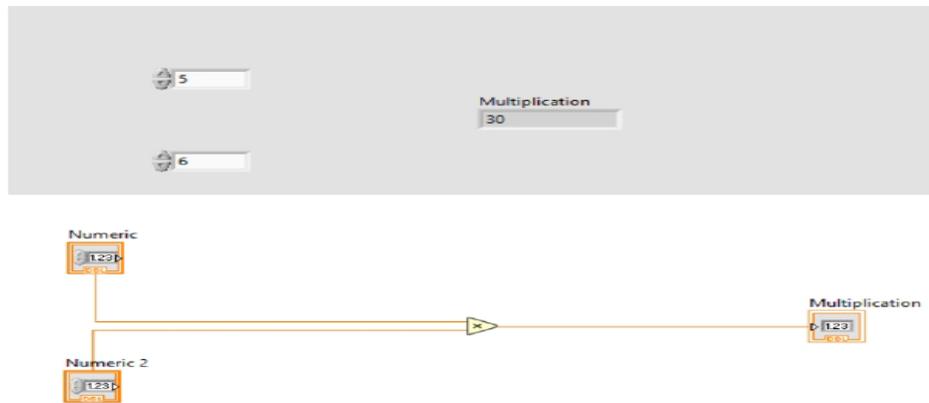
The above Fig.5.1 represents the user Control Panel and the back-end Block Diagram for addition of Two Random Numbers entered by the user

5.2. Subtraction:



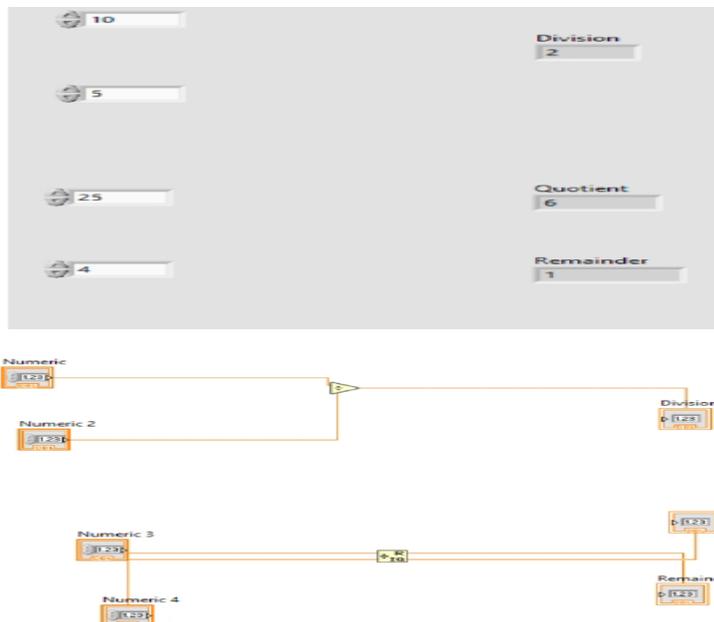
The above Fig.5.2 represents the user Control Panel and the back-end Block Diagram for Subtraction of Two Random Numbers entered by the user.

5.3. Multiplication:



The above Fig.5.3 represents the user Control Panel and the back-end Block Diagram for Multiplication of Two Random Numbers entered by the user.

5.4 Division:



The above Figs. 5.4 (i) & 5.4 (ii) represents the user Control Panel and the back-end Block Diagram for Division of Two Random Numbers entered by the user.

CHAPTER 6

SIMULATION OF PV-CELL

The simulation is designed such as at first it should ask for the respective and necessary

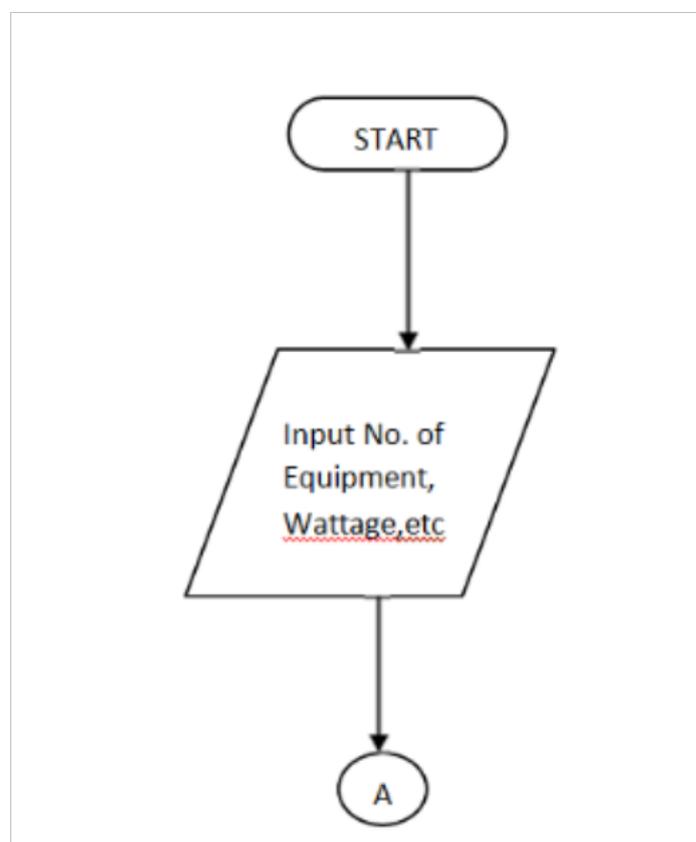
Inputs from the user, which is required for the processing of the results. The following

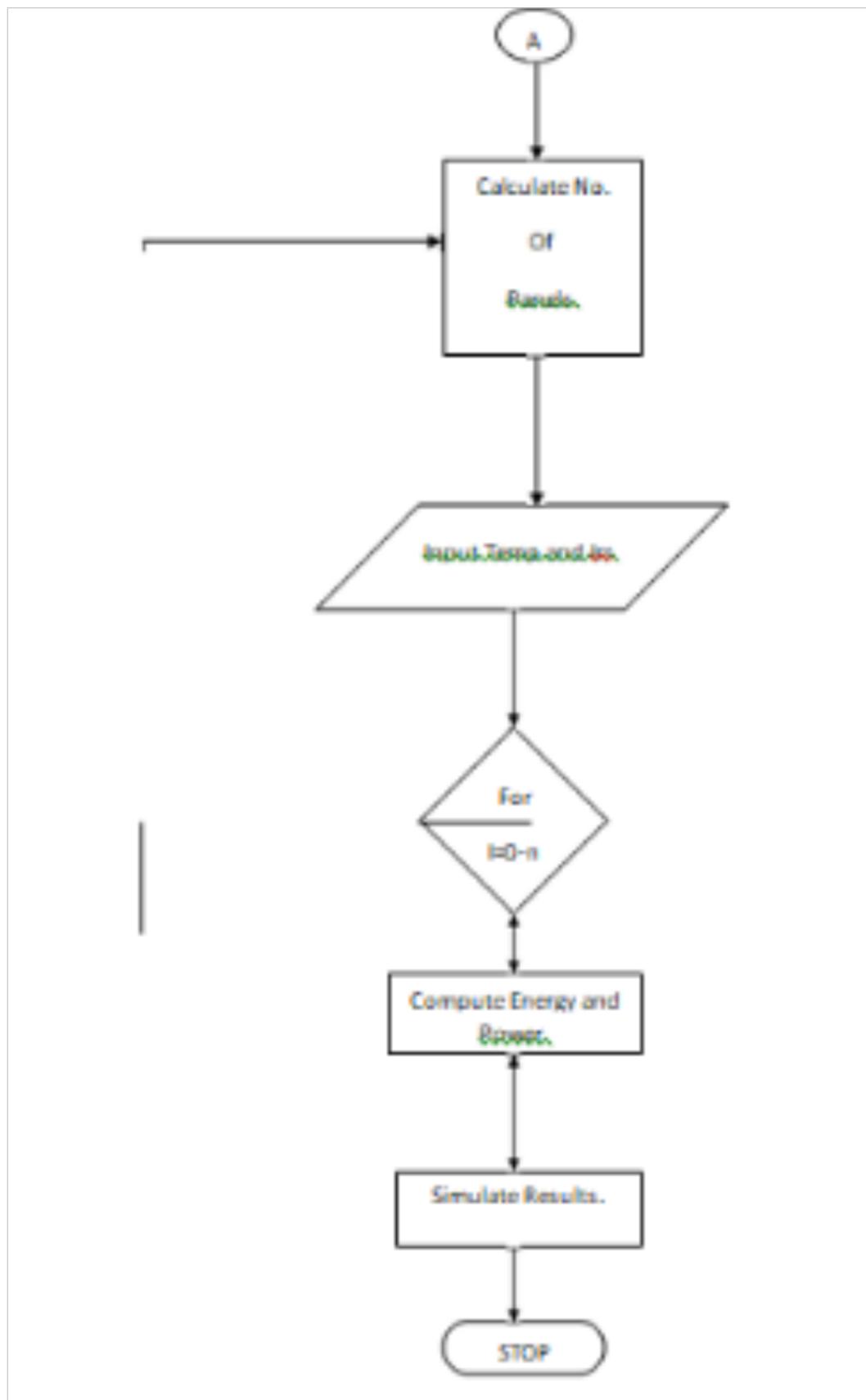
steps shows the chosen algorithm to get the required Output.

Algorithm-

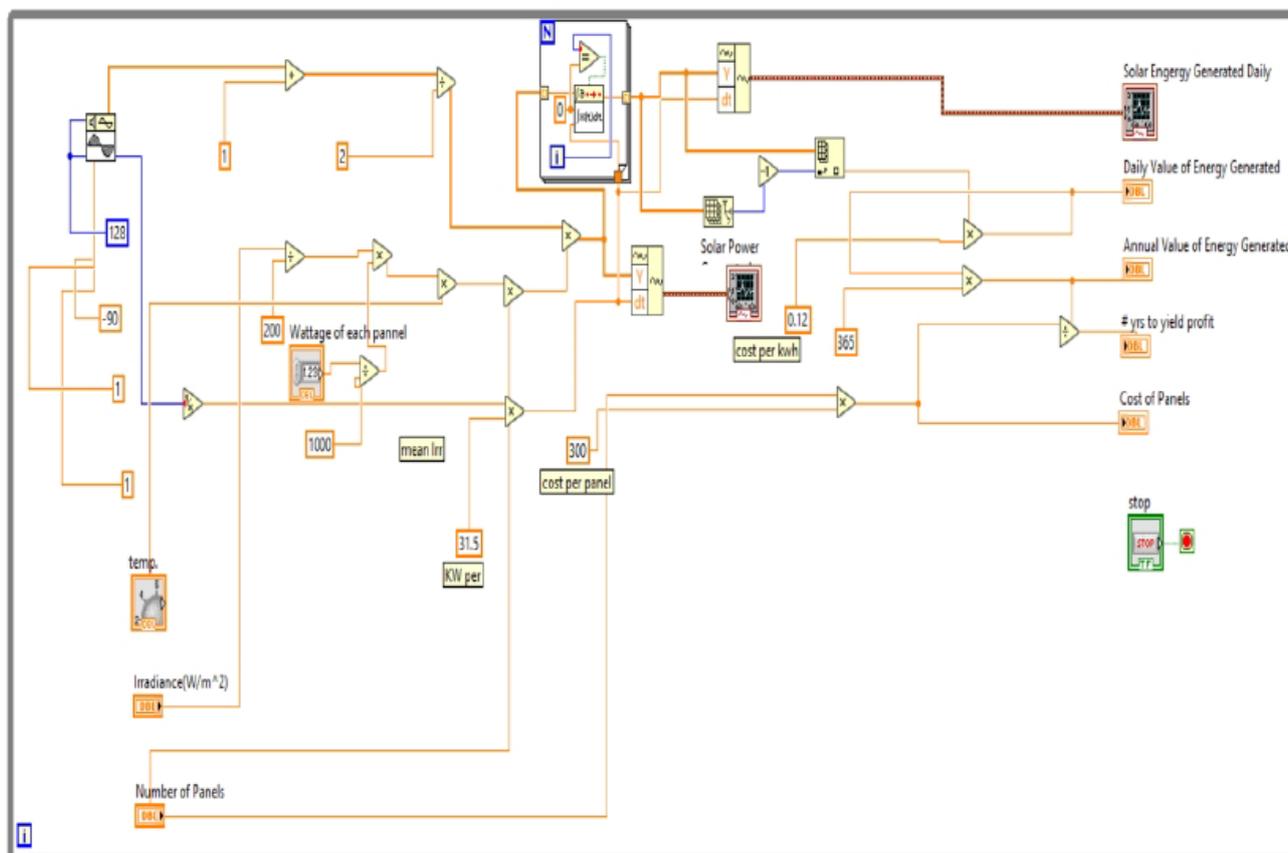
- Start the Simulation.
- Ask input for the load conditions.
- Calculate No. of panels for the applied load.
- Ask input for the Temperature and Irradiance conditions.
- Compute the Power & Energy output of the panels.
- Simulate the graph for energy output & Power output for varying conditions of
- Temperature & Irradiance.
- Stop the simulation.

Flow-Chart:





6.2. Back-End Block Diagram:



The Back-End Blocks are responsible for the processing of the input data and computes the Output which is desired by the User. The Input is computed to give the Power Generated and the Energy Output.

In this simulation the block diagram collects the inputs from the user such as the no. of panels, wattage, cost per panel, variance in temperature and irradiance, and then computes the power output for the given panel and demonstrates the result in the form of a graph of Power Generated Vs. Hours of use.

A Nested For-Loop is used to evaluate the results where the number of iterations the loop is going to execute is determined the Number of Panels given as input by the user.

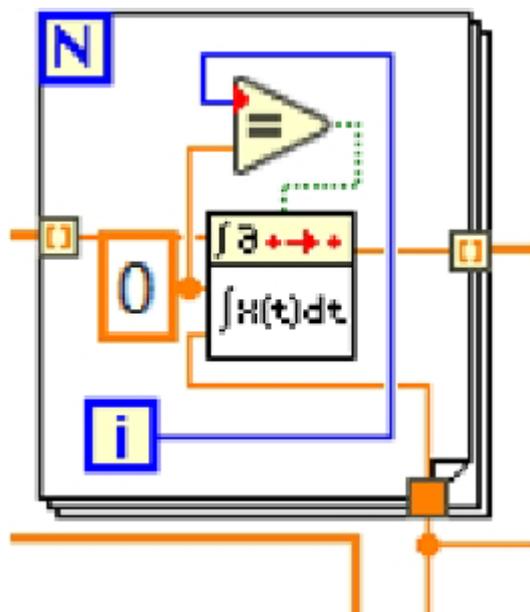
The Output is again transferred to the Front End Control Panel where the user can

interact

with the Output and generate Feed-Back Control.

The above Fig. 6.2 Represents the Block Diagram built to generate the Energy Output for a No. of Solar PV-varying conditions Irradiance.

6.3. Calculation



Cells working under of Temperature and

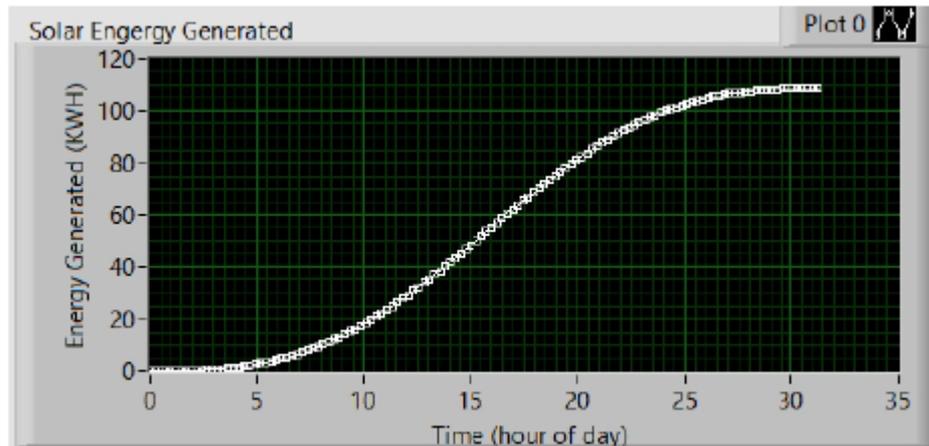
of Power Generated:

The above Block Diagram represents an Integration Function which calculates the power

generated by the Solar Panels. It uses a For Loop for calculating the limits of integration,

where it takes its limits from 0 to No. of Panels (given as input). It is shown in Figure 6.3.

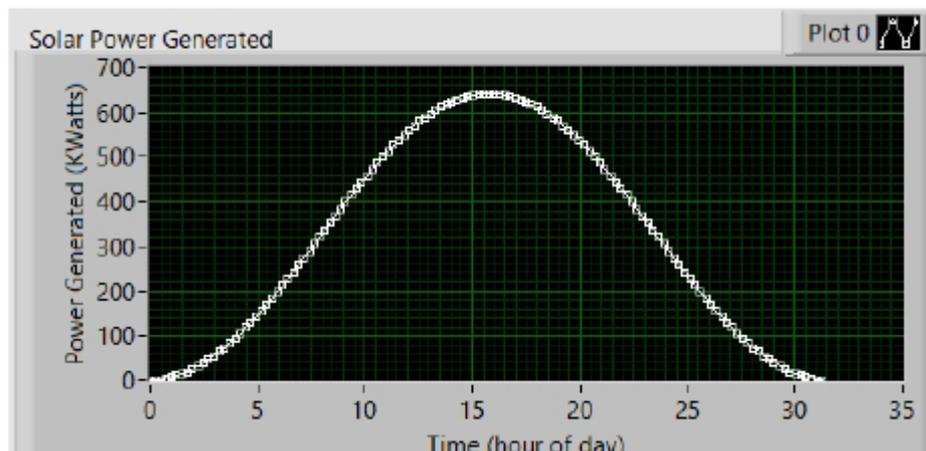
6.5. Simulation Results:



The above

graph shown in fig. 6.5(i) represent the Power Output from the panels Vs

Number of Hours of daily use. Power Generated is represented by the X-Axis .



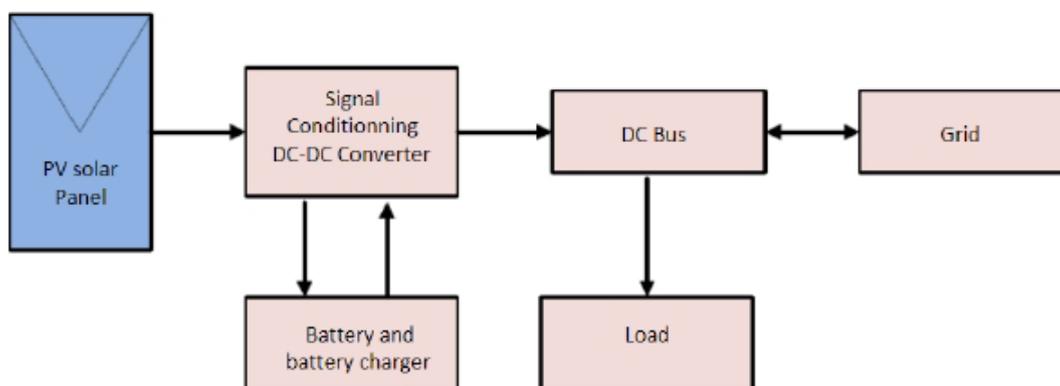
The 6.5(ii)

above fig.

represents the Energy Output from the panels Vs Number of Hours of daily use. Energy Generated is represented by the X-Axis and the Number of Hours is represented by the Y-axis

6.1 Theory:

The PV system consists from main part which is PV cells which produces the power but there are other components are also needed to, control, convert and store the energy such as PV modules, batteries, charge controllers, and inverters. The PV system and its components are detailed in the block diagram shown in fig 6.1.



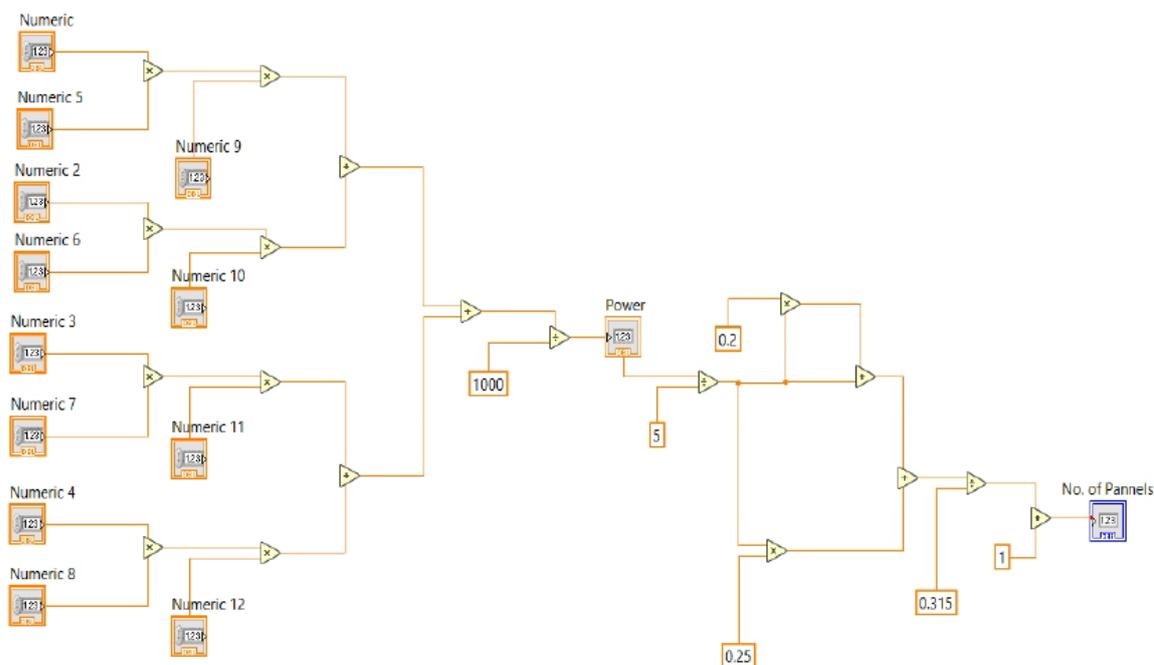
6.2 Calculations:

Considering the Power Systems Simulation (PSS) Lab as the case study for our simulation, and a standard data-sheet for V_{oc} , I_{sc} , P_{max} , V_{max} , I_{max} , for a single panel we are calculating the No. of Panels which are required for designing the Roof-Top Model considering the losses in power conversion and the Efficiency of 20%. Now, we calculate the total Power consumption by the equipments over the day.

6.3. Front Panel:

	Wattage	No. of Equipments	Hours
Light	60	8	3
Fan	75	2	5
Desktop-PC	450	21	5
Projector	280	1	3

The above Fig 6.2 shows the diagram for the Front End of the simulation where the user can give the different values for the Input Criteria in order to compute the desired Output. The User decides the No. of Equipment, Wattage, No. of Hours etc. This information is then passed on to the Back-End Block for the processing of results.



6.4 Block Diagram:

The above Fig 6.3 shows the Back-End Block Diagram representation of the simulation

which is processed in order to calculate the No. of Panels required to drive the load considered. The user is required to enter the load details which is then calculated to give out output and Number of required for of load.

	Wattage	No. of Equipments	Hours
Light	60	8	3
Fan	75	2	5
Desktop-PC	450	21	5
Projector	280	1	3
		Power	No. of Pannels
		50.28	47

6.5. Result:

the power also the panels the supply

Simulation

CHAPTER 7

7.1 Advantages of Solar Energy in India:

Some of the advantages of solar energy which makes it all the more suitable for India are

as follows:

- This is an inexhaustible source of energy and the best replacement to other non-renewable energies in India.
- Solar energy is environment friendly. When in use, it does not release CO₂ and other gases which pollute the air. Hence it is very suitable for India, India being one of the most polluted countries of the world.
- Solar energy can be used for variety of purposes like as heating, drying, cooking or electricity, which is suitable for the rural areas in India. It can also be used in cars, planes, large power boats, satellites, calculators and many more such items, just apt for the urban population.
- Solar power is inexhaustible. In an energy deficient country like India, where power generation is costly, solar energy is the best alternate means of power generation

You don't need a power or gas grid to get solar energy. A solar energy system can be installed anywhere. Solar panels can be easily placed in houses. Hence, it is quite inexpensive compared to other sources of energy.

7.2 Solar Energy Power in India : Future:

In solar energy sector, many large projects have been proposed in India.

- Thar Desert has some of India's best solar power projects, estimated to

generate 700 to 2,100 GW

- On March 1st, 2014, the then Chief Minister of Gujarat, Narendra Modi, inaugurated at Diken in Neemuch district of **Madhya Pradesh**, India's biggest solar power plant.
- The Jawaharlal Nehru National Solar Mission (JNNSM) launched by the Centre is targeting 20,000 MW of solar energy power by 2022
- Gujarat's pioneering solar power policy aims at 1,000 MW of solar energy Generation
- In July 2009, a \$19 billion solar power plan was unveiled which projected to produce 20 GW of solar power by 2020.

7.3 Applications:

(i) **Utility Interactive Applications:** In utility interactive (or grid-connected) PV systems, PV modules are connected to inverters that convert the DC produced by the PV

modules to AC. This electricity can then power household appliances or can be sold directly to the grid. As a building receives this energy, it is distributed to appliances and

lighting, or other devices where needed. Since PV systems are restricted to function only

exposed to the sun, a backup system is frequently required to ensure continuous supply of

electricity irrespective of the weather conditions. These systems are most commonly used

in houses or commercial buildings to offset electricity cost. A well designed PV system

with a proper storage facility can be an attractive prospect for displacing power during the

peak hours

(ii) Stand-Alone Systems:

Stand-alone systems directly use the generated produced electricity. Stand-alone

systems do not rely on utility/grid connections. When the requirement arises during night time or poor sunlight, a battery storage system is used. In some situations, stand-alone systems use conventional generators as backup systems. There are numerous applications of stand-alone PV systems, some of which are mentioned below.

(iii) Lighting:

With the invention of LED (light emitting diode) technology as low power lighting sources, PV systems find an ideal application in remote or mobile lighting systems. PV systems combined with battery storage facilities are mostly used to provide lighting for billboards, highway information signs, public-use facilities, parking lots, vacation cabins, lighting for trains

(iv) Communications:

Signals required by communication systems need amplification after intervals. Various relay towers are stationed to boost radio, television, and High grounds are mostly favored as the sites for repeater stations. High grounds are mostly favored as the sites for repeater stations. The far from power lines. To reduce the difficulty and systems are being installed as a viable alternative.

(v) Electricity for remote areas:

Some areas are quite far from the distribution network to establish connection with the grid. Areas under construction also need power supply before they are connected. PV systems are an attractive option for these cases. Furthermore, PV systems can be backed up by conventional generators to provide uninterrupted supply.

CHAPTER 8

RESULTS AND CONCLUSION

8.1 Results:

Analysed the Simulation to compute Power Output Vs No. of Hours used\day for a selected PV-Cell under varying Conditions of Temperature and Irradiance. Energy Output Vs No. of Hours used\day for a selected PV-Cell under varying Conditions of Temperature and Irradiance is observed and time to yield profit from the grid found

out. Design and simulation of a Roof-Top Model representing the load to calculate the Number of Required Solar Panels

Design and simulation of a Roof-top model to study and understand the Power and Energy Output Characteristics of the selected PV-Module under varying conditions of Temperature and Irradiance.

8.2 Conclusion:

The **“Design and Simulation of PV-Cell Characterisation under varying conditions of Temperature and Irradiance”** is simulated in a virtual environment software, which is LabVIEW. This software allows its user to change input parameter even when the system is processing. This enables the user to study the system in transient conditions. The design and simulation results are in acceptable range of errors and the expected Output Characteristics for PV-Cell under varying conditions of Temperature and Irradiance is Obtained.

8.3 Future Scope:

India is slowly gaining its prominence in the generation of solar power due to the comprehensive and ambitious state and the Centre’s solar policies and projects and National Solar Mission. In 2014 the Government has proposed to develop some mega solar power plants in Gujarat, Tamil Nadu, Rajasthan. Considering all these facts, we do have a bright picture in front of us as India’s potential to be a solar power driven country of the world

APPENDIX

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PROJECT REPORT

ON

“AN EXPERIMENTAL STUDY ON STRENGTH AND SELF HEALING CHARACTERISTICS OF BACTERIAL CONCRETE”

Submitted in partial fulfilment of the requirement for the award of

BACHELOR OF ENGINEERING

In

CIVIL ENGINEERING

Submitted by

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2019 - 2020

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CERTIFICATE

This is to certify that the project work entitled “AN EXPERIMENTAL STUDY ON STRENGTH AND SELF HEALING CHARACTERISTICS OF BACTERIAL CONCRETE” carried out by **Ms.IQRA RASHID (1AM16CV017),Mr.JAVAID AALAM(1AM16CV018),Mr.MOHAMMAD TAFZEEL QURESHI (1AM16CV055),Mr.ASIF AHMAD GANIE (1AM17CV401)** bonafide students of **AMC ENGINEERING COLLEGE**, in partial fulfilment for the award of **Bachelor of Engineering in Civil Engineering** of the **Visvesvaraya Technology University, Belagavi** during the year 2019-2020. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the department library. The project report has been approved as it satisfies the academic requirement in respect of project work prescribed for the said degree.

Signature of the Guide
Prof. Mohiyuddin C S

Signature of the HOD
Dr. Shashishankar A

Signature of the Principal
Dr. A G NATARAJ

Name of the Examiners

Signature with Date

1.

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AMC ENGINEERING COLLEGE
DEPARTMENT OF CIVIL ENGINEERING



DECLARATION

We, students of final year of B.E (Civil Engineering), AMC Engineering College hereby declare that the project work entitled “AN EXPERIMENTAL STUDY ON STRENGTH AND SELF HEALING CHARACTERISTICS OF BACTERIAL CONCRETE” has been carried out by us at AMC Engineering College, Bengaluru and submitted in partial fulfilment of the course requirements for the award of the degree of **Bachelor of Engineering in Civil Engineering of the Visvesvaraya Technology University, Belagavi** during the year 2019-2020. We also declare that to the best of our knowledge and belief, the work report does not form part of any other dissertation on the basis of which a degree or award was conferred on an earlier occasion on this by any other student.

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We proudly vest our honour to the **DEPARTMENT OF CIVIL ENGINEERING, AMC ENGINEERING COLLEGE**, Bengaluru which has given the privilege to imbibe technical knowledge, thereby enabling us attain the long cherished goal of our **GRADUATION in CIVIL ENGINEERING**.

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ABSTRACT

Concrete is the most commonly used building material which is recyclable. It is strong, durable, locally available and versatile. It is capable to resist the compressive load to a limit but if the load applied on the concrete is more than their limit but if the load applied on the concrete is more than their limit of resisting load, it causes the strength reduction of concrete by producing the cracks in concrete and the treatment of cracks is very expensive. Cracks in concrete affects the serviceability limit of concrete. The ingress of moisture and other harmful chemicals into the concrete may result in decrement of strength and life. Micro-cracks are the main cause to structural failure. One way to circumvent costly manual maintenance and repair is to incorporate an autonomous self-healing mechanism in concrete. One such an alternative repair mechanism is currently being studied, i.e. a novel technique based on the application of biomineralization of bacteria in concrete. The applicability of specifically calcite mineral precipitating bacteria for concrete repair and plugging of pores and cracks in concrete has been recently investigated and studies on the possibility of using specific bacteria as a sustainable and concrete-embedded self-healing agent was studied and results from ongoing studies are discussed. Synthetic polymers such as epoxy treatment etc. are currently being used for repair of concrete are harmful to the environment, hence the use of a biological repair technique in concrete is focused. Recently, it is found that microbial mineral precipitation resulting from metabolic activities of favourable microorganisms in concrete improved the overall behaviour of concrete. Hence in this paper define the bacterial concrete, its classification and types of bacteria, chemical process to fix the crack by bacteria, advantages and disadvantages and possibilities of application of MICP (Microorganism used for Calcium Carbonate Precipitation in Concrete). The different strengths of Normal concrete and concrete with different concentrations of Bacteria *Bacillus spp* were used and tests were conducted and compared.

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CHAPTER-1

INTRODCTION

Concrete is the most commonly used building material which is recyclable. It is strong, durable, locally available and versatile. It is capable to resist the compressive load to a limit but if the load applied on the concrete is more than their limit but if the load applied on the concrete is more than their limit of resisting load, it causes the strength reduction of concrete by producing the cracks in concrete and the treatment of cracks is very expensive. Cracks in concrete affects the serviceability limit of concrete. The ingress of moisture and other harmful chemicals into the concrete may result in decrement of strength and life. The ingress of sulphates and chlorides in concrete results in decrease of durability. These effects in concrete structures by cracking might be overcome by utilizing self-healing technology which has high potential to repair cracks in concrete and enhance the service life of concrete structures with a reduction of demand for repair and maintenance. Self-healing agents such as epoxy resin, bacteria, fibre, etc., are used to heal cracks in concrete. Among these bacteria is used commonly and is found to be effective. When the bacteria are mixed with concrete the calcium carbonate precipitates forms and these precipitates fills the cracks and makes the concrete free from cracks.

1.1 WHAT IS BACTERIAL CONCRETE?

Self-healing concrete is a product which biologically produces limestone by which cracks on the surface of concrete surface heal. Selected types of the bacteria genus Bacillus, along with calcium-based nutrient known as calcium lactate, and nitrogen and phosphorous are added to the concrete when it is being mixed. The self-healing agents can lie dormant within the concrete for up to two hundred years. When a concrete structure damages and water starts to penetrate in the cracks present in it the bacteria start to feed on the calcium lactate consuming oxygen and converts the soluble calcium lactate into insoluble limestone. The limestone formed thus seals the cracks present. It is similar to the process of how a fractured bone gets naturally healed by osteoblast cells that mineralize to reform bone. Consumption of oxygen in the bacterial conversion has an additional advantage. Oxygen which becomes an essential element for the corrosion of steel to take place is being used in the bacterial conversion. Hence the durability of steel in construction becomes higher. The process of bacterial conversion takes place either in the interior or exterior of the microbial cell or even some distance away within the concrete. Often the bacterial activities trigger a change in the chemical process that leads to over saturation and mineral precipitation. Utilization of concepts of bio mineralogy in concrete lead to invention of a new material termed as Bacterial Concrete. Bacterial concrete refers to a new generation concrete in which selective cementation by microbiologically induced CaCO_3 precipitation has been introduced for remediation of micro-cracks.

1.2 Various Types of Bacteria Used in Concrete

There are various types of bacteria were used in bacterial concrete construction are:

- Bacillus pasteurizing
- Bacillus sphaericus
- Escherichia coli
- Bacillus subtilis
- Bacillus cohnii
- Bacillus balodurans
- Bacillus pseudofirmus

1.3 Mechanism of Bacterial Concrete

- Self-healing concrete is a product that will biologically produce lime stone to heal cracks that appear on the surface of concrete structure.
- Specially selected types of bacteria genus Bacillus, along with calcium-based nutrients known as calcium lactate & nitrogen phosphorus are added to the ingredients of the concrete when it is being mixed these self-healing agents can lie dormant within the concrete for up to 200 hundred years.
- when a concrete structure is damaged water starts to seep through the cracks that appear in the concrete, the spores of the bacteria germinate on contact with the water and nutrients.
- Having been activated, the bacteria start to feeds oxygen is consumed and the soluble calcium lactate is converted to insoluble limestone. The lime stone solidifies on the crack surface, thereby sealing it up.
- It is similar to the process by which bone fractures in the human body are naturally healed by Osteoblast cells that mineralize to reform the bone.
- The consumption of oxygen during the bacteria conversion of calcium lactate to limestone has an additional advantage. Oxygen is an essential element in the process of corrosion of steel and when bacterial activity has consumed it all and increase the durability of steel reinforced concrete construction.

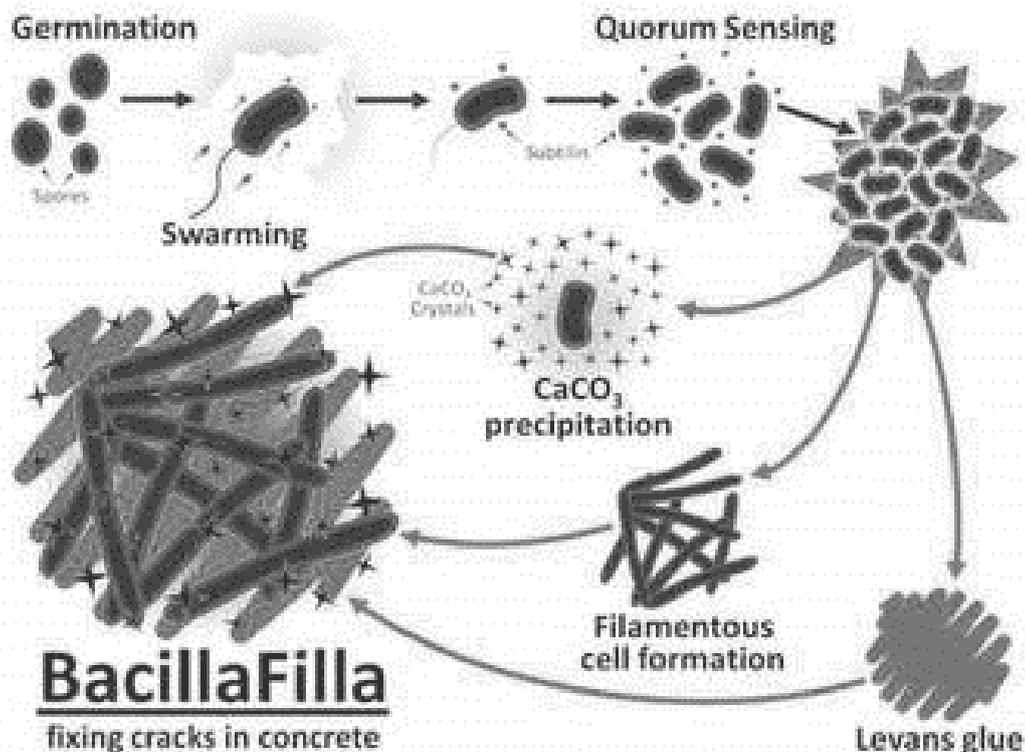
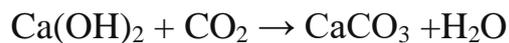
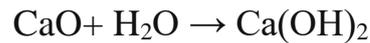


Fig 1: Mechanism of Bacterial Concrete

1.3.1: Chemical process involved in Self-healing or Bacterial Concrete:

When the water comes in contact with the un-hydrated calcium in the concrete, calcium hydroxide is produced by the help of bacteria, which acts as a catalyst, this calcium hydroxide reacts with atmospheric carbon dioxide and forms limestone and water. This extra water molecule keeps the reaction going.



The limestone then hardens itself and seals the cracks in the concrete.

1.4 Preparation of Bacterial Concrete:

Bacterial concrete can be prepared in two ways

- By direct application
- By encapsulation in lightweight concrete

In the direct application method, bacterial spores and calcium lactate is added into concrete directly when mixing of concrete is done. The use of this bacteria and calcium lactate doesn't change the normal properties of concrete. When cracks are occurred in the structure due to obvious reasons.

The bacteria are exposed to climatic changes. When water comes in contact with these bacteria, they germinate and feed on calcium lactate and produces limestone. Thus, sealing the cracks.

By encapsulation method the bacteria and its food i.e. calcium lactate, are placed inside treated clay pellets and concrete is prepared. About 6% of the clay pellets are added for making bacterial concrete.

When concrete structures are made with bacterial concrete, when the crack occurs in the structure and clay pellets are broken and the bacteria germinate and eat down the calcium lactate and produce limestone, which hardens and

thus sealing the crack. Minor cracks about 0.5mm width can be treated by using bacterial concrete.

Among these two-methods encapsulation methods is commonly used, even though it's costlier than direct application.

1.5 Advantages and Disadvantages of Bacterial Concrete:

1.5.1 Advantages of Bacterial Concrete

- Self-repairing of cracks without any external aide.
- Significant increase in compressive strength and flexural strength when compared to normal concrete.
- Resistance towards freeze-thaw attacks.
- Reduction in permeability of concrete.
- Reduces the corrosion of steel due to the cracks formation and improves the durability of steel reinforced concrete.
- Bacillus bacteria are harmless to human life and hence it can be used effectively.

1.5.2 Disadvantages of Bacterial Concrete

- Cost of bacterial concrete is double than conventional concrete.
- Growth of bacteria is not good in any atmosphere and media.
- The clay pellets holding the self-healing agent comprise 20% of the volume of the concrete. This may become a shear zone or fault zone in the concrete.
- Design of mix concrete with bacteria here is not available any IS code or other code.
- Investigation of calcite precipitate is costly.

1.6 Applications of bacterial Concrete:

1. Bacterial concrete technology has proved to be better than many conventional technologies because of its eco- friendly nature, self-healing abilities and increase in durability of various building materials.
2. Work of various researchers has improved our understanding on the possibilities and limitations of biotechnological applications on building materials.
3. Enhancement of compressive strength, reduction in permeability, water absorption, reinforced corrosion has been seen in various cementitious and stone materials.
4. In bacterial concrete interconnectivity of pores is disturbed due to plugging of pores with calcite crystals, since interconnected pores are significant for permeability, the water permeability is decreased in bacteria treated specimens.
5. Cementation by this method is very easy and convenient for usage. This will soon provide the basis for high quality structures that were cost effective and environmentally safe but, more work is required to improve the feasibility of this technology from both an economical and practical viewpoint.
6. The application of bacterial concrete to construction may also simplify some of the existing construction processes and revolutionize the ways of new construction processes.
7. Used as
 - Repairing of monuments constructed in limestone.
 - Healing of concrete cracks
 - low cost durable roads
 - high strength building
 - river banks
 - low cost durable housing.

CHAPTER-2

LITERATURE REVIEW

2.1 Sakina Najmuddin Saifee et.a¹ published a paper on Critical appraisal on Bacterial Concrete. In this paper they discussed about the different types of bacteria and their applications. The bacterial concrete is very much useful in increasing the durability of cementitious materials, repair of limestone monuments, sealing of concrete cracks to highly durable cracks etc. It is also useful for construction of low-cost durable roads, high strength buildings with more bearing capacity, erosion prevention of loose sands and low-cost durable houses. They have also briefed about the working principle of bacterial concrete as a repair material. It was also observed in the study that the metabolic activities in the microorganisms taking place inside the concrete result into increasing the overall performance of concrete including its compressive strength. This study also explains the chemical process to remediate cracks.

2.2 Meera C M and Dr Subha V², have published a paper on Strength and Durability assessment Of Bacteria Based Self-Healing Concrete. In this paper they have discussed about the effect of *Bacillus subtilis* JC3 on the strength and durability of concrete. They used cubes of sizes 150mm x 150mm x 150mm and cylinders with a diameter of 100mm and a height of 200mm with and without addition of microorganisms, of M20 grade concrete. For strength assessments, cubes were tested for different bacterial concentrations at 7 days and 28 days and cylinders were tested for split tensile strength at 28 days. It was observed that the compressive strength of concrete showed significant increase by 42% for cell concentration of 10^5 of mixing water. And also, with the addition of bacteria there is a significant increase in the tensile strength by 63% for a bacteria concentration of 10^5 cells/ml at 28 days. For durability assessment, acid durability test, chloride test and water absorption test were done. From the results it could be inferred that the addition of bacteria prevents the loss in weight during acid exposure to a certain limit, proving the bacterial concrete to have higher Acid Attack Factor. The Water Absorption Test, showed a lesser increase in weight of bacterial concrete sample than control, from which it could be reckoned that the concrete will become less porous due to the formation of Calcium Carbonate, due to which it resulted in lesser water absorption rate. Chloride test results showed that the

addition of bacteria decreases weight loss, due to Chloride exposure and enhances the Compressive Strength.

2.3 Ravindranatha, N. Kannan, Likhith M. L³ have published a paper on Self-Healing Material Bacterial Concrete. In this paper a comparison study was made with concrete cubes and beams subjected to compressive and flexural strength tests with and without the bacterium *Bacillus pasteurii*. The concrete cubes and beams were prepared by adding calculated quantity of bacterial solution and they were tested for 7 and 28 day compressive and flexural strengths. It was found that there was high increase in strength and healing of cracks subjected to loading on the concrete specimens. The microbe proved to be efficient in enhancing the properties of the concrete by achieving a very high initial strength increase. The calcium carbonate produced by the bacteria has filled some percentage of void volume thereby making the texture more compact and resistive to seepage.

2.4 A.T.Manikandan¹, A.Padmavathi⁴, have published a paper on An Experimental Investigation on Improvement of Concrete Serviceability by using Bacterial Mineral Precipitation. In this paper, the bacteria *Bacillus subtilis* strain 121 was from Microbial Type Culture Collection and Gene Bank, Chandigarh. Samples were prepared in sets of three for a water cement ratio of 0.5 by mass for conventional concrete and a water cement ratio of 0.25 and bacterial culture of 0.25 for bacterial concrete by mass. The cubes were tested by Non-Destructive Testing and HEICO compression testing machine on the 3rd, 7th and 28th days after casting. There was an improvement in compressive strength by *B. subtilis* strain 121 due to deposition of Calcite (CaCO_3) in cement-sand matrix of microbial concrete which remediate the pore structure within the mortar. The temperature sustainability test of *B. subtilis* in bacterial concrete was carried out at various temperatures and found that the *B. subtilis* was found to be alive at – 30 C low temperatures to 700 C high temperatures. There is increase in compressive strength of the bacterial concrete with *B. subtilis* bacteria with microbial calcite precipitation in the crack sample was examined in SEM. The sample showed the presence of calcite crystals grown all over the surface of the crack and also the presence of *B. subtilis* bacteria is the evidence, that suggests microbial remediation properties of bacterial concrete.

2.5 Jagadeesha Kumar B G, R Prabhakara and Pushpa H⁵, published a paper on Effect of Bacterial Calcite Precipitation on Compressive Strength of Mortar Cubes. This paper describes about the experimental investigations carried out on mortar cubes which were subjected to bacterial precipitation by different bacterial strains and influence of bacterial calcite precipitation on the compressive strength of mortar cube on 7, 14 and 28 days of bacterial treatment. Three bacterial strains *Bacillus flexus*, isolated from concrete environment, *Bacillus pasturii* and *Bacillus sphaericus* were used. The cubes were immersed in bacterial and culture

medium for above mentioned days with control cubes immersed in water and was tested for compressive strength. The result indicated that there was an improvement in the compressive strength in the early strength of cubes which were reduced with time. Among the three strains of bacteria, Cubes treated with *Bacillus flexus*, which is not reported as bacteria for calcite precipitation has shown maximum compressive strength than the other two bacterial strains and control cubes. It was studied that the increase in compressive strengths is mainly due to consolidation of the pores inside the cement mortar cubes with micro biologically induced Calcium Carbonate precipitation. The urease activity was determined for all the bacteria in Urease media by measuring the amount of ammonia released from urea according to the phenol hypochlorite assay method. All the three strains of bacteria were tested for urease activity. The change of the colour of the media from yellow to pink indicated that it is urease positive. All the three strains were urease positive. X-ray diffraction analysis was also carried out to determine chemical composition of the precipitation that occurred due to bacterial mineralization.

2.6 RA. B. Depaand T. Felix Kala⁶, have published a paper on Experimental Investigation of Self-Healing Behaviour of Concrete using Silica Fume and GGBFS as Mineral Admixtures. In this paper cubes have been prepared by adding silica fume in percentage of 2.5%, 5%, 7.5%, 10%, 12.5% as a binder in addition to adding cement to concrete and also by replacing 35% and 55% of cement with GGBFS. A conventional mixture without any admixture is cast for comparing the strength and durability properties of silica fume and GGBFS concretes. The specimens are first tested for compressive strength at 28 days, and then 70% and 90% of the compressive load is applied to another set of specimens to generate microcracks for studying the durability properties of the specimens. The preloaded concrete specimens are tested for compressive strength at 7 and 28 days and sorptivity index tests after 28 days. The concrete mix containing cement replaced with 35% GGBFS has given maximum compressive strength value. Further when silica fume is added as mineral admixture, the mix has given maximum strength at 12.5% addition of silica fume.

2.7 Chithra P Bai and Shibi Varghese⁷, have published a paper on an experimental investigation on the strength properties of fly ash based Bacterial concrete. In this paper, the bacteria *Bacillus Subtilis* was used for study with different cell concentrations of 10^3 , 10^5 and 10^7 cells/ml for preparing the bacterial concrete. Cement was partially replaced by 10%, 20% and 30% of fly ash by weight for making the bacterial concrete. Concrete of grade M30 was prepared and tests such as Compressive strength, split tensile strength, Flexural strength and Ultrasonic Pulse Velocity were conducted after 28 and 90 days of water curing. For fly ash concrete, maximum compressive strength, split tensile strength, flexural Strength and Ultrasonic Pulse Velocity values were obtained

for 10% fly ash replacement. For bacterial concrete maximum compressive strength, split tensile strength, flexural strength, and UPV values were obtained for the bacteria cell concentration of 105 cells/ml. The improvement in the strength properties of fly ash concrete is due to the precipitation of calcium carbonate (CaCO_3) in the micro environment by the bacteria *Bacillus Subtilis*.

2.8 V Srinivasa Reddy, M V Seshagiri Rao and S Sushma⁸, have published a paper on Feasibility Study on Bacterial Concrete as an innovative self-crack healing system. This paper describes about the effect of bacterial cell concentration of *Bacillus subtilis* JC3, on the strength, by determining the compressive strength of standard cement mortar cubes of different grades, incorporated with various bacterial cell concentrations. This shows that the Improvement in compressive strength reaches a maximum at about 105/ml cell concentration. The cost of using microbial concrete compared to conventional concrete which is critical in determining the economic feasibility of the technology, is also studied. The cost analysis showed an increase in cost of 2.3 to 3.9 times between microbial concrete and conventional concrete with decrease of grade. And nutrients such as inexpensive, high protein- containing industrial wastes such as corn steep liquor (CSL) or lactose mother liquor (LML) effluent from starch industry can also be used, so that overall process cost reduces dramatically. Precipitation of these crystals inside the gel matrix also enhances the durability of concrete significantly. Furthermore, this analysis has shown an increase in the cost of production and a significant decrease in carbon footprint compared to conventional concrete. MohitGoyal and P. Krishna Chaitanya⁹ published a paper on Behaviour of Bacterial Concrete as Self-Healing Material. In this paper they have carried out laboratory investigations to compare the different parameters of bacterial concrete with ordinary concrete and concrete, in which 70% cement was partially replaced with 30% of Fly Ash and 30% of GGBS. In this paper, *Bacillus pasteurii*, is used to prepare M25 concrete. Various tests such as slump flow test, compressive strength, flexural strength and split tensile strength were conducted for different specimens of, bacterial concentrations of 40ml, 50ml and 60 ml for each specimen. In order to identify atomic and molecular structure and to check the presence of formation of calcium carbonate X- Ray diffraction test was conducted. There was significant improvement of compressive strength by 30% in concrete mix with bacteria and more than 15% in fly ash and 20% in GGBS. It was observed that bacterial concrete achieves maximum split tensile strength and flexural strength when 40 ml and 50 ml bacterial solution was used but loses this trend after 14 days with 60ml bacterial solution when flexural strength test was performed. Also, 50ml bacterial solution proved to be effective in increasing the split tensile strength, compressive strength and flexural strength of the specimen as compared to 40ml and 60 ml bacterial solution. Also, from the XRD analysis, it is proven that the

presence on bacteria is contributing to CaCO₃ production, which has reduced the percentage of air voids, thus, increasing the strength of the structure considerably.

2.9 N. Ganesh Babu and Dr. S. Siddiraju⁹, has published a paper on an experimental study on strength and fracture properties of self-healing concrete. In this paper they have made an attempt is made to arrest the cracks in concrete using bacteria and calcium lactate. The percentages of bacteria selected for the study are 3.5% and 5% by weight of cement. In addition, calcium lactate was used at 5% and 10% replacement of cement by weight. Bacteria produce calcium carbonate crystals which blocks the micro cracks and pores in the concrete after reacting with calcium lactate. *Bacillus pasteurii* is used for different bacterial concentrations for M40 grade of concrete. Various tests such as compressive strength, elastic modulus and fracture of concrete were analysed. The cubes of dimensions of 100x100x100 mm were used for compressive strength test. It was observed that compressive strength for controlled concrete using calcium lactate, at 7 days and 28 days were 19.8 MPa and 40.53 MPa respectively. With the addition of calcium lactate, there is considerable decrease in compressive strength. Compressive strength of concrete with 5% bacteria was found to be 49.5 Mpa at 28 days, which is more than controlled concrete. With the addition of calcium lactate at 10% (optimum percentage) and bacteria to concrete, there is considerable increase in compressive strength. Hence calcium lactate along with 3.5% and 5% bacteria can be used as an effective self-healing agent.

CHAPTER-3

MATERIALS AND TESTS ON MATERIALS

3.1 Materials Used

3.1.1 WATER: -

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water is required to be looked into very carefully. Water should be free from acids, oils, alkalis, vegetables or other organic impurities. Soft water also produces weaker concrete. Water has two functions in a concrete mix. First, it reacts chemically with cement to form a cement paste in which the inert aggregates are held in suspension until the cement paste has hardened. Next, it serves as a vehicle or lubricant in the mixture of fine aggregate and cement. Potable water is generally considered satisfactory. In the present investigation, potable tap water was used for both mixing and curing purposes.

3.1.2 Cement: -

Cement is a fine, grey powder. It is mixed with water and materials such as sand, gravel, and crushed stone to make concrete. The cement and water form a paste that binds the other materials together as the concrete hardens. The ordinary cement contains two basic ingredients namely argillaceous and calcareous. In the present work 53 grade ACC cement was used for casting cubes and beams for all concrete mixes. The cement was of uniform colour i.e. grey with a light greenish shade and was free from any hard lumps and fulfilling the requirements as per IS 12269 -1987.

The chief chemical components of ordinary Portland Cement are:

- 1 Calcium
2. Silica
3. Alumina
4. Iron

Calcium is usually derived from limestone, marl or chalk while silica, alumina and iron come from the sands, clays & iron ores. Other raw materials may include shale, shells and industrial by-products.

Table 3.2.2 Basic Composition

Lime (CaO)	60-67 %
Silica (SiO ₂)	17-25 %
Alumina (Al ₂ O ₃)	3-8 %
Iron Oxide (Fe ₂ O ₃)	0.5-6 %
Magnesia (MgO)	0.1-4 %
Sulphur Trioxide (SO ₃)	1-3 %
Soda and/or Potash (Na ₂ O+K ₂ O)	0.5-1.3 %

3.1.3 Fine Aggregate: -

The sand used for the experimental works was locally procured and conformed to grading zone II. Sieve Analysis of the Fine Aggregate was carried out in the laboratory as per IS383-1970.

3.1.4 Coarse Aggregate: -

Crushed basalt stones obtained from local quarries were used as coarse aggregate. The maximum size of coarse aggregate used was 20 mm. The properties of coarse aggregate were determined by conducting tests as per IS: 2386 (Part – III).

3.1.5 Bacillus Subtilis Bacteria: -

Bacillus subtilis will be brought up in its log phase in concreting site in liquid or aqueous state. This stage is having bacterial concentration 2×10^8 cells/ml. This full-grown stage is aimed to last for 2 to 3 hours at room temperature. These bacteria should be impregnated in concrete in its full-grown stage.

Bacillus subtilis is considered the best studied Grampositive bacterium and a model organism to study bacterial chromosome replication and cell differentiation.

Table 3.2.5 Basic Description of Bacteria

Bacteria Name	<i>Bacillus spp</i>
Specific gravity	1.09
Cell count	2×10^8 cells/ml.
pH	6.9

3.2 Tests on Materials:

3.2.1 Tests on Cement:

1. Setting Time
2. Specific Gravity
3. Normal Consistency
4. Physical Examination

1. SETTING TIME

When cement is mixed with water, it hydrates and makes cement paste. This paste can be moulded into any desired shape due to its plasticity. Within this time cement continues with reacting water and slowly cement starts losing its plasticity and set harden. This complete cycle is called Setting time of cement.

Initial Setting time of Cement:-

The time to which cement can be moulded in any desired shape without losing its strength is called Initial setting time of cement.

Final setting time of Cement:-

The time at which cement completely loses its plasticity and becomes hard is a final setting time of cement.

Calculation of Initial and Final Setting time of Cement:-

As Per **IS: 4031 (Part 5) – 1988**. Initial and final setting time of cement is calculated using VICAT apparatus conforming to IS: 5513 – 1976.

Apparatus Required:-

Weighing balance of 1000g with accuracy 1g and Measuring cylinder of 200ml, VICAT apparatus, VICAT Mould, Glass plate, the plunger of 10mm dia and Hand Trowel, stop watch.

TESTING PROCEDURE:

1. Take 400g of cement and place it in a bowl or tray.
2. Now add water of Start the stopwatch at the moment water is added to the cement. Water of quantity $0.85P$ times (Where P is the standard normal consistency)is considered.
3. Now fill the mix in Vicat mould. If any excessive paste remained on Vicat mould is taken off by using a trowel.
4. Then, place the VICAT mould on non-porous plate (Glass plate) and see that the plunger should touch the surface of VICAT mould gently.
5. Release the Plunger and allow it to sink into the test mould.
6. Note down the penetration of the plunger from the bottom of mould indicated on the scale.
7. Repeat the same experiment at different positions on the mould until the plunger should stop penetrating 5 from the bottom of the mould.

The time period elapsed between the moment water is added to the cement and the time, the needle fails to penetrate the mould of 5mm when measured from the bottom of the mould, is the initial setting time of cement.

Now replace the needle (plunger) by the one with an annular attachment. The cement is assumed as finally set When, upon applying the needle gently to the surface of the test mould, the needle makes an impression therein, while the attachment fails to do so. The time period between the moment water is added to the cement and the time at which needle makes an impression on the surface of the mould, while the attachment fails to do so, is **the final setting time of cement.**

OBSERVATIONS:

Time at which water is first added to cement, $t_1 = 3.02$ Minutes.

- Time when needle fails to penetrate 5mm to 7mm from bottom of the mould, $t_2 = 46.02$ Minutes.
- Time when needle makes an impression but the attachment fails to do so, $t_3 = 603.02$ Minutes

Initial setting time = $t_2 - t_1 = 46.02 - 3.02 = 43.02$ Minutes

Final setting time = $t_3 - t_1 = 603.02 - 3.02 = 599$ Minutes.

RESULT:

- Initial setting time of cement = **43.02 Mints.**
- Final setting time of cement = **599 Mints.**

CONCLUSION:

- ❑ As per the recommended values for initial setting time is 30 minutes and final setting time is 600minutes.
- ❑ As per IS code 12269, our material is satisfactory.

2. SPECIFIC GRAVITY

What is Specific Gravity?

Specific Gravity is the ratio of a Weight of Volume of material (Your testing material) to the same Weight of Volume of water. In simple words, we are comparing the volume of our Testing material either it may be sand, cement, aggregate with the same volume of water at certain temperature.

Specific gravity test /Density of Cement test :

As per Le Chatelier's Principle, Specific gravity of cement is determined by Le Chatelier's Flask method. And the IS code for Specific gravity test is **IS 2720- Part 3.**

Apparatus Required for Le Chatelier's Principle:-

1. Cement
2. Kerosene
3. Specific Gravity Bottle capacity of 250 ml with stopper.
4. Weighing balance with 0.1 gm accurate

Why is kerosene used in the Specific gravity of cement test?

In general, to calculate the specific gravity of material, we use water. But in cement, we use kerosene for finding specific gravity in it. The reason behind this, cement hydrates and forms calcium oxide when it reacts with water. Cement won't show any reaction when it mixed with kerosene.

Procedure for finding Specific gravity in cement:-

1. The Lechatlier flask should be free from moisture content, that mean flask is thoroughly dried.
2. Now, weigh the empty flask and note it as W_1 .
3. Take 50gm of cement and add it in Flask. Now weight the Flask with the stopper as W_2
4. Now pour kerosene in the sample up to the neck of the bottle. Mix thoroughly and see that no air bubbles left in the flask. Note down the weight as W_3
5. Empty the flask and fill the bottle with kerosene up to the tip of the bottle and record the weight as W_4 .

OBSERVATIONS AND RESULTS:

S.NO.	PARTICULARS	DETERMINATION NUMBER	
		1	2
1.	Density bottle no.	S-1	S-3
2.	Mass of empty density bottle (W1)	0.024	0.024
3.	Mass of bottle and dry cement (W2)	0.032	0.032
4.	Mass of bottle, cement and kerosene (W3)	0.070	0.071
5.	Mass of bottle filled with kerosene (W4)	0.064	0.065
6.	W2 – W1	0.008	0.008
7.	W3 – W4	0.006	0.006
8.	calculate Sg using formula	3.16	3.16
	AVERAGE VALUE	3.16	

Table 4 Specific Gravity of Cement

FORMULA USED:

$$Sg = \left\{ \frac{W2 - W1}{(W2 - W1) - (W3 - W4)} * 0.79 \right\}$$

RECOMMENDED VALUES:

- specific Gravity of Cement = 3.15

RESULT:

Specific gravity of the given cement is = 3.16

3. Normal Consistency

The **Consistency of cement test** is performed to determine the amount of water content that is to be added in cement to attain Standard consistency or normal consistency of cement.

OR

Amount of water added in cement to penetrate the **Vicat plunger up to a depth of 5-7mm** from the bottom of the **Vicat mould** or **33-35mm** from top of the Vicat Mould

Apparatus required:-

Weighing balance of 1000g with accuracy 1g and Measuring cylinder of 200ml, VICAT apparatus, VICAT Mould, Glass plate, the plunger of 10mm dia and Hand Trowel.

Procedure:-

1. Take 400g of cement and place it in a bowl or tray.
2. Now Assume standard consistency of water is 28% and add the same quantity of water in cement and mix it.
3. Mix the paste thoroughly within 3-5 minutes. The time taken to obtain cement paste after adding water is called gauging time.
4. Now fill the paste in Vicat mould correctly any excessive paste remained on Vicat mould is taken off by using a trowel.
5. Then, place the VICAT mould on Glass plate and see that the plunger should touch the surface of VICAT mould gently.
6. Release the Plunger and allow it to sink into the test mould.
7. Note down the penetration of the plunger from the bottom of mould indicated on the scale.
8. Repeat the same experiment by adding different percentages of water until the reading is in between 5-7mm on the Vicat apparatus scale.

OBSERVATION:

- Weight of cement taken (g)= 400gm
- Initial percentage of water added to cement = 25%
- Quantity of water added to cement = 100

Table 5:Normal Consistency

S.No.	QUANTITY OF WATER ADDED (ml)	DEPTH OF PENETRATION (mm)
1.	100	34
2.	108	30
3.	112	11
4.	116	7

RESULT:

Percentage of water content for standard consistency = **29%**

CONCLUSION:

- Generally, the normal consistency for cement ranges from 26 to 33%.
- Therefore, as per IS 4031 code our material is satisfactory.

4. PHYSICAL EXAMINATION:

- i. **Color Test of Cement:** The color of the cement should be uniform. It should be grey colour with a light greenish shade.
- ii. **Presence of Lumps:** The cement should be free from any hard lumps. Such lumps are formed by the absorption of moisture from the atmosphere. Any bag of cement containing such lumps should be rejected.
- iii. **Cement Adulteration Test:** The cement should feel smooth when touched or rubbed in between fingers. If it is felt rough, it indicates adulteration with sand
- iv. **Temperature Test of Cement:** If hand is inserted in a bag of cement or heap of cement, it should feel cool and not warm.
- v. **Float Test:** If a small quantity of cement is thrown in a bucket of water, the particles should float for some time before it sinks.
- vi. **Date of Packing:** Strength of cement reduces with time, so it is important to check the manufacturing date of the cement. Generally, the cement should be used before 90 days from the date of manufacturing.

3.2.2 TESTS CONDUCTED ON COARSE AGGREGATES

1. CRUSHING VALUE TEST
2. LOS ANGELES ABRASION TEST
3. IMPACT TEST
4. SHAPE TESTS
5. SPECIFIC GRAVITY

CRUSHING VALUE TEST:

The objective of this test is to:

1. Determine the aggregate crushing value of coarse aggregate
2. Assess suitability of coarse aggregates for use in different types of road

Apparatus

1. A steel cylinder 15 cm diameter with plunger and base plate.
2. A straight metal tamping rod 16mm diameter and 45 to 60cm long rounded at one end.
3. A balance of capacity 3 kg readable and accurate to one gram.
4. IS sieves of sizes 12.5mm, 10mm and 2.36mm
5. A compression testing machine.
6. Cylindrical metal measure of sufficient rigidity to retain its form under rough usage and of 11.5cm diameter and 18cm height.
7. Dial gauge

Procedure of Aggregate Crushing Value Test

1. Put the cylinder in position on the base plate and weigh it (**W**).
2. Put the sample in 3 layers, each layer being subjected to 25 strokes using the tamping rod. Care being taken in the case of weak materials not to break the particles and weigh it (**W1**).
3. Level the surface of aggregate carefully and insert the plunger so that it rests horizontally on the surface. Care being taken to ensure that the plunger does not jam in the cylinder.

4. Place the cylinder with plunger on the loading platform of the compression testing machine.
5. Apply load at a uniform rate so that a total load of 40T is applied in 10 minutes.
6. Release the load and remove the material from the cylinder.
7. Sieve the material with 2.36mm IS sieve, care being taken to avoid loss of fines.
8. Weigh the fraction passing through the IS sieve (W2).

Calculation of Aggregate Crushing Value

The ratio of weight of fines formed to the weight of total sample in each test shall be expressed as a percentage, the result being recorded to the first decimal place.

$$\text{Aggregate crushing value} = (W2 \times 100) / (W1 - W)$$

Observation Table:

PARTICULARS	SAMPLE 1	SAMPLE 2
Empty weight of cylinder with base plate =W gm	3.780	3.780
Total weight of dry sample + cylinder = W1 gm	6.685	6.55
Weight of portion passing 2.36mm sieve =W2 gm	0.880	0.720
Aggregate crushing value = ((W2)/(W1-W)) *100 (percent)	30.29	25.99

Table 6:Crushing Value Test on Coarse Aggregate

RESULT:

The crushing value of given sample = **28.14%**

CONCLUSION: Coarse aggregates are suitable for flexible as well as rigid pavement.

II. LOS ANGELES ABRASION TEST

Los Angeles abrasion test on aggregates is the measure of aggregate toughness and abrasion resistance such as crushing, degradation and disintegration.

The Los Angeles abrasion test on aggregates are done for following purpose:

1. To determine the Los Angeles abrasion value.
2. To find the suitability of aggregates for use in road construction.

Apparatus for Los Angeles Test

The apparatus as per IS: 2386 (Part IV) – 1963 consists of:

1. Los Angeles Machine
2. Abrasive charge: Cast iron or steel balls, approximately 48mm in diameter and each weighing between 390 to 445 g; six to twelve balls are required.
3. Sieve: 1.70, 2.36, 4.75, 6.3, 10, 12.5, 20, 25, 40, 50, 63, 80 mm IS Sieves.
4. Balance of capacity 5 kg or 10 kg
5. Drying oven
6. Miscellaneous like tray.

Procedure for Los Angeles Test

The test sample consists of clean aggregates dried in oven at 105° – 110°C. The sample should conform to any of the gradings shown in table 1.

1. Select the grading to be used in the test such that it conforms to the grading to be used in construction, to the maximum extent possible.
2. Take 5 kg of sample for gradings A, B, C & D and 10 kg for gradings E, F & G.
3. Choose the abrasive charge as per Table 2 depending on grading of aggregates.
4. Place the aggregates and abrasive charge on the cylinder and fix the cover.

5. Rotate the machine at a speed of 30 to 33 revolutions per minute. The number of revolutions is 500 for gradings A, B, C & D and 1000 for gradings E, F & G. The machine should be balanced and driven such that there is uniform peripheral speed.
6. The machine is stopped after the desired number of revolutions and material is discharged to a tray.
7. The entire stone dust is sieved on 1.70 mm IS sieve.
8. The material coarser than 1.7mm size is weighed correct to one gram.

Observational Result:

PARTICULARS	SAMPLE 1	SAMPLE 2
Total weight of dry sample taken = W1 gm	5000	5000
Weight of portion passing 1.7 mm sieve = W2 gm	755	865
Aggregate abrasion value = $(W2/W1) * 100$ (percent)	15.1	17.3

Table 7: Los Angeles Abrasion Test

RESULT:

Los Angeles Abrasion Value = 16.2%

IV IMPACT VALUE TEST

The property of a material to resist impact is known as toughness. Due to movement of vehicles on the road the aggregates are subjected to impact resulting in their breaking down into smaller pieces.

The aggregate impact value is a measure of resistance to sudden impact or shock, which may differ from its resistance to gradually applied compressive load.

Procedure of Aggregate Impact Test:

The test sample consists of aggregates sized 10.0 mm 12.5 mm. Aggregates may be dried by heating at 100-110° C for a period of 4 hours and cooled.

- (i) Sieve the material through 12.5 mm and 10.0mm IS sieves. The aggregates passing through 12.5mm sieve and retained on 10.0mm sieve comprises the test material.
- (ii) Pour the aggregates to fill about just 1/3 rd depth of measuring cylinder.
- (iii) Compact the material by giving 25 gentle blows with the rounded end of the tamping rod.
- (iv) Add two more layers in similar manner, so that cylinder is full.
- (vi) Determine the net weight of the aggregates to the nearest gram(W).
- (vii) Bring the impact machine to rest without wedging or packing up on the level plate, block or floor, so that it is rigid and the hammer guide columns are vertical.
- (viii) Fix the cup firmly in position on the base of machine and place whole of the test sample in it and compact by giving 25 gentle strokes with tamping rod.
- (ix) Raise the hammer until its lower face is 380 mm above the surface of aggregate sample in the cup and allow it to fall freely on the aggregate sample.

Give 15 such blows at an interval of not less than one second between successive falls.

(x) Remove the crushed aggregate from the cup and sieve it through 2.36 mm IS sieves until no further significant amount passes in one minute. Weigh the fraction passing the sieve to an accuracy of 1 gm. Also, weigh the fraction retained in the sieve.

Compute the aggregate impact value. The mean of two observations, rounded to nearest whole number is reported as the Aggregate Impact Value.

Observational Table:

PARTICULARS	SAMPLE 1	SAMPLE 2
Total weight of dry sample taken = W1 kg	0.325	0.346
Weight of portion passing 2.36 mm sieve = W2 kg	0.055	0.070
Aggregate impact value = $(W2/W1) * 100$ (percent)	16.92	20.23

Table 8: Impact value test on coarse aggregate

RESULT:

Aggregate Impact Value = **18.58%**

CONCLUSION:

- As Per BS 812 value ranges between 10 -20%, hence strong quality of aggregate.

V Shape Tests on Coarse Aggregates:

Following tests are conducted on coarse aggregates under shape tests:

- The elongation index of the given aggregates.
- The flakiness index of the given aggregates.

The particle shape of aggregates is determined by the percentages of flaky and elongated particles contained in it. For base course and construction of bituminous and cement concrete types, the presence of flaky and elongated particles are considered undesirable as these causes inherent weakness with possibilities of breaking down under heavy loads.

Thus, evaluation of shape of the particles, particularly with reference to flakiness and elongation is necessary.

The Elongation index of an aggregate is the percentage by weight of particles whose greatest dimension (length) is greater than nine-fifths (1.8times) their mean dimension. This test is not applicable for sizes smaller than 6.3mm.

Procedure of Shape Tests on Coarse Aggregates:

- 1 Sieve the sample through the IS sieves (as specified in the table).
- 2 Take a minimum of 200 pieces of each fraction to be tested and weigh them.
- 3 To separate the flaky materials, gauge each fraction for thickness on a thickness gauge. The width of the slot used should be of the dimensions specified in column (4) of the table for the appropriate size of the material.
- 4 Weigh the flaky material passing the gauge to an accuracy of at least 0.1 per cent of the test sample.
- 5 To separate the elongated materials, gauge each fraction for length on a length gauge. The width of the slot used should be of the dimensions specified in column (6) of the table for the appropriate size of the material.
- 6 Weigh the elongated material retained on the gauge to an accuracy of at least 0.1 per cent of the test sample.

Observational table :

SIZE OF AGGREGATE		THICKNESS GUAGE SIZE, (mm)	WEIGHT OF FRACTION CONSISTING OF ATLEAST 200 PIECES , g(W)	WEIGHT OF AGGREGATES IN EACH FRACTION PASSING THICKNESS GUAGE, mm (X)
PASSING THROUGH IS SIEVE, mm	RETAINED ON IS SIEVE, mm			
20	16	10.80	0.320	0.060
16	12.5	8.55	0.585	0.105
12.5	10	6.75	0	0
10	6.3	4.89	0.005	0.001

Table 9:Flakiness Index

a. FLAKINESS INDEX

$$\text{FLAKINESS INDEX} = \frac{(X / W)}{100} * 100 = \frac{(0.166 / .910)}{100} * 100 = 18.24\%$$

RESULT:

$$\text{THE FLAKINESS INDEX} = 18.24\%$$

As Per IS:2386(Part I) the limits are within standard limits for use as building material

b. ELONGATION INDEX:

SIZE OF AGGREGATE		THICKNESS GUAGE SIZE, (mm)	WEIGHT OF FRACTION CONSISTING OF ATLEAST 200 PIECES, g(W)	WEIGHT OF AGGREGATES IN EACH FRACTION RETAINED ON LENGTH GUAGE, mm (X)
PASSING THROUGH IS SIEVE, mm	RETAINED ON IS SIEVE, mm			
20	16	32.4	0.320	0.292
16	10	25.6	0.585	0.480
10	4.75	20.2	0.005	0.006

Table 10:Elongation Index

FORMULA: $(Y/W) * 100 = (0.778/.910) * 100 = 85.49\%$

Elongation index = $(100 - 85.49) = 14.51\%$

RESULT:

Elongation index = 14.51%

As Per IS:2386(Part I) the limits are within standard limits for use as building material

VI: Specific Gravity:

Specific gravity test of aggregates is done to measure the strength or quality of the material while water absorption test determines the water holding capacity of the coarse and fine aggregates.

Specific Gravity is the ratio of the weight of a given volume of aggregate to the weight of an equal volume of water. It is the measure of strength or quality of the specific material. Aggregates having low specific gravity are generally weaker than those with higher specific gravity values.

The main objective of these test is to:

- 1.To measure the strength or quality of the material.
- 2.To determine the water absorption of aggregates.

PROCEDURE OF SPECIFIC GRAVITY:

There are three methods of testing for the determination of the specific gravity of aggregates, according to the size of the aggregates larger than 10 mm, 40 mm and smaller than 10 mm. For Samples larger than 10 mm, 40 mm, the below given test method is used and for samples smaller than 10 mm Pycnometer test is done.

Apparatus Required:

1. A balance of capacity about 3kg, to weigh accurate 0.5g, and of such a type and shape as to permit weighing of the sample container when suspended in water.
2. A thermostatically controlled oven to maintain temperature at 100-110° C.
3. A wire **basket of not** more than 6.3 mm mesh or a perforated container of convenient size with thin wire hangers for suspending it from the balance.
4. A container for filling water and suspending the basket
5. An air tight container of capacity similar to that of the basket
6. A shallow tray and two absorbent clothes, each not less than 75x45cm.

Procedure

1. About 2 kg of aggregate sample is washed thoroughly to remove fines, drained and placed in wire basket and immersed in distilled water at a temperature between 22- 32° C and a cover of at least 5cm of water above the top of basket.
2. Immediately after immersion the entrapped air is removed from the sample by lifting the basket containing it 25 mm above the base of the tank and allowing it to drop at the rate of about one drop per second. The basket and aggregate should remain completely immersed in water for a period of 24 hour afterwards.
3. The basket and the sample are weighed while suspended in water at a temperature of 22° – 32°C. The weight while suspended in water is noted = W_1g .
4. The basket and aggregates are removed from water and allowed to drain for a few minutes, after which the aggregates are transferred to the dry absorbent clothes. The empty basket is then returned to the tank of water jolted 25 times and weighed in water= $W_2 g$.
5. The aggregates placed on the absorbent clothes are surface dried till no further moisture could be removed by this cloth. Then the aggregates are transferred to the second dry cloth spread in single layer and allowed to dry for at least 10 minutes until the aggregates are completely surface dry. The surface dried aggregate is then weighed = $W_3 g$

Observations of Test

Weight of saturated aggregate suspended in water with basket = W_1g

Weight of basket suspended in water = $W_2 g$

Weight of saturated surface dry aggregate in air = W_3g

Formulas:

$$(1) \text{ Specific gravity} = W_3 / (W_3 - (W_1 - W_2))$$

RESULT:

The specific gravity of coarse aggregates: 2.67

Within IS LIMITS

3.3.3 Tests conducted on Fine Aggregate:

I. SIEVE ANALYSIS

II.SPECIFIC GRAVITY

I. Sieve Analysis:

Fineness Modulus of Aggregates:

Fineness modulus is only a numerical index of fineness, giving some idea of the mean size of the particles in the entire body of the aggregate.

To a certain extent it is a method of standardization of the grading of the aggregate. It is obtained by adding the percentage weight of material retained in each of the standard sieves and dividing it by 100.

The objective of finding the fineness modulus is to grade a given aggregate for the most economical mix and workability with minimum quantity of cement.

Apparatus for Grain Size Analysis

Indian standard test sieves, weighing balance ,sieve shaker etc .

1. For fine aggregate- 4.75mm, 2.36mm, 1.18mm, 600 microns, 300 microns, 150 microns.

Procedure of Grain Size Analysis of Aggregates:

For Fine Aggregates

1. Take one kg of sand from the laboratory sample
2. Arrange the sieves in order of IS sieves no's 480, 240, 120, 60, 30 and 15, Keeping sieve no.480 at the top and 15 at the bottom and cover the top.
3. Keep the sample in the top sieve no.480.
4. Carry out the sieving in the set of sieves for not less than 10 minutes.
5. Find the weight of sample retained in each sieve.
6. Tabulate the values in given tabular column .

Observations and Results:

IS SIEVE SIZE	WEIGHT RETAINED (Kg)	CUMMULATIVE WEIGHT RETAINED (Kg)	% WEIGHT RETAINED	% CUMULATIVE WEIGHT	% FINER
4.75mm	0.0265	0.0265	2.65	2.65	97.35
2.36mm	0.0305	0.057	3.05	5.7	94.30
1.18mm	0.121	0.178	12.1	17.8	82.20
600 microns	0.238	0.416	23.8	41.6	58.40
300 microns	0.367	0.783	36.7	78.35	21.65
150 microns	0.153	0.936	15.3	93.65	6.35
Pan	0.0165	0.950	1.65	95.3	4.7

Table 11:Sieve Analysis

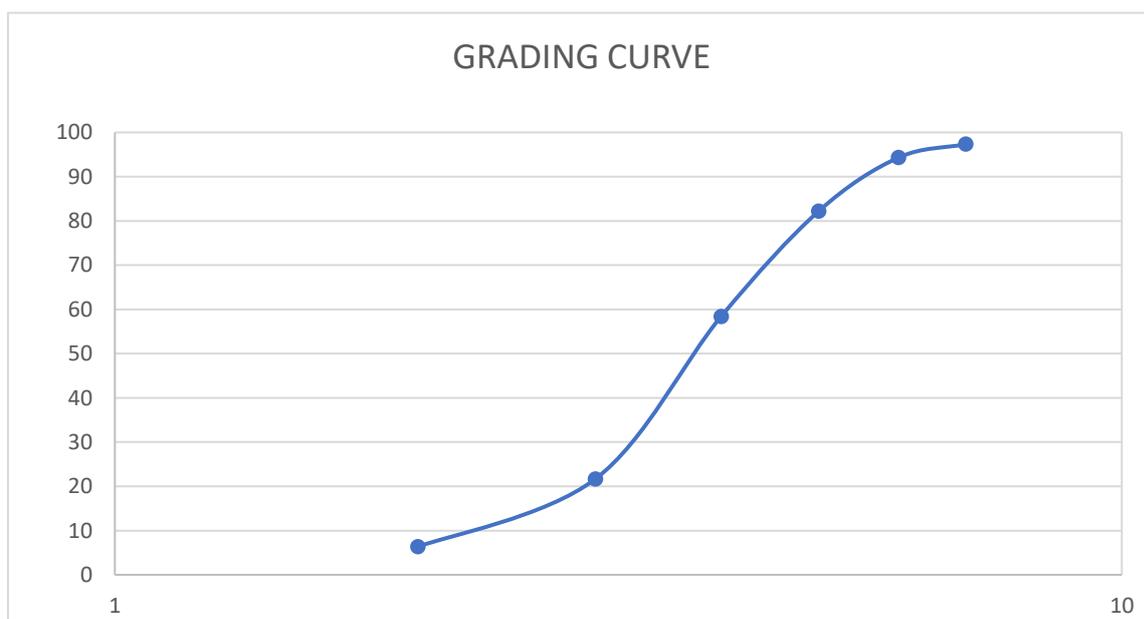


FIG 2:GRADING CURVE

Formula used:

Fineness modulus (Sum of cumulative % wt. retained /100)

RESULT:

Fineness modulus = 2.39

CONCLUSION:

As per recommended value for Fineness Modulus of fine aggregate is 2.0 - 3.5 mm.

Therefore, we got the value of 2.39.

As per IS code 490:2000 our material is satisfactory.

II. Specific Gravity:

Specific gravity of fine aggregate (sand) is the ratio of the weight of given volume of aggregates to the weight of equal volume of water.

Apparatus for Specific Gravity Test

1. A balance of capacity not less than 3kg ,readable and accurate to 0.5 gm and of such a type as to permit the weighing of the vessel containing the aggregate and water .
2. A well-ventilated oven to maintain a temperature of 100°C to 110°C
3. Pycnometer of about 1 litre capacity having a metal conical screw top with a 6mm hole at its apex . The screw top shall be watertight .
4. A means supplying a current warm air .
5. A tray of area not less than 32cm².
6. An airtight container large enough to take the sample.
7. Filter papers and funnel.

Procedure of Test

1. Take about 1/3rd of sample and place it in the pycnometer.(W2)
2. Pour distilled water into it until it is full.(W3)
3. Eliminate the entrapped air by rotating the pycnometer on its side ,the hole in the apex of the cone being covered with a finger.
4. Wipe out the outer surface of pycnometer and weigh it (W1)
5. Transfer the contents of the pycnometer into a tray, care being taken to ensure that all the aggregate is transferred .
6. Refill the pycnometer with distilled water to the same level .
7. Find out the weight (W4)
8. Drain water from the sample through a filter paper .
9. Place the sample in oven in a tray at a temperature of 100°C to 110° C for 24±0.5 hours ,during which period ,it is stirred occasionally to facilitate drying .
- 10.Cool the sample and weigh it (W2)

Observations and Results:

S.No.	PARTICULARS	SAMPLE
1.	Weight of empty pycnometer, W1 kgs	0.588
2.	Weight of 1/3 rd of sand + pycnometer, W2 kgs	0.972
3.	Weight of 1/3 rd of sand + pycnometer and water, W3 kgs	1.664
4.	Weight of water and pycnometer and water, W4 kgs	1.422
5.	W2-W1	0.384
6.	W3-W4	0.242

Table 12:Specific Gravity of Fine aggregate

RESULT:

The specific gravity of sand = 2.7

The specific gravity of sands is considered to be around **2.65**.

.....

CHAPTER-4

METHODOLOGY AND EXPERIMENTAL RESULTS

4.1 Design Mix:

The concrete of Grade M₂₅ Was designed as per IS 10262:2009

The Steps of design are as follows:

Step 1: Target Strength for Mix Purporting

$$f_{ck}': f_{ck} + 1.65 * S$$

$$25 + (1.65 * 4)$$

$$31.6 \text{ N/mm}^2$$

For S refer IS 10262:2009 clause 3.2.1.2 Table No 1 Page no 2

Step 2: Selection of Water/cement Ratio :

Referring IS 10262:2009 Clause 4.1 page no 2

The maximum water cement shall be taken from table No 5 IS 490:2009 page 20

$$=.45$$

Step 3: Selection of Water Content:

Referring IS 10262:2009 clause 4.2 table No 2 page 3

$$\text{Water Required for } 1\text{m}^3 = 197 \text{ lit}$$

Step 4: Calculation of Cement Content

$$(197/.45)=438 \text{ kg/m}^3$$

Which is greater than the minimum cement content required as per table No.4 of IS 490-2000

Step 5: Proportioning of Volume of Course Aggregate(CA) and Fine Aggregate(FA):

From IS 10262:2009 clause 4.4.1 & table no 3, Page no 3

For .45=.61

Volume of CA=.61

Volume of FA=1-.61=.39

Step 6: Mix Calculations

a) Volume of Concrete= 1m^3

b) Volume of Cement =(Mass of Cement/Specific gravity of Cement)*(1/1000)
 $(438/3.16)*(1000^{-1})=.138\text{m}^3$

c) Volume of Water =(Mass of Water/Sg of water)*(1/1000)
 $=197/1000 =.197\text{m}^3$

d) Volume of all aggregates
 $=(a-(b+c))$
 $(1-(.138+.197))$
 $=.665\text{m}^3$

e) Mass of CA =e*Vol of CA*Sg of CA*1000
 $=(0.665*0.61*2.67*1000)$
 $=1083.086 \text{ Kg}$

f) Mass of FA= e*Vol of FA*Sg of FA*1000

$$=(0.665*0.39*2.7*1000)$$

$$= 700.245 \text{ Kg}$$

g) Ratio Cement: Fine Aggregate:Coarse Aggregate

$$=438:700.245:1083.086$$

$$=1:1.6:2.47$$

• **4.2 Compressive Strength: -**

Test result for 7,14,18 and 90 days for Bacterial Concrete the cube moulds of size 150mm x 150mm x 150mm were cleaned and checked against the joint movement. A coat of oil was applied on the inner surface of the moulds and unbroken prepared for the concreting operation. Meantime the specified quantities of cement, fine mixture and coarse mixture (passing through IS sieve of 20mm size and maintained on 4.75 mm) for the actual combine were weighed accurately for concreting. Fine mixture and cement were mixed completely in an exceedingly hand mixer specified the colour of the mixture is uniform. Then, weighed amount of coarse mixture were further mixed until uniform dry mixture is obtained. Then, calculated amount of microorganism and water were further added and compounding were continuing for three to five minutes to obtain a regular combine. The wet concrete was poured into the moulds in a pair of three layers and compacted manually. Once concreting operations, the upper surface was levelled and finished with a mason's trowel. The corresponding identification marks were labelled over the finished surface and that they were be tested for 7,14,28 days and 90-day strengths in an exceedingly compressive strength testing machine.

OBSERVATION TABLE

PEAK STRESS(MPA)	7 DAYS	14 DAYS	28 DAYS	90 DAYS
CODE	AVG	AVG	AVG	AVG
NORMAL	28.05	29.09	33.2	35.05
CONCENTRATION I (30ML/Litre of Water)	34.3	37.3	39.95	42.83
CONCENTRATION II (45ML/Litre of Water)	34.8	38.3	42.0	43.53
CONCENTRATION III (60ML/Litre of Water)	37.4	38.91	44.06	45.85

TABLE 13:COMPRESSIVE STRENGTH

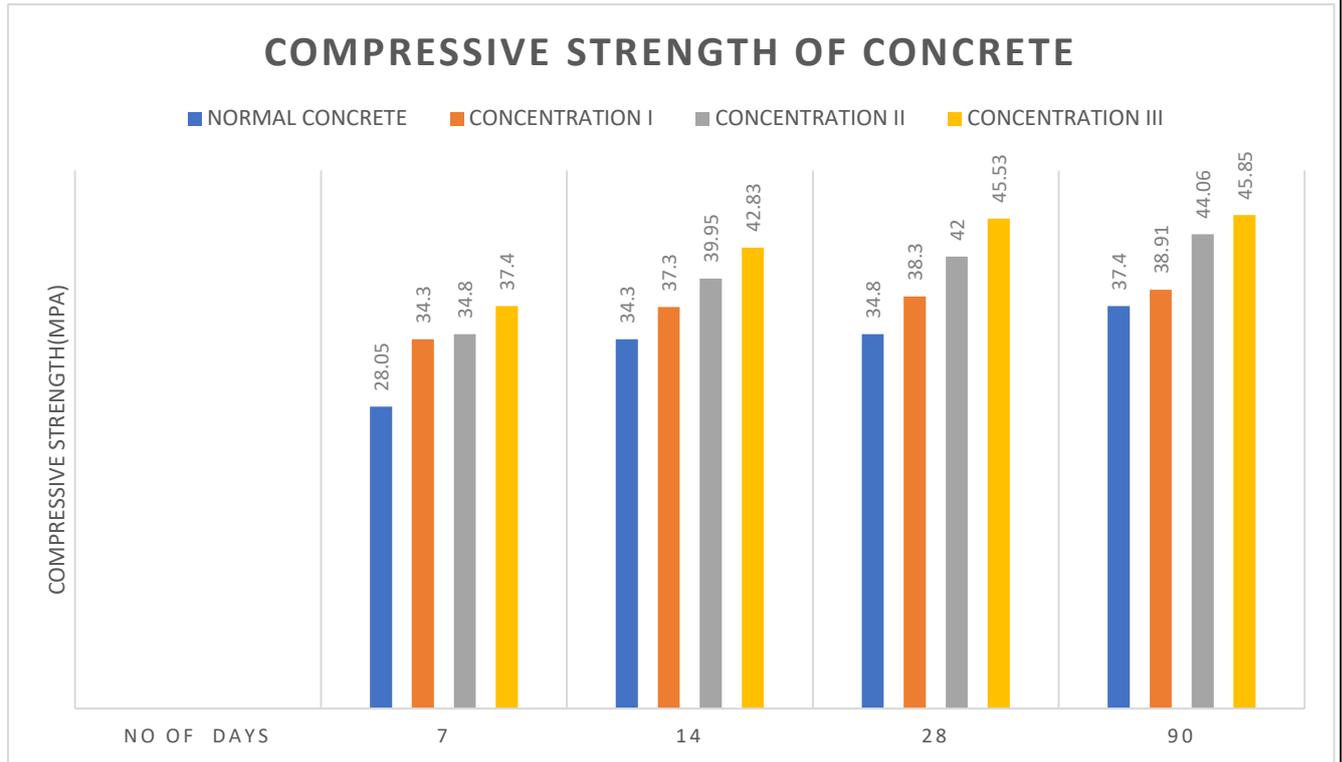


FIG 3: Compressive Strength Bar Chart

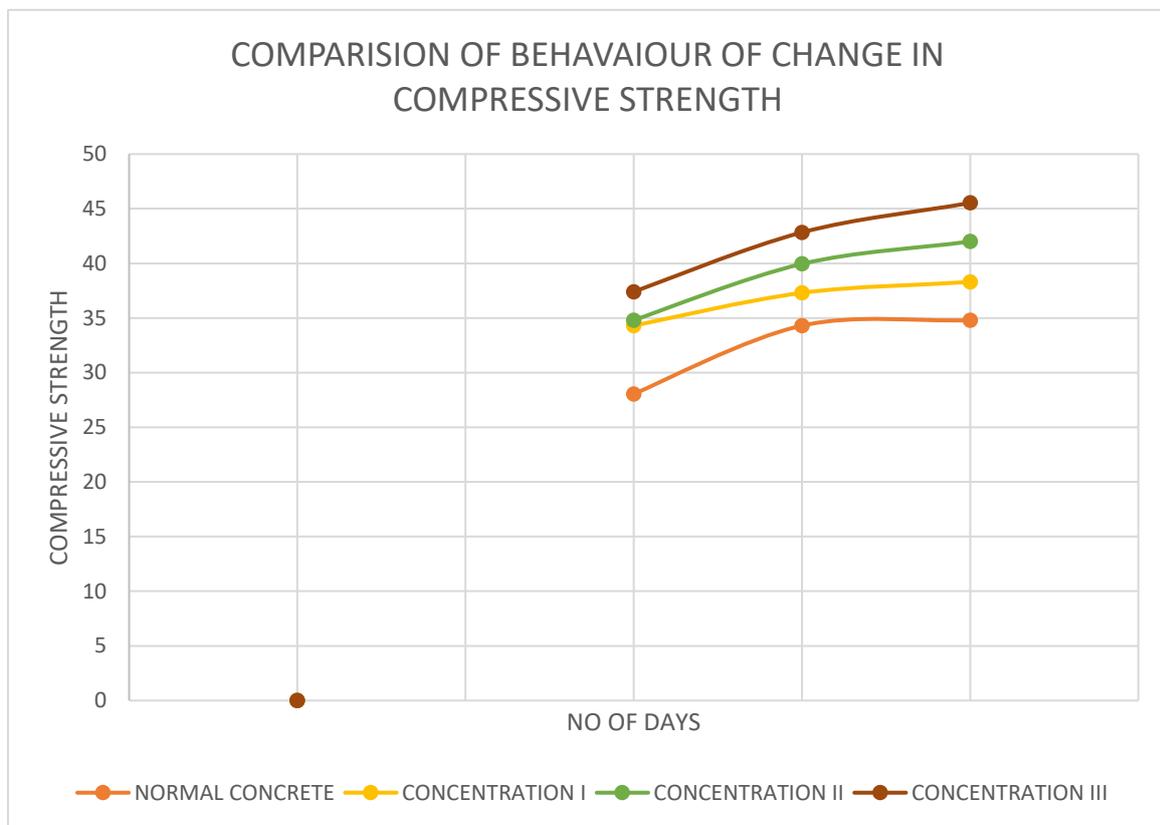


FIG 4: Comparison of behaviour of change in compressive strength

4.3 Flexural Strength Test result for 7,14,28 and 90 days for Bacterial Concrete: -

Moulds of 10cm x 10cm x 50cm were employed and therefore the Moulds were cleaned and therefore the joints between the sections of Moulds shall be thinly coated with oil and the same coating of oil shall be applied between the contact surfaces of all sides of the Moulds and the base plate so as to confirm that no water escapes throughout the filling. the inside faces of the assembled Moulds shall be thinly coated with Moulds oil to stop adhesion of the concrete. Meantime the desired quantities of cement, fine combination and corresponding coarse combination for the actual combine were weighed accurately for concreting. Fine combination and cement were mixed totally in a hand mixer such that the colour of the mixture was uniform. Then, weighed amount of coarse combination were added to the mixer so it turns into a uniform dry mixture. Then, calculated amount of water and microorganism were added and intermixture was continuing for concerning three to five minutes to urge a consistent combine. The wet concrete was poured into the Moulds in two to three layers and compacted manually. once concreting operations is over, the upper surface was levelled and finished with a mason's trowel. The corresponding identification marks were labelled over the finished surface and therefore the beams were tested for 7,14,28 and 90 days' strengths.

Observation Table

FLEXURAL STRENGTH N/mm²	7 DAYS	14 DAYS	28 DAYS	90 DAYS
NORMAL	7.95	8.00	8.02	8.4
CONCENTRATION I (30ML/Litre of Water)	8.06	8.31	8.50	8.55
CONCENTRATION II (45ML/Litre of Water)	9.1	9.33	9.52	9.77
CONCENTRATION III (60ML/Litre of Water)	10.30	10.50	10.55	10.82

Table 14 Flexural Strength of Concrete

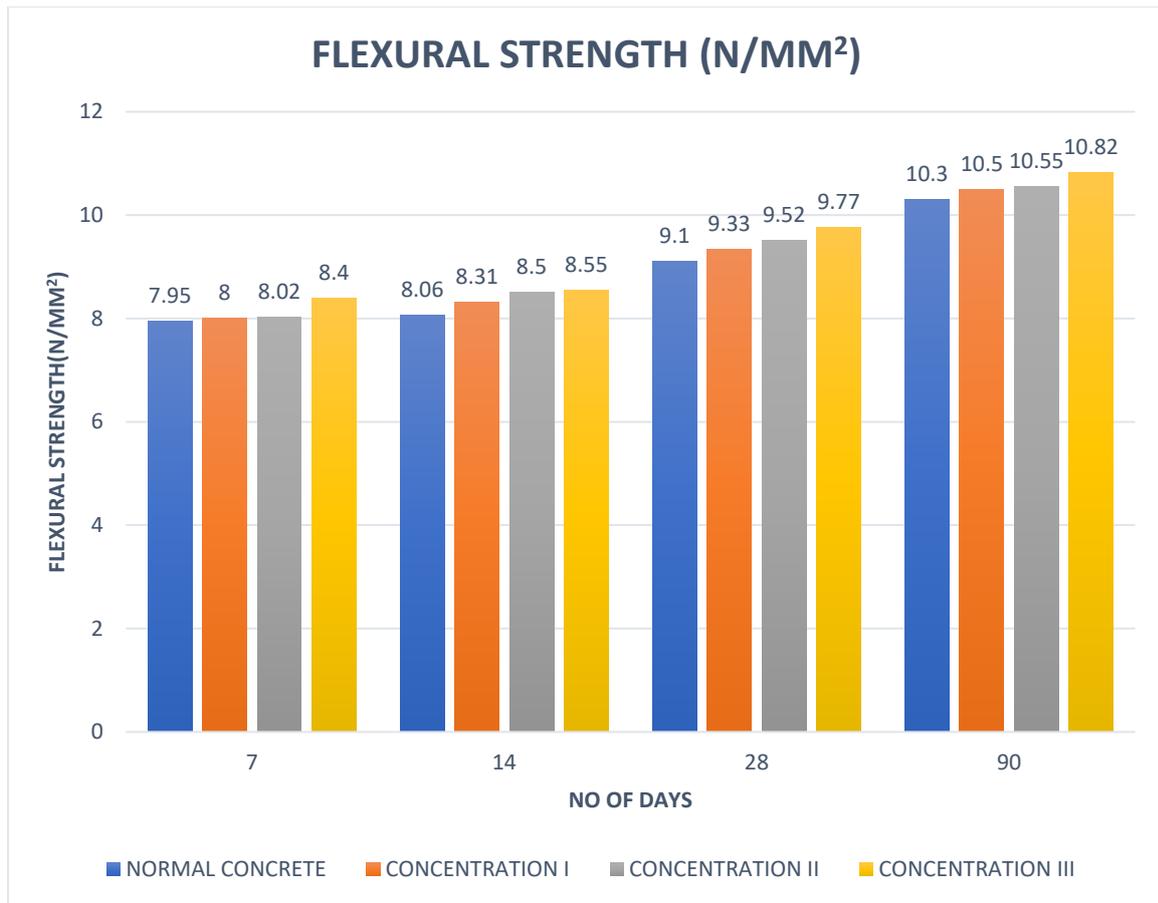


FIG 5:Flexural Strength

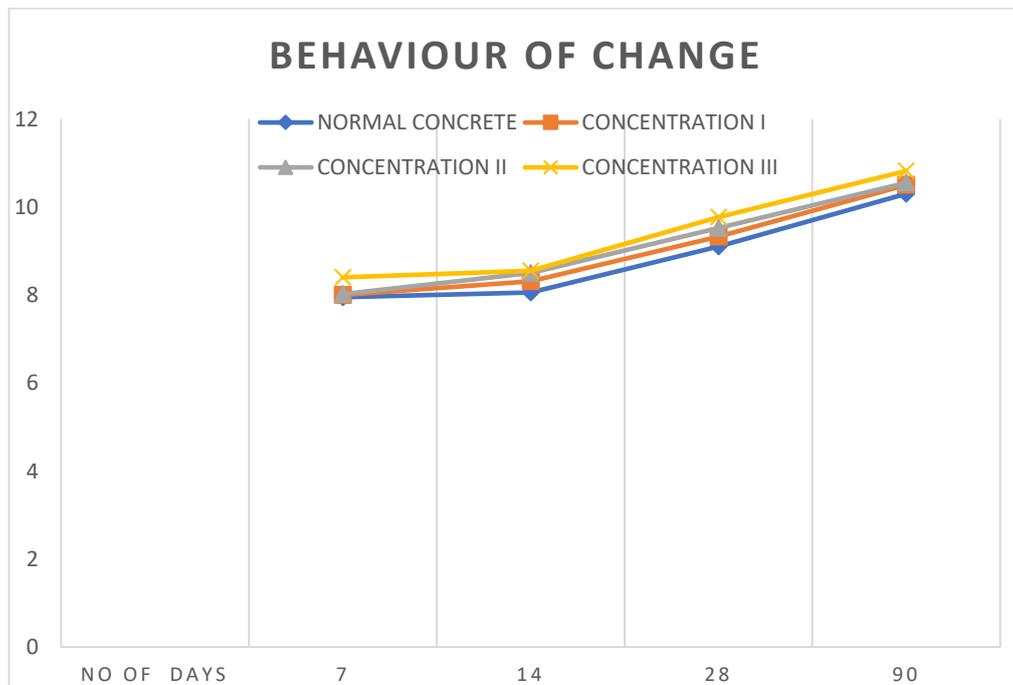


FIG 6:Behaviour of change in flexural Strength

4.4 Split Tensile Strength Test:

Splitting tensile strength test in concrete cylinder (height 300mm, dia- 150mm) is a method to determine the tensile strength of concrete, which is one of its basic and important properties. Concrete due to its brittle nature is not expected to resist the direct tension and hence develop cracks when subjected to tensile forces. Thus, this test directly indicates the load at which concrete members tend to crack.

Observation Table

SPLIT TENSILE STRENGTH(Mpa)	7 DAYS	14 DAYS	28 DAYS	90 DAYS
NORMAL	2.90	3.35	4.21	4.28
CONCENTRATION I (30ML/Litre of Water)	4.48	4.76	4.80	4.87
CONCENTRATION II (45ML/Litre of Water)	4.56	4.88	4.98	5.02
CONCENTRATION III (60ML/Litre of Water)	4.90	5.10	5.21	5.86

Table 15:Split Tensile Strength

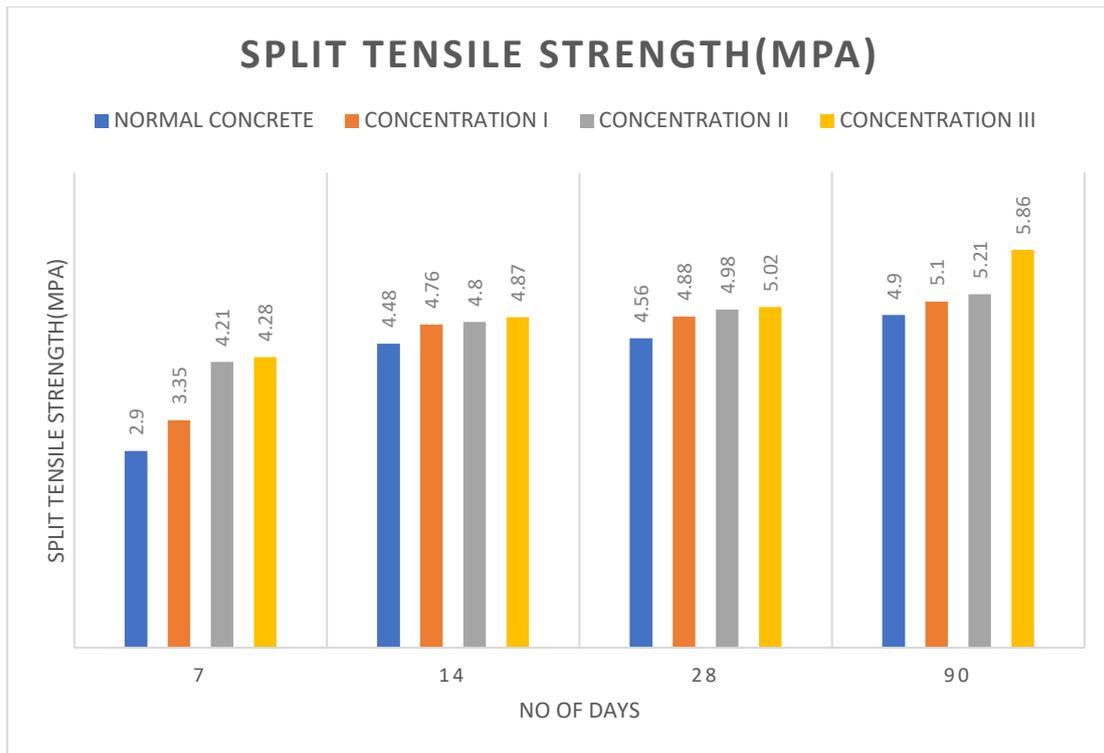


FIG 7: Split Tensile Strength Bar Chart

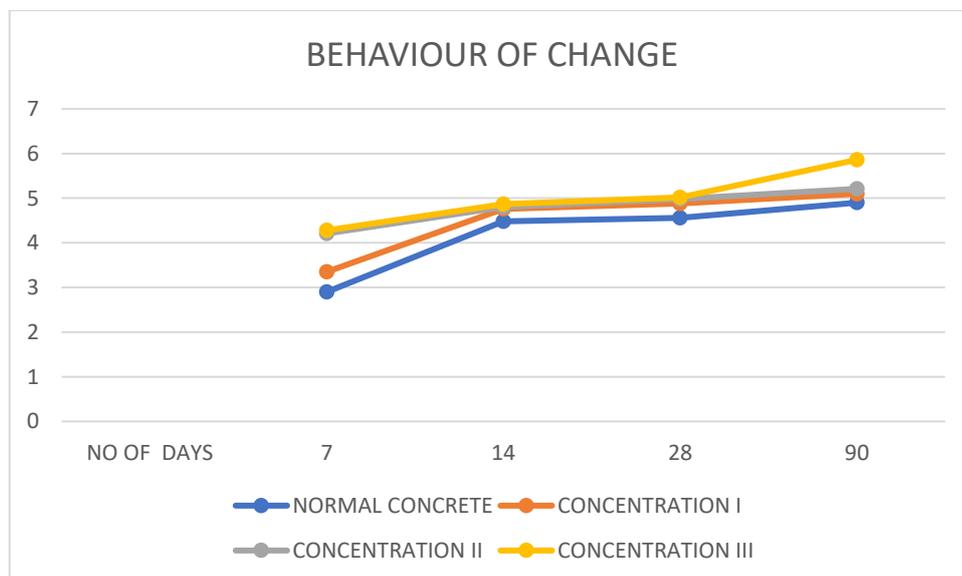


FIG 8: Behaviour of Change in Spilt Tensile Strength

4.5 Ultrasonic pulse velocity test: -

The UPV [Ultrasonic Pulse Velocity] test will be conducted on the normal and bacterial concrete specimens under Direct method of testing. The equipment to be used will be RTUL UX4600 of accuracy $0.1\mu\text{s}$ and frequency 60KHz.

The UPV results were a direct indication of the density and hence the quality of the concrete specimens. High values of pulse velocities were expected from bacterial concrete specimens due to the filling of micro cracks in them owing to the calcite precipitation.

specification as per IS 13311 -Part 1 (1992)

Sl.No	Pulse Velocity by Cross Probing (Km /sec)	Concrete Quality Grading
1.	Above 4.5	Excellent
2.	3.5 to 4.5	Good
3.	3.0 to 3.5	Medium
4.	Below 3.0	Doubtful

CHAPTER-5

CONCLUSION

The aim of the project was the experimental study of the bacterial concrete and its self-healing capabilities.

From the different experiments conducted during the course of this project the results are summarised below.

1. In this study it is found that bacillus subtilis was more suitable bacteria for self-healing concrete.

2. The Compressive Strength of the Concrete having concentration of (60 ml/litre of water) increased by 32.71% at 28 days as compared to normal concrete, however over all strength at 90th day was found to be increased by 31%.

3. The flexural strength of the concrete increased for by 31.54% as compared to normal concrete at 28 days and at 90 days it was found to be increased 28.80% at 90th day of testing.

4. The change in tensile strength was also found to be on increasing side in the study, the tensile strength increased by 23.75% at 28 days for same concentration and at 90th day was found to have increased from 23.75% to 36.91% as compared to normal concrete.

5. As there is no change in compressive strength when concrete exposed to harsh weather conditions bacteria is alive in any extreme weather conditions.

CHAPTER-6

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IS CODES

1. IS 456:2000, Indian Standard Code For code of practice for Plain and Reinforced Concrete(4th Revision), BIS, New Delhi
2. IS 1199:1959: Method of Sampling and Analysis of concrete.
3. IS 516:1959: Method of Test for strength of concrete
4. IS 2386:(part I, II III & IV): Method of testing for aggregate for concrete.
5. IS 10262-2009: Concrete Mix Proportioning. Guideline (first revision)
6. IS 383:1970: Specification for coarse and fine aggregate for use in mass concrete.
7. IS 4031: (PART 5) Method of tests for hydraulic cement.
8. IS 2720: Method of tests on soils.
9. BIS 812 Testing on aggregates.

CHAPTER 7

PHOTOS











A Project Report on

“A study on capital structure of Adithya Birla sun life insurance”

By

KAVANA A M

1AM19MBA14

Submitted to



VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

In partial fulfilment of the requirements for the award of the degree of

MASTER OF BUSINESS ADMINISTRATION

Under the Guidance of

INTERNAL GUIDE

Mr. MURALI MOHAN

Professor

AMC Engineering College, Bangalore

EXTERNAL GUIDE

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2019-2021

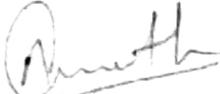


TO WHOM SO EVER IT MAY CONCERN

This is to certify that **Ms. KAVANA A MUSN: 1AM19MBA14** student of "**The AMC ENGINEERING COLLEGE BANGALORE** " ,had undergone his project, in our organization and engaged herself in studying the various aspects related to "**A study on CAPITAL STRUCTURE ADITHYA BIRLA SUN LIFE INSURANCE** " in our organization from 23rd February 2021 to 6th April 2021

During her project with us, we observed that **Ms.KAVANA A M** to be very keep on learning, systematic in her approach towards the study on the topic chosen and learning serious on pursuing a career growth.

We wish all the best for her future.


Yours sincerely,



Aditya Birla Capital Sun Life Insurance

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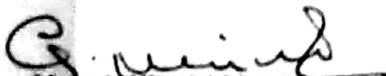
Website: www.amcegroup.edu.in, www.amcedu.in

DEPARTMENT OF MBA

(BATCH 2019-2021)

CERTIFICATE

This is to certify that KAVANA AM bearing USN 1AM19MBA14 is a bonafide student of Master of Business Administration course of the AMC engineering college (2019-2021), affiliated to Visvesvaraya Technological University, Belagavi. A Study on "CAPITAL STRUCTURE" ADITHYA BIRLA SUN LIFE INSURANCE is Prepared by KAVANA AM under the guidance of Mr G Murali Mohan faculty of MBA Department in partial fulfilment of the requirement for the award of the degree of Master of Business Administration of Visvesvaraya Technological University, Belagavi, Karnataka.


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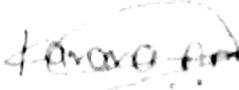
**PRINCIPAL
AMC ENGINEERING COLLEGE
BENGALURU - 560 083**

DECLARATION

I **KAVANA AM.** hereby declare that the project report entitled "A Study on **CAPITAL STRUCTURE**" with reference to "**ADITHYA BIRLA SUN LIFE INSURANCE**" prepared by me under guidance of **Mr. G Murali Mohan** faculty of MBA Department, **AMC ENGINEERING COLLEGE**, Bangalore, and external assistance by **NAVNEETH** "**ADITHYA BIRLA SUN LIFE INSURANCE**" and also declare that this project work is towards the partial fulfilment of the university. Regulations for the award of degree of master of **Business Administration** by **VISVESVARAYA TECHNOLOGICAL UNIVERSITY**, **Belagavi**. I have undergone a summer project for a period of six weeks. I further declare that this project is based on the original study undertaken by me and has not been submitted for award of any degree/ diploma from any other university/ Institution.

Place: Bangalore

Date: 05/04/2021


Signature of the student

ACKNOWLEDGEMENT

Project is itself an acknowledgment to the intensity, lot of inspiration and well of the individuals who have contributed to them. My primary thanks go to the almighty god whose favor made me active in bringing this project.

I express my deep gratitude to our respected Principal **Dr. A. G NATARAJ** and our **HOD Dr. UMADEVI**, AMC Engineering college, Bengaluru for their kind co-operation.

I would like to express my sincere thanks to **Mr. MURALI MOHAN (project guide)**, AMC engineering college, Bengaluru for her valuable suggestions and encouragement, which are imperative for the completion of this project.

I am very thankful to **ADITHYA BIRLA SUN LIFE INSURANCE** giving me the opportunity for carrying the dissertation project in their organization. The valuable guidance provided by external Guide

MR. NAVNEETH at **ADITHYA BIRLA SUN LIFE INSURANCE**. Has helped me towards the accomplishment of the project.

Place:

KAVANA A M

Date:

1AM19MBA14

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6. 12

TABLE

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1. The first part of the report is devoted to a general survey of the situation in the country.

2

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3

3. The third part of the report is devoted to a study of the social situation in the country.

4

Chapter-1

Introduction

1.1 Introduction about the Internship

Internship and project work is a part of academic activity of Visvesvaraya Technological University, Belgaum. It is an initial to bridge the gap among the knowledge and its application over a series of invention to the student of MBA program that enable to achieve knowledge and explore to the industry.

A meaningful six-week project has exposed me to the corporate culture at Aditya Birla sun life insurance Ltd . This internship training served as the right platform to implement the theoretical imbibed concepts in a best possible way.

It was interesting to learn in an organization like Aditya Birla sun life insurance. This is committed with the society's wellbeing and ethical standards. All though the human resources are grouped into various levels of responsibility, the company keeps an open door policy to encourage free intrapersonal interaction which I believe is real strength of any organization. It exposed to the quality of work culture, timelines and cooperativeness in the company. The interaction with the company gave an insight and a first experience of the industrial scenario in the competitive environment outside the realms of the company. Learnt how to interact with customers, how to behave with the superiors, subordinates, and how to retain the customers. It helps students to apply their skill in practical field under the guidance of experienced practitioners.

It helps to learn company ethics, organization behavior, rules, provision, etc..., once the students finish the academy students can easily fit to the companies by learning norms through this internship program. It boosts confident level among the students. This program adds academic value and ability to earn academic credit. It also gives the opportunity to make valuable future jobs.

All together it was a good learning experience to carry the project in the company like Aditya Birla sun life insurance and I thankful to all the people who have helped to complete my project, without which the project would not have been success.

INDUSTRY PROFILE

Protection is a way of safeguarding against financial loss.

It is a sort of hazard the board that is primarily used to protect against the risk of an unexpected or questionable catastrophe.

Insurance is a method of protecting oneself against financial distress.

It is a type of danger employed by leaders to hedge against the possibility of a surprise or uncertain setback.

A well-being net supplier, protection organisation, insurance carrier, or underwriter is a substance that provides assurance.

A person or thing who buys insurance is referred to as a protected or a policyholder.

The insurance industry includes the protected tolerating a guaranteed and referred to as respectably small adversity as part of the back up arrangement as a trade-off for the wellness net supplier's assurance to recompense the safeguarded in the event of a got shortfall.

The disaster might be financial, but it should be reducible to monetary terms, and it typically refers to anything for which the insured has an insurable premium generated via ownership, proprietorship, or a previous connection.

The insured receives a contract, known as the insurance methodology, that specifies the terms and conditions under which the underwriter would refund the shielded.

The expenditure is the proportion of money supplied by the back arrangement to the Policy holder for the consideration specified in the insurance methodology.

If the insured encounters an obstacle that may have been caused by the security technique, the insured submits a case to the health insurance provider for handling by a claims specialist.

The backup arrangement may hedge its own risk by obtaining reinsurance, in which another protection office agrees to pass on a portion of the risk, particularly if the primary wellbeing net supplier considers the risk to be excessively high to pass on.

A STUDY ON CAPITAL STRUCTURE

Early methods:



Since the beginning of time, dealers have sought strategies to limit risks.

Ferdinand Bol, Governors of the Wine Merchant's Guild, 1680.

Procedures for transferring or appropriating risk were comprehended by Chinese and Babylonian expedites as far back as the third and second millennia BC, respectively.

Chinese brokers going through deceptive stream rapids would reorganise their products over several vessels to minimise the mishap caused by any single vessel's disturbance.

Methods of today:

Insurance (Protection) grew indisputably more sophisticated in Enlightenment-era Europe, and specific varieties emerged.

A STUDY ON CAPITAL STRUCTURE



Lloyd's Coffee House was the main composed market for marine protection.

The devastating consequences of the fire shifted assurance "from a matter of convenience to one of urgency, a difference in sentiment mirrored in Sir Christopher Wren's conception of a location for 'the Insurance Office' in his new course of action for London in 1667."

Despite the fact that a number of previous fire security measures failed horribly, in 1681, economist Nicholas Barbon and eleven collaborators established the first fire protection agency, the "Security Office for Houses," behind the Royal Exchange to defend square and edge dwellings.

His Insurance Office was responsible for securing 5,000 houses from the start.

IRDA is the procedure maker for the whole insurance sector in India, as well as the customer rights regulator.

As the name implies, fiasco assurance organisations spread the hazards associated to an individual's existence, and non-life inclusion organisations spread other risks related to our constantly living, for example, prosperity, our automobiles, travel, and home insurance, to name a few examples.

Non-additional security covers a wide range of hazards in the business sector, from basic office insurance to safeguarding entire facilities and mechanical types of equipment.

Over a vague time span, disaster assurance methodologies have begun joining an endeavour part close by the essential security spread so your money creates while it remains contributed with the security organisations – experiences concerning such courses of action will be exhaustively covered in the unavoidable posts in this game plan.

Regardless, non-additional security associations have so far been limited to pure danger distribution.

A STUDY ON CAPITAL STRUCTURE

**COMPANY PROFILE ADITYA BIRLA
SUN LIFE INSURANCE**

A STUDY ON CAPITAL STRUCTURE

PROFILE ADITYA BIRLA SUN LIFE INSURANCE:

Aditya Birla SunLife Insurance Group was founded in the 1960s by Aditya Birla, who founded Business Empire at the age of 24.

In any event, the Birla domestic consumed remained unique of India's most famous current and financial families for almost a century by that point.

Despite the British occupation and the British commercial organisations' efforts to establish overpowering plans of action, Birla was successful in establishing the family's first wealth.

IN THE BACKGROUND:

ABFL is registered with the RBI as a fundamentally crucial non-banking finance company (NBFC) and is one of the top five largest private sector NBFCs in India in terms of AUM as of March 31st, 2017. (source: CRISIL).

Aditya Birla Capital Limited (ABCL) is the Aditya Birla Group's budgeting entity.

ABCL has a nationwide reach and more than 200,000 administrators/channel associates, thanks to more than 17,000 agents.

VISION AND MISSION STATEMENT:

Vision:

"To be a leader and role model in a broad-based and integrated financial services

A STUDY ON CAPITAL STRUCTURE

MISSION:

To be the preferred provider of innovative, need-based life insurance and retirement solutions to people and corporations.

Well-trained personnel will make this solution available via a multi-channel distribution network and excellent technologies.

QUALITY POLICY :

Aditya Birla Group will most likely meet or surpass our clients' expectations while also ensuring the consistency, execution, dependability, security, and estimation of our products and s

A STUDY ON CAPITAL STRUCTURE

ervices through solid quality frameworks and executive forms.

Our Group Companies are devoted to guaranteeing that the goods and administrations they supply are in line with client and applicable legal and administrative requirements, therefore communicating our key point of increased consumer loyalty.

PRODUCT PROFILE OF BIRLA SUN LIFE:

❖ TERM PLANS:

BIRLA SUN LIFE INSURANCE TERM PLAN to ensure that your family receives a large lump sum payout, known as the entire guaranteed, in the unfortunate event of the Insured's death.

People can benefit from BIRLA SUN LIFE Insurance's basic assurance inclusion.

Term insurance policies are often reasonable plans that provide complete protection and monetary stability to your friends and family in the event of any unanticipated events.

Details of the BIRLA SUN Life Insurance Term Plan:

BIRLA SUN Life Insurance Term Plan provides the finest Plans with a wide range of benefits for you and your family. There are certain common features, benefits, and coverage's that are noted down for all of these BIRLA SUN Life Term Plans.

Any requirement you may have.

The term plan is more than simply the premium; it is also about what it covers.

Benefits of BIRLA SUN Life Term Insurance:

If the guaranteed died within the approach time period, the death benefit would kick in.

At that moment, the whole amount guaranteed will be paid to the insured's family or a candidate chosen by the insured.

A STUDY ON CAPITAL STRUCTURE

Maturity Benefit: There is no development benefit to this term protection plan by the insured family.

For further information on the Tax on Insurance Policies,

Term of Policy:

You can obtain a strategy term ranging from 10 to 35 years.

BIRLA SUN Life Insurance Term Plan Benefits: Family Income Benefit; Premium Discount on Limited Pay.

Benefit for Terminal Illness

Improve your defences.

BIRLA SUN Life Insurance Term Plans: An Overview:

These two period insurance plans have enticing features and benefits.

Let's have a look at the plan diagram.

- BIRLA SUN LIFE My Term Insurance Plan.
- BIRLA SUN LIFE Term Rider Plan.

Life of BIRLA SUN

My Term Insurance Plan: The BIRLA SUN Life Term Insurance Plan is ideal for anybody who wants to protect their family's financial goals.

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Life of BIRLA SUN

The life spread in MY Term Insurance Plan ranges from 25 lakhs to 25 crores.

Life of BIRLA SUN

My Term Insurance provides Family Income Benefits, Terminal Illness Benefits, and a Premium Discount for People with Limited Income.

For more information on the BIRLA SUN Life My Term Insurance plan.

BIRLA SUN Life Term Rider Plan: BIRLA SUN Life

BIRLA SUN Life Term Rider Plan is available to those looking to enhance their assurance.

BIRLA SUN Life Term Rider Plan is an optional item that may be purchased in addition to the BIRLA SUN Life Insurance Term Plan.

Traditional designs for better living spread at an apparent price.

Review of BIRLA SUN Life Pension Plan: BIRLA SUN Life Insurance Company provides BIRLA SUN Life Pension Plan.

BIRLA SUN LIFE Pension Plan or Annuity programmes provide you with a steady income once you retire.

Inflation is on the rise.

Higher Monetary assets would be necessary to live a comfortable existence.

A STUDY ON CAPITAL STRUCTURE

BIRLA SUN Life Insurance Company provides a number of BIRLA SUN Retirement Plans for individuals, families, and so on.

Some of the different Features and Benefits cited for this BIRLA SUN Pension Plan are listed below.

BIRLA SUN LIFE INSURANCE PENSION PLAN provides customised plans to cover virtually every Retirement demand that you may have.

BIRLA SUN Life Pension Plan Key Features

Enjoy normal month-to-month pay payments for the rest of your life, with flexible pay-out choices to acquire your Annuity Amount.

You can select a monthly or quarterly annuity pay-out frequency.

Every six months or every year.

There will be no medical examination.

BIRLA SUN Life Pension Plan :

The finest Pension Plans are provided by BIRLA SUN Life Insurance Company.

BIRLA SUN's retirement programmes feature enticing highlights and benefits.

You may get a summary of the BIRLA SUN Retirement Plan.

BIRLA SUN LIFE INSURANCE PENSION PLAN DIAGRAM:

- BIRLA SUN LIFE's Golden Years Retirement Plan; and
- BIRLA SUN LIFE's Immediate Annuity Plan.

The insured will be protected with additional benefits based on the arrangement chosen.

A STUDY ON CAPITAL STRUCTURE

Refer to the following section for further information about BIRLA SUN Life Insurance Plans.

BIRLA SUN LIFE GOLDEN YEARS RETIREMENT PLAN: provides guaranteed benefits upon vesting and demise.

This is a non-participating Variable Insurance Pension Plan.

The chosen one will have the option of taking advantage of the guaranteed demise advantage.

All premiums, including top-up premiums, are guaranteed to increase by at least 1% every year.

This arrangement also allows you to live a secure and calm resigned existence.

If it's not too much hassle allude beneath connect for additional data.

BIRLA SUN LIFE IMMEDIATE ANNUITY PLAN: Provides lifelong annuity payouts.

Depending on the price tag run, the insured might receive a substantial discount on annuity rates.

Another client's base age is 45 years, and the most extreme age for implementing this technique is between 70 and 75 years.

This Pension Plan does not need a clinical evaluation.

Please refer to the interface below for specific info.

BIRLA SUN LIFE Money Back Plan Review: BIRLA SUN LIFE Money Back Plan is the greatest Money Back arrangement provided by BIRLA SUN Life Insurance.

The BIRLA SUN Life New Fulfilling Life is an Endowment Assurance Plan that provides liquidity within the strategy's typical time periods.

A STUDY ON CAPITAL STRUCTURE

The BIRLA SUN Life Money Back Plan assists the Life Insured with key life events such as child education, BIRLA SUN Life Insurance New Fulfilling Life.

Key Characteristics:

The Key Benefits of BIRLA SUN Life Insurance New Fulfilling Life are listed below.

The BIRLA SUN Life Money Back Plan provides Life coverage for the duration of the agreement.

The Plan provides the Life Assured with intermittent endurance benefits.

In this BIRLA SUN Life New Fulfilling Life, the policyholder will receive a Guaranteed Death Benefit that is multiple times the yearly premium. Protection against any crisis or unforeseen event is covered in this arrangement. Safe return is provided to the Life Assured.

BIRLA SUN Life Insurance New Fulfilling Life Eligibility Criteria:

THE BIRLA SUN LIFE MONEY BACK PLAN.

The clients who needed to purchase this arrangement should meet the underneath qualification standards. The subtleties given in this BIRLA SUN Life New Fulfilling Life are development age, strategy term, premium installment term, section time of life guaranteed and different subtleties. The accompanying

table shows the concise insights regarding

CHILD PLAN:

A STUDY ON CAPITAL STRUCTURE

BIRLA SUN Life Insurance Child Plan Review:

The BIRLA SUN Life Insurance Child Plan is the greatest option for your child's future.

The BIRLA SUN Life Insurance Company provides this Child Plan.

Every parent wishes for the finest future for their child.

Budgetary planning is critical to ensuring those fantasies and having a certain future.

BIRLA SUN Child Plan provides the solutions for making the guardians' dream a reality in terms of financial planning.

This BIRLA SUN Child Education Plan assists with the costs of children's higher education.

BIRLA SUN Child Insurance Plan Policy ensures that your child will get the Guaranteed Benefits at a critical juncture in life, even if you are not present.

If the guardians are faced with an unexpected event, the BIRLA SUN Child Insurance Plan provides financial assistance for the child's future.

Why should you purchase this BIRLA SUN Child Insurance Plan?

BIRLA SUN Life Insurance Child Plan is needed to ensure your child's bright future.

Nowadays, it is prohibitively expensive to test your children's abilities.

This arrangement allows your children to make an informed decision about their education without having to worry about financial assistance.

With this, guardians' and children's imaginations become real with suitable resolution in their lives.

It provides additional benefits within the strategy time frame for your interests in this BIRLA SUN Life Insurance.

This BIRLA SUN Insurance Child Plan also aids with your child's marriage.

It provides financial stability to your children even if you are no longer alive or unable to attend.

BIRLA SUN Child Investment Plans provides great benefits for your premium.

A STUDY ON CAPITAL STRUCTURE

As a result, begin putting money down for your children's bright future with BIRLA SUN Life from today onwards.

Policy Information for BIRLA SUN Life Insurance Child Plans:

BIRLA SUN provides the most extreme security to your youngster's education in the event that you are in financially tight at specific circumstances to overcome the unforeseen future conditions.

This BIRLA SUN Life Insurance Child Plan is a standalone, no-interest disaster protection plan.

BIRLA SUN Child Insurance Plan provides incredible outstanding characteristics and benefits for the backup plan.

The features and advantageous circumstances of the BIRLA SUN Child Plan are as follows.

Benefits of BIRLA SUN Child Plans:

The Family Income Benefit is a government programme that provides financial assistance to members of a family

A STUDY ON CAPITAL STRUCTURE

Premiums are not waived.

Alternative for Limited Pay.

Death Benefit: The candidate will get a 100% guaranteed lump sum of the premiums paid.

BIRLA SUN LIFE INSURANCE CHILD PLANS DESCRIPTION:

BIRLA SUN LIFE WEALTH MAXIMIZATION PLAN

Plan BIRLA SUN Life MeraAashirvad.

BIRLA SUN LIFE NEW GENERATION LIFE INSURANCE PLUS PLAN

A STUDY ON CAPITAL STRUCTURE

BIRLA SUN LIFE INSURANCE CHILD PLANS DIAGRAM :

We are quickly providing each and every BIRLA SUN Life Insurance Child Plan Policy.

SUN LIFE WEALTH BIRLA

Maxima Plan is a non-participating unit-linked life insurance policy.

There are three variations in this arrangement.

Maxima Invest, Maxima Family, and Maxima Child are their names.

These three goods are beneficial to the entire family in terms of satisfying their desires, ensuring their self-esteem, and developing in an efficient manner.

The time frames for the strategies are 10, 15, and 20 years.

The strategy term is identical to the premium paying term.

The age determines the basic and additional entirety guaranteed.

To reflect clearly on the fundamental aggregate guaranteed and various benefits,

The BIRLA SUN LIFE WEALTH MAXIMIZATION PLAN:

A STUDY ON CAPITAL STRUCTURE

The BIRLA SUN Life MeraAashirvad plan is a non-connected, no-interest life insurance policy.

It is a child protection plan with guaranteed rewards that will fulfil the children's dreams.

This is beneficial for the child's education as well as for marriage.

It provides three guaranteed benefits.

The approach terms are ten and twenty years.

The yearly premium is multiplied by the passing advantage.

There are two options for the development advantage.

Based on the alternative chosen by the backup plan, he will obtain the development completely assured.

To rapidly consider these BIRLA SUN Life Insurance Child Plan development options,

Overview of BIRLA SUN Life Insurance Saving Plans/ Investment Plans:

During the pay payment period, the Death Benefit can also be benefited from.

After the Policy Term has expired, the Maturity Benefit is paid to the Life Insured in the form of the Sum Assured.

Tax breaks are granted in accordance with the Income Tax Act.

Please refer to the below interface for further information.

BIRLA SUN Life Guaranteed Income Insurance Plan:

BIRLA SUN Life Wealth Maxima: provides three item variants that are beneficial at different stages of life.

The Fund Value is delivered to the Life Insured as a lump sum or in parts on the Date of Maturity.

During the Policy Term, the changing financial needs at various stages of life, such as marriage and labour, are buried in this structure.

The BIRLA SUN Life Wealth Maxima provides the insured the option of switching between variants.

The strategy Holder can also benefit Devotion Additions.

A STUDY ON CAPITAL STRUCTURE

BIRLA SUN Life Assured Gain Plus: BIRLA SUN Life Assured Gain Plus provides Insured with lifelong inclusion by paying just for a long time.

At the time of Maturity, BIRLA SUN Life Insurance pays the whole guaranteed amount, plus any Simple Reversionary Bonus and Guaranteed Terminal Increments.

The BIRLA SUN Life Assured Gain Plus provides you the option of upgrading your basic illness insurance.

The Life Insured can benefit from the Advance Facility under specific situations.

The legacy accumulation is to be delivered to the cutting edge with secure returns.

This agreement provides long-term insurance coverage.

The Double Sum Assured will be made available upon the conclusion of the arrangement period.

The Policy Holder can also take advantage of the advance office provided by this BIRLA SUN Life New Fulfilling Life Plan.

BIRLA SUN LIFE INSURANCE CHILD PLAN DIAGRAM:

BIRLA SUN LifeMeraAashirvad: provides a Guaranteed Payout of multiple times the yearly premium or 105 percent of premiums paid or Sum Assured in the event of a tragic event.

The premiums are postponed due to the insured's untimely death, thus the insured's family will be relieved of the burden of paying premiums.

The Life Insured receives a tax-free Maturity Benefit.

Health Plan :

BIRLA SUN Life Health Insurance Plan Review :

The BIRLA SUN Health Insurance Plan is the finest option available from the BIRLA SUN Life Insurance Company.

Medical coverage entails the insurance company providing instalment benefits for clinical and medical expenditures incurred as a result of any illness or accident.

It also includes coverage for untimely death and any disasters incurred during a mishap or disaster assembly.

BIRLA SUN Life Insurance provides the policyholder with the BIRLA SUN Life Critical Illness Rider Plan.

BIRLA SUN Life Health Insurance Plan Eligibility Criteria: Customers who need to acquire this arrangement should be aware of the qualifying criteria.

These nuances assist clients in understanding the section age, aggregate guaranteed, Policy terms, inclusion term, and other nuances of the BIRLA SUN Life Critical Illness Plan.

BIRLA SUN Rider Plan Features :

- The policyholder gets the lump sum guaranteed on determination to cover the basic disease.
- In this 2 alternatives are there.
- Option – A spreads the 4 critical Illnesses.
- Option – B covers the 25 basic Illnesses.

BIRLA SUN Life Critical Illness Rider Plan Benefits :

This CI Benefit covers the entirety guaranteed on some basic diseases.

Choice A Covers the 4 significant basic diseases that are accessible beneath.

- Cancer of Stated Severity.

A STUDY ON CAPITAL STRUCTURE

- First Heart Attack of indicated seriousness.
- Stroke was bringing about Permanent Symptoms.

AREAS OF OPERATION AND BUSINESS:

1. AREA OF OPERATION:

Bangalore
Hyderabad
Chanai
Mumbai
Pune

INFRASTRUCTURE FACILITIES:

Future Group:

Group of the Future

When two big names get together, it's a source of great pride since it allows their consumers to make wise selections.

Clients may use the computerised EMI Network Card to convert their purchases from any Future Group Store into easy EMIs, gradually creation their spending knowledge more pocket-friendly and useful.

Our SME clients can also benefit from a reduced Rating price by working with us.

Our collaboration with CRISIL provides you with a plethora of benefits that go beyond a SME /SSI credit.

COMPETITORS:

1. LIC

2. Reliance Life Insurance

3. SBI Life Insurance :

SBI Life Insurance is a joint endeavor extra security organization between State Bank of India (SBI), the biggest state-possessed banking and money related administrations organization in India, and BNP Paribas Cardif. BNP Paribas is a French worldwide bank and money related administrations organization with worldwide home office in Paris. SBI

A STUDY ON CAPITAL STRUCTURE

claims 62.1% of the all out capital and BNP Paribas Cardif 22% of the capital. Different financial specialists are Value Line Pte. Ltd. furthermore, MacRitchie Investments Pte. Ltd., holding 1.95% of the all out capital each and staying 12% with Public. SBI Life Insurance has an approved capital of ₹20 billion (US\$280 million) and a settled up capital of ₹10 billion (US\$140 million).

In 2007, CRISIL Ltd, an auxiliary of worldwide rating office Standard and Poor's, gave organization an AAA/Stable/P1+ rating.

SBI extra security is Public Limited Listed organization. SBI Life Insurance Listed on BSE And NSE (Stock Exchange of India). SBI Life began as a joint endeavor with BNP Paribas in 2001. While in its underlying stage its business was essentially from bancassurance channel, presently it is building up its own office group for selling its extra security items. SBI General Life Insurance is a joint endeavor between State Bank of India and Insurance Australia Group. SBI possesses 74% of the all out capital and 26% remaining IAG. The organization offers different protection plans for people like – Motor Insurance Plan, Home Insurance, Personal Accident Insurance, Health Insurance and Travel Insurance. The organization additionally offers plans for systematic – Fire Insurance, Health Insurance, Motor Insurance, Marine Insurance, Package Insurance, Construction Engineering and different protection. SBI General is as of now serving three key client sections for example Retail Segment, Corporate Segment and SME Segment. We are sharing here complete data about SBI General Life Insurance organization's arrangements, polices and their advantages.

4. Max Life Insurance :

Max Life Insurance Company Limited (formerly known as Max New York Life Insurance Company Limited) is an Indian life insurance company.

5. HDFC Life :

Following the completion of the aforesaid transaction, HDFC will own 61.65 percent of HDFC Life, while Standard Life's share will increase to 35.00 percent, with the remainder held by others.

FUTURE GROWTH AND PROSPECT:

Aditya Birla Capital, which is being recorded today, is energising the market.

A STUDY ON CAPITAL STRUCTURE

Aside from establishing an incentive by posting the financial administrations businesses separately, Kumar Mangalam Birla led Group hopes to combine rapidly expanding organisations and simplify the structure by eliminating cross holding.

PremjiInvest (Azim Premji) has acquired a 2.2 percent interest in Aditya Birla Group for Rs. 32000 crores in cash.

SWOT ANALYSIS OF BIRLA LIFE INSURANCE:

STRENGTHS:

ADITYA BIRLA SUN LIFE INSURANCE CAPITAL has a good name in the industry because of its visibility as well as the huge number of clients it has added to its repertoire.

Furthermore, because it 66 delayed lengthy periods of great customer support.

SKILLED PERSONNEL: BRILA SUN LIFE INSURANCE is awarded with exceptional compared to other workers in the market, and representatives obtain with ten years of experience and the capacity required to complete the tasks.

BRILA SUN LIFE INSURANCE PROVIDES A VARIETY OF SERVICES TO CUSTOMERS: For the client's convenience, BRILA SUN LIFE INSURANCE provides a variety of administrations such as shared assets, protection, subordinates, and value.

EXTENSIVE Expertise: ADITYA BIRLA SUN LIFE INSURANCE CAPITAL has 66 years of experience.

WEAKNESS

A STUDY ON CAPITAL STRUCTURE

- Inadequate proximity to the world's largest market
-
- Insignificant proximity in institutional parts
-
- Employee turnover
-
- Employees are departing the activity on a regular basis, and executives are consistently confronted with the issue of worker enrollment as well as the typical charges of cost reduction and improvement.
-
- High cost structure in IT due because the organisation is contributing more on online administrations and innovations that are used.
-
- Inadequate use and a shortage of phone devices to communicate with clients and consumers.
-
- Lack of anticipation on creative work below the business standard since they must proceed with development and assessment.

OPPORTUNITIES:

Why Dissatisfied rivals' customers

- Insurance fees can be increased by future developments in near proximity
- tax assessment

Market expansion for the organization's core products and services

Loan fees are decreasing as a result of the organization's favourable rate.

Changing preferences and customer preferences

- The economy is anticipated to grow by 4% in the next year.

THREATS:

- New or expanded rivalry

A STUDY ON CAPITAL STRUCTURE

- Insurance plan changes as indicated by time
- Adverse government policies influences the organization contrarily with regards to efficiency
- economic log jam
- lender lessening credit lines expanding charges
- many online contenders who are collaborating and extending the circulation channels and client base.

FINANCIAL STATEMENT

BALANCE SHEET AS ON 31ST MARCH

Statement of Cash Flows for the year ended 31st March, 2020

₹corer

Particulars	Year ended 31st March, 2020	Year ended 31st March, 2019
A. CASH FLOWS FROM OPERATING ACTIVITIES		
(Loss)/Profit Before Tax	(11.64)	36.17
Adjustments for :		
Impairment on Financial Instruments	0.18	0.91
Net (Loss)/Gain on Fair Value Changes	2.88	(38.14)
Depreciation and Amortisation	0.87	0.49
Expense on Employee Stock Options Schemes	27.04	(11.13)
Finance Costs	88.53	25.38

A STUDY ON CAPITAL STRUCTURE

Exceptional Item	30.32	-
Interest Income on Financial Assets (Held at Amortised Cost)	(18.65)	(14.77)
Interest Income - Others	(0.35)	(0.45)
Profit on Sale of Property, Plant and Equipment	(0.02)	(0.01)
Share Issue Expenses	-	(2.81)
	130.80	(40.53)
B. OPERATING PROFIT/(LOSS) BEFORE WORKING CAPITAL CHANGES	119.16	(4.36)
Adjustments for:		
Decrease/(Increase) in Loans	(45.14)	(57.83)
Decrease/(Increase) in Other Bank Balance	(0.03)	(0.23)
Decrease/(Increase) in Receivables	105.68	88.85
Decrease/(Increase) in Other Non-Financial Assets	(3.89)	(0.49)
Increase/(Decrease) in Trade Payables	(12.01)	15.62
Increase/(Decrease) in Other Financial Liabilities	3.25	5.59
Increase/(Decrease) in Other Non-Financial Liabilities	(5.86)	6.12
Increase/(Decrease) in Provisions	(14.39)	5.35
	27.61	62.98
Cash Generated From Operations	146.77	58.62
Income Taxes Refund/(Paid)	(2.02)	(1.88)
Net Cash Generated From Operating Activities	144.75	56.74
C. CASH FLOWS FROM INVESTING ACTIVITIES		
Purchase of Property, Plant and Equipment and Intangible Assets	(5.28)	(6.92)
Sale of Property, Plant and Equipment	0.56	0.01
Acquisition of Additional Shares/Investment in Subsidiary	(845.89)	(1,156.97)
Sale of Shares in Subsidiary	8.20	-
Proceeds Received from Private Equity Fund on Redemption of Units	20.57	138.04
(Purchase)/Sale of Current Investments (Net)	(6.86)	151.86
Interest Accrued on Loans to Subsidiaries (Held at Amortised Cost)	9.28	6.50
Rent Income on Investment Property	0.13	-
Interest Income - Others	-	0.45
Net Cash (Used in) Investing Activities	(819.29)	(867.03)

A STUDY ON CAPITAL STRUCTURE

Particulars	Year ended 31st March, 2020	Year ended 31st March, 2019
D. CASH FLOWS FROM FINANCING ACTIVITIES		
Proceeds From Issue of Shares (Including Securities Premium)	0.68	704.21
Proceeds From Debt Securities Issued	5,166.39	1,732.30
Debt Securities Repaid	(4,490.00)	(1,626.96)
Net Cash Generated from Financing Activities	677.07	809.55
Net Increase in Cash and Equivalents	2.53	(0.74)
Cash and Cash Equivalents (Opening Balance)	1.73	2.47
Cash and Cash Equivalents (Closing Balance)	4.26	1.73

2nd chapter

BACKGROUND OF THE STUDY:-

The word capital structure refers to the amount of capital (cash) at work in a firm based on its kind.

Capital is classified into two types: value capital and obligation capital.

Obligation comprises advances and various types of credit that must be returned later, sometimes with interest.

A STUDY ON CAPITAL STRUCTURE

Offering a fractional interest for the company to financial experts, ordinarily as stock, is an example of value.

Value finance, as opposed to obligation financing, does not entail an immediate commitment to refund the assets.

Rather, value finance professionals become part-owners and partners in the firm, gaining a return on their investment while exercising some amount of control over how the business is operated.

Each has its own set of benefits and drawbacks.

While dissecting capital structure, the amount of an organization's current and long-term obligations is considered.

When people discuss capital structure, they are undoubtedly referring to a company's obligation to-value proportion, which offers insight into how risky an organisation is.

Normally, a more intensively funded by obligation organisation provides more significant risk, as this company is somewhat deeply changed.

It is the arrangement of long-term obligations, explicit transitory liabilities such as banknotes, basic value, and preferred value that comprise the assets with which a business entity funds its responsibilities and growth.

A company's capital is essentially the proper side of its asset report.

Organizations and entrepreneurs seek to determine how much of their starting capital should come from a bank advance without jeopardising the firm.

There is a truism that "if capital structure is inconsequential in a perfect market, then flaws that occur in reality should be the explanation for its relevance."

There are few rumours to back up the announcement (exchange off hypothesis and hierarchy hypothesis).

MERITS OF EQUITY FINANCE:

A STUDY ON CAPITAL STRUCTURE

- Permanent wellspring of capital.
- No installment of intrigue.
- Improved capacity to confront business downturn.
- Freedom from money related concerns of acquiring.
- Earnings stay with the firm.
- Liquidation of advantages. (On the off chance that a business is sold the benefits of the business stay with the proprietors.)
- Repayment of assets.
- Financial base. (the assets provided by the proprietors give a money related base to the capital structure of a business)
- Ability to acquire. (on the off chance that a business is financed well with value capital, its capacity to acquire obtained capital is improved)

DEMERITS OF EQUITY FINANCE:

- Idle money adjusts.
- Over capitalization.
- Weak control.
- No favorable position of obtained capital.
- Investors' desires.

MERITS OF DEBT FINANCE:

- Tax shield.
- Positive impact on R and D exercises.
- More control.
- Easy to regulate.
- Increases to EPS.
- Lower financing cost.

DEMERITS OF DEBT FINANCE:

- High chance.
- Insolvency.
- Bankruptcy.
- Regular installment of intrigue.
- Reduction in incomes.
- Failure to make installments.

THEORIES OF CAPITAL STRUCTURE:

To plan capital structure, we ought to consider the accompanying two suggestions are:-

- 1) Wealth maximization is attained
- 2) Best approximation to the optimal capital structure.

A STUDY ON CAPITAL STRUCTURE

SOURCES OF CAPITAL:-

• DEBT CAPITAL:-

Obligation capital may be obtained through a variety of ways for private businesses.

Raising Venture Capital also includes friends and relatives, banks, credit unions, purchaser account organisations, business fund organisations, exchange credit, insurance companies, factoring companies, and rental organisations.

Open sources of obligation funding are different advance initiatives provided by state and federal governments to assist independent enterprises.

• EQUITY CAPITAL:-

Independent enterprises employ two primary ways to gain value financing: private stock arrangements with speculators or funding firms and open stock donations.

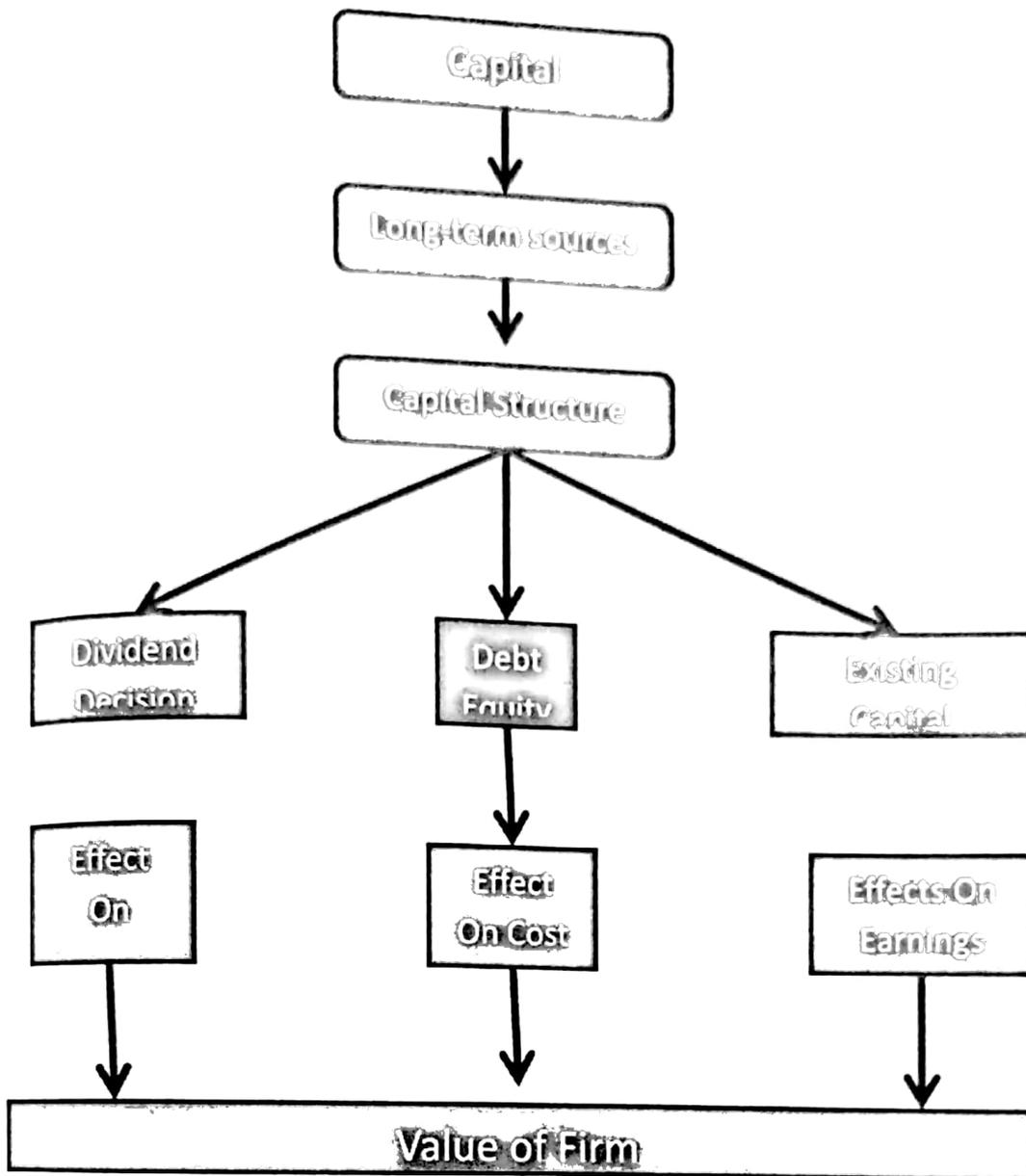
Private scenario is simpler and more basic for young companies or new businesses.

Despite the fact that the private position of frozen in place complies with a few federal and state protection regulations, it does not necessitate official registration with the Securities and Exchange Commission.

Factors determining capital structure:-

- **Minimization of Risk:** a capital structure obligation stand reliable with business hazard. It should bring about a specific degree of budgetary hazard.
- **Control:** It ought to mirror the administration's way of thinking of power over the firm.
- **Flexibility:** It alludes to the capacity of the firm to meet the prerequisite of the evolving circumstance.
- **Profitability:** It ought to be productive from the value investors perspective.
- **Solvency:** The utilization of over the top obligation may from that point the dissolvability of the Company.

A STUDY ON CAPITAL STRUCTURE



MEANING OF CAPITAL STRUCTURE:

A combination of an organization's long-term debt and its stated present obligation.

Basic and preferred value The capital structure is the method through which a company funds its general operations.

And development via the utilisation of diverse sources of assets.

Obligation takes the form of bond offerings or long-term notes payable, whilst value is referred to as common stock, preferred stock, or retained profit.

A STUDY ON CAPITAL STRUCTURE

Assumptions: 1) There are only two types of assets, such as value and obligation, with a fixed interest rate.

2) All of the firm's resources are provided, and there is no change in the firm's investment strategy.

3) The firm's EBIT (Earnings before Interest and Tax) and NOP (Net Operating Profits) are provided and must be consistent.

4) The retention proportion is ZERO.

In other words, all of our advantages are distributed as profits.

[Dividend payout ratio of 100 percent]

Components of Capital Structure: When developing a long-term financial strategy, an organisation should first break down its current budgetary structure, followed by the important components of the Company's financial structure that require genuine analysis and inquiry.

1) Capital Allocation:

- Firms must decide on the appropriate mix of obligation and value capital.

What is the composition of obligation instruments?

Is the reliance fair and square, and the instruments of obligation reasonable, given The Company's dangers?

A STUDY ON CAPITAL STRUCTURE

Is the company's obligation strategy adaptable enough to pursue Strategic interests under difficult financial conditions?

There are companies and specialists.

Employ obligation proportions, obligation administration inclusion proportions, and the assets flow explanation.

Examine the capital mix.

2) Maturity and need: - The evolution of safeguards used in the capital mix

This is subject to change.

The greatest long-lasting capital is value.

Inside liability, commercial Paper has the most limited development and open liability has the longest; similarly, the Priorities of safeguards differ.

Obligation promoted, such as rent or recruit purchase

Finance is extremely safe from the standpoint of the lender and the calculation of benefits.

Sponsorship of the obligation provides the moneylender with certainty.

3) Conditions & Terms:

- Firms have alternatives when it comes to the concept of interest payments.

They may get advances at set or floating rates of interest.

If there is a value event, the company may have the opportunity to return pay in the form of enormous profits or huge capital growth.

What is the association's preference?

Regarding the idea of interest and profit instalments?

What is the relationship between the company's interest and profit instalments and its income and working incomes?

The association's choice on the instalment premise indicates Management's assessment of future loan expenses and the firm's earnings.

A STUDY ON CAPITAL STRUCTURE

4) Currency: Various countries have the option of raising assets from foreign markets.

Foreign monetary markets provide opportunities.

To amass a large amount of assets.

Having access to financing on a worldwide scale also allows the company to quickly globalise its operations.

5) Financial development: - Firms can raise money through the issuance of Simple protections or through the issuance of creative safeguards.

Money-related innovations are likely to make the security problem more enticing to speculators while also lowering the cost of capital.

Another possibility is that the organisation.

On debentures, a larger basic loan cost may be offered, as well as the option to convert the interest sum into value.

The business will have the option of reducing its cash outflows.

6) Financial market fragments: The company might obtain money from a few portions of the budgetary Markets.

For example, a company can raise long-term obligation by tapping the Private or open obligation market.

The company can raise short-term debt from banks or by selling business papers or certificate stores in the currency market.

The company also has the possibility of raising short-term assets through open shops.

What monetary pieces are related?

What markets has the business used to raise assets, and why?

How did the movie turn out?

Tap and approach these areas.

LITERATURE REVIEW:-

Capital structure is defined as the specific mix of obligation and value that a company employs to support its operations.

Four major hypotheses are used to explain capital structure choices.

These are based on hilter kilter statistics, tax breaks linked to obligation usage, chapter 11 expenses, and office costs.

The first is established in the hierarchical structure, whilst the other three are depicted as far as the static exchange off choice is concerned.

These hypotheses are investigated in this manner.

In light of the concept of unequal data, Myers (1984) and Myers and Majluf (1984) explain the idea of optimum capital structure.

The presence of data asymmetries between the company and potential account providers raises the overall costs of fund movement across multiple money sources.

For example, an inward wellspring of money where the assets provider is the company will have more information about the firm than new value holders, thus these new value holders would expect a faster rate of profit for their initiatives.

This means that it will cost the company more to issue new value shares than to use inward assets.

Similarly, similar argument may be made between inside funds and new obligation holders.

The conclusion obtained from the disparate data guesses is that there is a clear hierarchy or progression of business preferences regarding the funding of their projects (Myers and Majluf, 1984).

This "hierarchy" hypothesis proposes that organisations will initially rely on internally produced reserves, i.e., undistributed income, in the absence of data asymmetry; they will then go to obligation if additional assets are required; and finally, they will give value to cover any remaining capital requirements.

The request for preferences reflects the overall costs of various financing options.

Unmistakably, companies would prefer to raise funds from inside rather than from outside sources (Myers and Majluf, 1984).

A STUDY ON CAPITAL STRUCTURE

As a result, according to the hierarchy hypothesis, businesses that are profitable and so generate high revenue are obliged to use less obligation capital than those that do not generate high profit.

The firm's capital structure might also be defined in terms of tax advantages associated with the use of obligation.

Green, Murinde, and Suppakitjarak (2002) contend that charge strategy has a significant impact on businesses' capital structure decisions.

Corporate fees enable businesses to deduct enthusiasm on obligation when processing eligible benefits.

This suggests that highly advantageous circumstances obtained through obligation would lead to companies being entirely supported by obligation.

This benefit is obtained because intrigue payments linked to duty are charge deductible, but instalments related to worth, such as earnings, are not charge deductible.

As a result, this assessment effect enables the firm's obligation usage, as more obligation grows the following expense continues to the proprietors (Modigliani and Miller, 1963; Miller, 1977).

It is crucial to remember that, while there is a corporate duty benefit because of the deductibility of premium instalments on obligation, financial specialists receive these intrigue payments as compensation.

The premium pay received by financial professionals is also accessible for their own use, and the individual yearly assessment impact is negative.

Mill operator (1977) and Myers (2001) contend that as the flexibility of obligation from all partnerships expands, financial specialists with increasingly elevated expense sections must be enticed to hold corporate obligation and to get a greater portion of their pay as interest rather than capital additions.

Loan costs rise when more obligation is granted, thus partnerships face rising obligation expenditures in comparison to value expenses.

The tax advantages that result from the issue of rising company obligation may be offset by a high duty on intrigue compensation.

A STUDY ON CAPITAL STRUCTURE

Thus, the optimal capital structure refers to a level of influence that balances liquidation costs and the benefits of obligation money.

The greater the probability of insolvency that a business confronts as a result of increases in the cost of obligation, the less obligation they utilise in the issuing of fresh capital (Pettit and Singer, 1985).

The use of obligation in the firm's capital structure also results in office costs.

Organizational expenses arise as a result of the linkages between investors and directors, as well as those between obligation holders and investors (Jensen and Meckling, 1976).

The links can be seen as head specialist relationships.

While the company's administration is the operator, the chiefs are both the obligation holders and the investors.

The operator may opt not to increase the leaders' wealth.

The disagreement between investors and administrators arises from the fact that directors own less than 100 percent of the remaining case (Harris and Raviv, 1990).

As a result, they do not receive the entire gain from their benefit upgrading activities, but they do bear the entire cost of these exercises.

Detachment of possession and control may result in administrators performing insufficient labour, enjoying perquisites, and selecting information sources and outputs that fit their own preferences.

Administrators may invest in initiatives that reduce the firm's value while increasing their control over its assets.

For example, even if it would be perfect for the speculators to sell the company, managers may opt to persist with operations to advance their position.

According to Harris and Raviv (1990), administrators have an incentive to continue with a company's current duties regardless of whether investors want liquidation.

However, the conflict between obligation holders (loan bosses) and investors is due to good risk.

According to the office hypothesis, data asymmetry and excellent risk would be more significant for smaller businesses (Chittenden et al., 1996).

A STUDY ON CAPITAL STRUCTURE

Conflicts between investors and banks may arise as a result of their different cases against the company.

Value contracts do not require companies to pay set returns to financial professionals, but rather provide a long-term guarantee on an organization's income.

Regardless, obligation contracts often provide holders with a predetermined case over an acquiring company's profits.

When a company supports an endeavour via obligation, the banks charge a loan cost that they accept is adequate compensation for the risk they incur.

Leasers are concerned about the extent to which companies devote resources to unnecessarily risky projects because their case is fixed.

For example, after collecting funds from bondholders, the business may shift its focus from a lower-risk to a higher-risk venture.

According to Jensen and Meckling (1976), the conflict between obligation holders and value holders occurs because the obligation contract motivates value holders to contribute sub-optimally.

Moreover, in the case of a high-yielding speculation, value holders get the majority of the benefits.

In any event, as a result of the speculation falling short, and due to limited duty, obligation holders suffer the majority of the consequences.

At the end of the day, if the initiative is successful, the banks will be paid a predetermined sum, and the association's investors will benefit from its increased profitability.

If the endeavour fails, the business will default on its contract, and investors will invoke their limited risk status.

Regardless of the benefit replacement issue among investors and loan officers, investors may choose not to put resources into productive businesses (under contribute) if they agree they will need to distribute earnings to leasers.

A STUDY ON CAPITAL STRUCTURE

The whole structure of the money connected case might be used to satisfy the office expenditures of obligation.

Barnea et al. (1980) claim that office difficulties such as data asymmetry, administrative (investor) chance motivating pressures, and done without development opportunities can be resolved by techniques for the development structure and call arrangement of the obligation.

For example, decreasing the obligation's development structure and the ability to call the bond before the termination date can assist reduce the office expenditures of underinvestment and risk shifting.

Barnea et al. (1980) demonstrate that the two aspects of corporate responsibility serve as identical goals in dealing with organisational difficulties.

INTRODUCTION OF THE STUDY:-

Capital structure alludes to the manner by which a firm is financing its all out resources, activities and development through giving value, obligation and cross breed protections. Financing is the way toward gathering cash through sure to be utilized on buying or look after resources, current tasks of firm and any normal development.

Value originates from giving normal stocks, favored stocks and held income while obligation can be ordered into long haul obligation and transient obligation.

The capital structure choice is significant for insurance agencies. This is a result of the need to expand comes back to investors and different partners. Likewise the effect on the association's expense of capital and its capacity to manage its serious condition, if the firm expense of capital can be affected by its capital structure then capital structure the board is unmistakably a significant is obviously a significant subset of business money related administration.

Associations in the non-budgetary segment need capital predominantly to obtain operational resources, protections or seek after new zones of business. While this is likewise valid for insurance agencies, their primary center is to some degree extraordinary. The idea of protection business is to give assurance to strategy holder's in the midst of mishap through the minimization of misfortune. Because of this capacity, insurance agencies have continually being worry with both dissolvability and liquidity.

So as to oversee dangers, insurance agencies firms must have compelling methods of deciding the fitting measure of capital that is important to ingest surprising misfortunes emerging from protection claims and other operational hazard exposures.

As indicated by Abor and Bickpe (2005), in excess of 50 percent of the benefits of recorded firms are financed by obligation and that there was a relationship between's obligation proportion and firm size, development, resource, substantial quality, hazard and corporate

A STUDY ON CAPITAL STRUCTURE

duty. Because of the special budgetary qualities of protection firms and the earth in which they work, there is a solid ground for a different report on capital structure of insurance agencies.

3rd chapter

RESEARCH DESIGN:

MEANING OF RESEARCH:

Exploration just methods a quest for realities – answers to questions and answers for issues. It is a purposive inspection. It is a "sorted out enquiry". It tries to learn explanations to unexplained wonder, to explain the dicey suggestions and to address the confused realities.

Meaning OF RESEARCH:

As per Emory research has been characterized as "any sorted out enquiry planned and completed to give data to taking care of an issue".

As per Kerligner research has been characterized as "deliberate, controlled, experimental and basic examinations of speculative suggestions about the assumed relations among regular marvels".

A STUDY ON CAPITAL STRUCTURE

DEFINATION OF RESEARCH DESIGN:

The process of circumstances for gathering and investigating information in a way that intends to link significance to investigate reason with economy in approach is known as examination design.

In reality, the investigation structure is the calculated framework through which inquiry is directed; it creates the blueprint for the collection, estimate, and investigation of information.

Meaning OF RESEARCH DESIGN:

Examination Design might be characterized as an "a program that manages the specialist during the time spent gathering, dissecting and deciphering perceptions. It gives an orderly arrangement of strategy for the scientist to follow".

STATEMENT OF THE PROBLEM:-

The choice on an ideal capital structure stays a basic money related decision of insurance agencies. In the mean time, the decision of a capital structure of insurance agencies impact their productivity. This exploration investigates the impact of capital structure on benefit of recorded insurance agencies in the stock trade. Relapse investigation were utilized to decide and appraise the measurable connection among benefit and capital structure proportions. The examination unveils a positive and measurably critical connection between money related execution and insurance agency's capital structure. The result additionally shows that gainful protection firms rely more upon obligation. The outcomes likewise portrays a positive and factually noteworthy connection between firm size and money related execution. The examination recommends that beneficial insurance agencies relies more upon long haul obligation (A normal D/E estimation of 1.027) as a methods for financing corporate exercises, this proposition were conflicting with the static exchange off hypothesis.

A STUDY ON CAPITAL STRUCTURE

Capital structure as a methods for financing element center exercises has a great deal of models and investigation deal with its effect on association's appraisal. Disregarding these ideas, an ideal capital structure persevere an incredible worry for the two analysts and firm directors.

NEED OF THE STUDY

- To know whether there is a harmony among obligation and value
- To know the condition of capital structure in Aditya Birla sun extra security Co Ltd
- To know the fluctions paying off debtors and value when contrasted with a years ago
- To realize the capital structures sway on working incomes and cost of capital
- To realize various components influencing the capital structure, for example, charges, industry gauges and so on.
- To know the money related ris, business hazard and exchange off between them

OBJECTIVES OF THE STUDY:-

- EBIT-EPS examination to locate the correct capital blend.
- To investigate the estimation of the firm.
- To learn about the compelling capital structure which assists with augmenting the estimation of the firm.
- To examination how the expense of capital is decreased or limited.
- To know the soundness of Aditya Birla sun disaster protection Co.ltd capital structure when contrasted with its rivals SBI, LIC, ICICI protections and so forth... ..
- To comprehend the capital structure of Aditya Birla Sunlife Insurance.

A STUDY ON CAPITAL STRUCTURE

- To discover obligation proportion, obligation value proportion and intrigue inclusion proportion of the organization.

SCOPE OF THE STUDY:-

- The examination causes the administration to expand the estimation of the firm.
- The investigation encourages the administration to improve their association's monetary choices.
- The investigation encourages the administration to diminish or expand the expense of capital.
- The organization will settle on the budgetary plans and takes choices with the assistance of recommendations of the investigation.

RESEARCH METHODOLOGY:-

sources OF DATA:

Information was gathered through PRIMARY DATA and SECONDARY DATA.

PRIMARY DATA:-

The important information as to capital structure of the organization was gathered through moving toward the concerned branch chief of the organization – Descriptive Research Design.

SECONDARY DATA:-

For social event optional information the accompanying strategies were utilized they are:

- Different bookkeeping records of the organization.
- Internet, past task reports.
- Based on Annual records/data's of the organization.
- By benefit and misfortune A/C and Balance sheet gave by the organization.

LIMITATIONS OF THE STUDY:-

A STUDY ON CAPITAL STRUCTURE

- An itemized investigation couldn't be done due to time requirement.
- Because of absence of data it was impractical to make an appropriate examination of organization capital structure.
- People recognitions towards protection.
- Industry elements.

Hypothesis testing

Ho: Debt-value proportions of firms in a modern area are not impacted by monetary factors, for example, size, development, liquidity, gainfulness, and profit.

H1: Debt value proportions of firms in a modern area are impacted by the fundamental budgetary factors.

M-M HYPOTHESIS CORPORATE TAXES:

Modigliani and Miller later perceived the significance of presence of corporate duties. In like manner, they concurred that the estimation of the firm will increment or the expense of capital will diminish with the utilization of obligation because of assessment deductibility of intrigue charges. In this manner, the ideal capital structure can be accomplished by augmenting obligation part in the capital structure.

As indicated by this methodology, estimation of a firm can be determined as follows

Estimation of Unlevered firm (V_u) = $EBIT/K_e (1-t)$.

Where EBIT = Earnings before interest and taxes

K_e = overall cost of capital

T = tax rate

I = interest on debt capital.

DIFFERENT THEORIES OF CAPITAL STRUCTURE:

NET INCOME APPROACH:

A firm that funds its advantages by value and obligation is known as a turned firm. Then again, a firm that utilizes no obligation and accounts its benefits altogether by value is called and unlevered firm. Assume firm L is turned firm and it anticipated EBIT or net working Income of Rs 100-and intrigue installment of Rs 300. The organizations cost of value (or value capitalization rate), k_e , is 9.33 and the expense of obligation, k_d , is 6 percent. What is the company's worth? The estimation of the firm is the aggregate of the estimations of the entirety of its protections. For this situation, firm L's protections incorporate value and obligation; along these lines the entirety of the estimations of value and obligation is the company's worth. The estimation of a company's worth.

A STUDY ON CAPITAL STRUCTURE

NET OPERATING INCOME (NOI) APPROACH:

TRADITIONAL APPROACH:

takes a mid-way between the NI approach and the NOI approach

MODIGLIANI – MILLER (MM) HYPOTHESIS:

The Modigliani-Miller theory is indistinguishable with the net activity Income approach, Modigliani and Miller contended that, without charges the expense of capital and the estimation of the firm are not influenced by the adjustments in capital structure. As such, capital structure choice are unimportant and estimation of the firm is autonomous of obligation value blend.

Basic propositions::

M-M Hypothesis can be clarified as far as two suggestions of Modigliani and Miller They are:

The money related hazard increments with more obligation content in the capital structure. Subsequently cost of value (K_e) increments in a way to counterbalance precisely the minimal effort favorable position of obligation. Henceforth in general expense of capital continues as before.

ARBITRAGE PROCESS :

According to M-

M, two businesses that are indistinguishable in every way save their capital structure cannot have different market values or different costs of capital.

If these companies have dissimilar market valuations, the swap will take place and market valuations will be restored in a couple of seconds.

The exchange procedure refers to the transfer of venture speculation from one business to another.

When market esteems diverge, financial experts will try to profit by selling their safeguards at a high market cost and acquiring protections at a lower market cost.

The use of obligation by financial professionals is known as close to home influence or home produced influence.

Based on this exchange procedure, the market cost of protections in the high incentive market will fall and the market cost of protections in the lower esteem market will rise, and this exchanging procedure is repeated until the market esteems are balanced, so MM contend that there is no possibility of various market an incentive for indistinguishable firms.

MM Hypothesis and Cost Of Capital:

CRITICISM OF MM HYPOTHESIS:

The exchange procedure is the conduct and operational establishment for M Hypothesis. In any case, this procedure bombs the ideal harmony in view of the accompanying confinement.

1) Rates of intrigue are not the equivalent for people and firms. The organizations by and large have a higher credit standing in light of which they can obtain assets at a lower pace of enthusiasm when contrasted with people

2) Home-Made influence is certifiably not an ideal substitute for corporate influence. In the event that the firm obtains, the hazard to the investors is restricted to hello there shareholding in that organization. In any case, on the off chance that he acquires by and by, the risk will be reached out to his own property too. Thus, the presumption that individual home-made influence is an ideal substitute for corporate influence isn't substantial.

3) The presumption that exchanges costs don't exist isn't legitimate on the grounds that these expenses are essentially associated with purchasing and selling protections

M-M HYPOTHESIS CORPORATE TAXES:

According to this method, the worth of a company may be determined as follows:

Unlevered firm value (V_u) = $EBIT / K_e (1-t)$.

Where EBIT stands for earnings before interest and taxes.

K_e denotes the total cost of capital.

T is the tax rate.

I stands for interest on loan capital.

CHAPTER 4
DATA ANALYSIS AND INTERPRETATION

A STUDY ON CAPITAL STRUCTURE

DATA ANALYSIS AND INTERPRETATION:-

Ratio Analysis of Aditya Birla Sun Life Insurance company

- **Debt Ratio :**

Obligation proportion is a monetary proportion that indicates the extent to which an organization's advantages are provided through obligation. It is the ratio of absolute obligation to total resources.

Formula:-

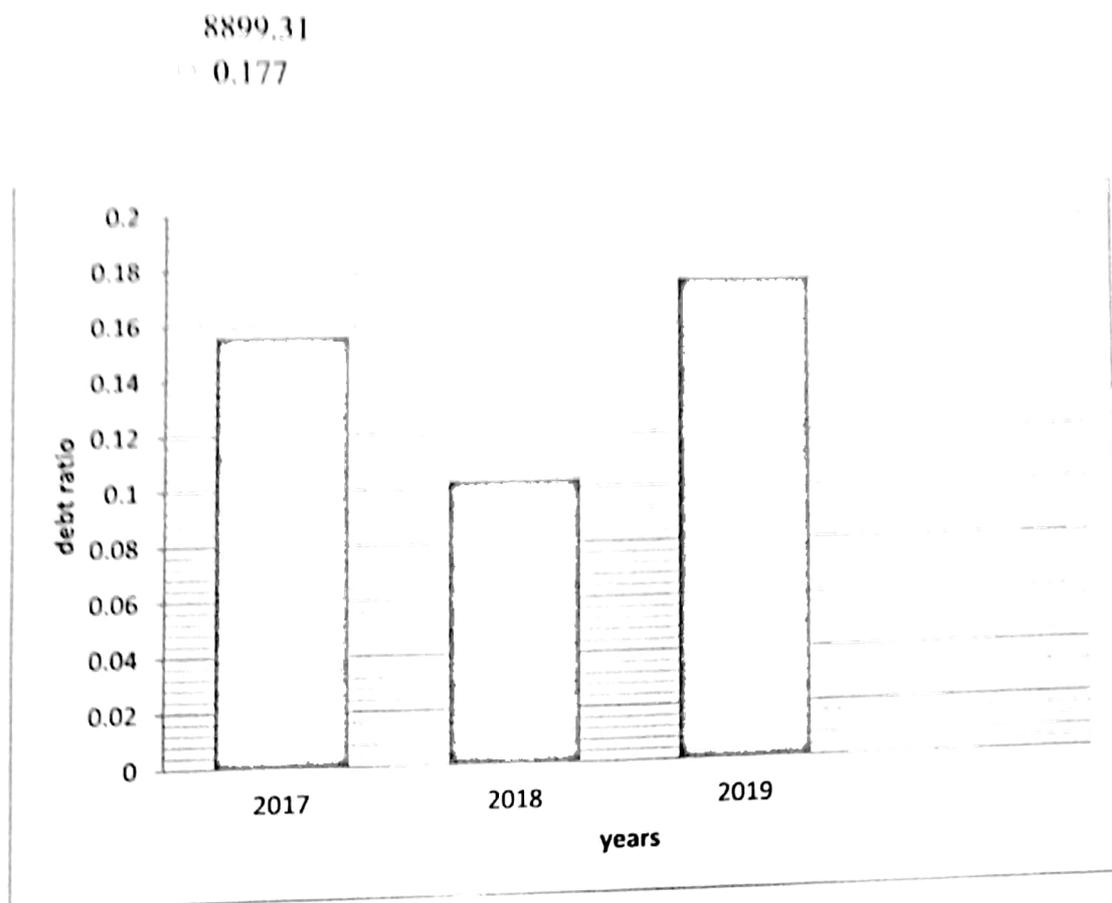
$$\text{Debt ratio: } \frac{\text{Total debt}}{\text{Total assets}}$$

Table no 1.1 showing debt ratio

Particulars	2018 (cr)	2019	2020
Total debt	13.94	828.60	1573.65
Total assets	8899.31	8083.75	8899.31
Debt ratio	0.156	0.103	0.177

$$\begin{aligned} \text{Debt ratio : } & \frac{\text{Total debt}}{\text{Total assets}} \\ & = \underline{1573.65} \end{aligned}$$

A STUDY ON CAPITAL STRUCTURE



Interpretation:-

It covers under productivity proportion which demonstrates how well the organization is adjusting all out obligation and resources.

This proportion demonstrates how best level of the organization gave resources by means of obligation. On the off chance that the proportion is higher than one, than absolute resources which implies the organization money related influence is high and have progressively monetary hazard. For the year 2017 it shows that organization has complete obligation equivalent to 0.156% of its absolute resources. For the year 2018 it shows that organization has absolute obligation isn't equivalent to 0.103% of its all out resources. For the year 2019 it shows that organization has complete obligation is over 0.177% of its all out resources.

- **Debt- equity ratio:**

The obligation value proportion is a monetary percentage that depicts the whole extent of a n investor's value and obligation utilised to support an organization's advantages..

Formula:-

$$\text{Debt - equity ratio} = \frac{\text{total liabilities}}{\text{Share holders equity}}$$

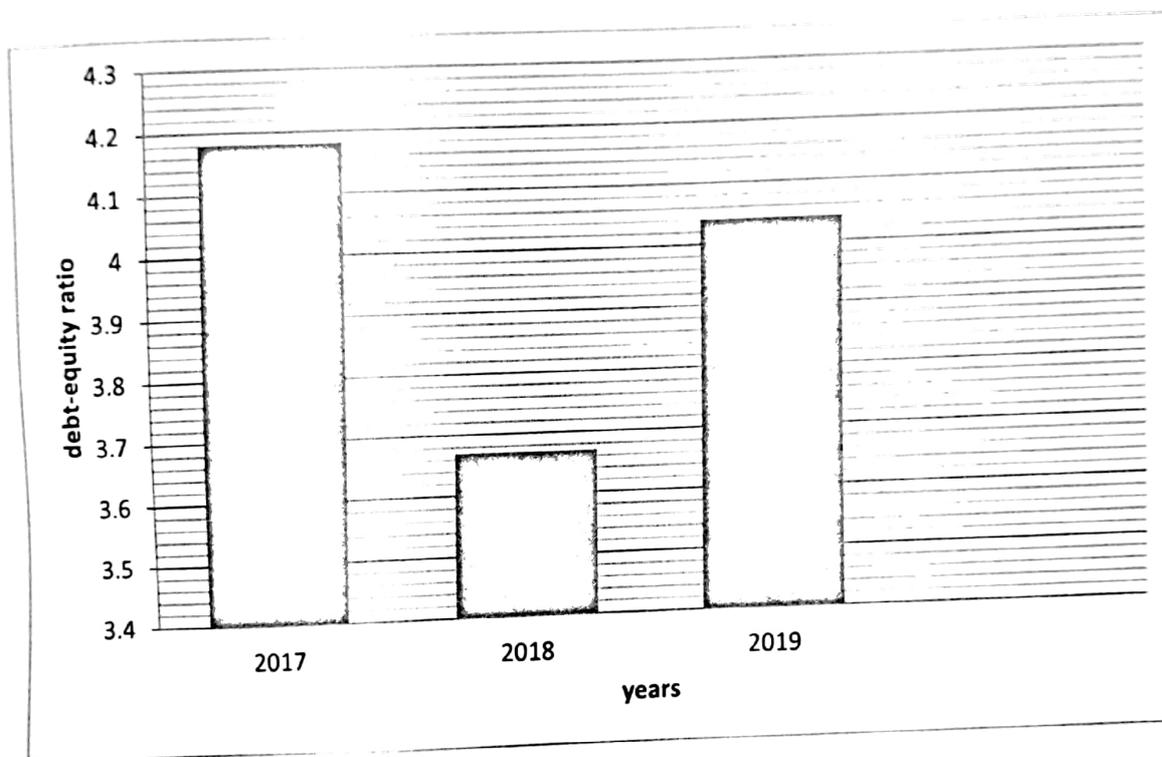
A STUDY ON CAPITAL STRUCTURE

Particulars	2017	2018	2019
Total liabilities	5,155.42	8,083.75	8,899.31
Share holder's equity	1,232.24	2,201.04	2,201.04
Debt-equity ratio	4.18	3.67	4.04

$$\text{Debt- equity ratio} = \frac{\text{total liabilities}}{\text{Share holders equity}}$$

$$= \frac{8899.31}{2,201.04}$$

$$= 4.04$$



Interpretation:-

It covers under productivity proportion which demonstrates how well the organization investors store and obligation is utilized to back resources.

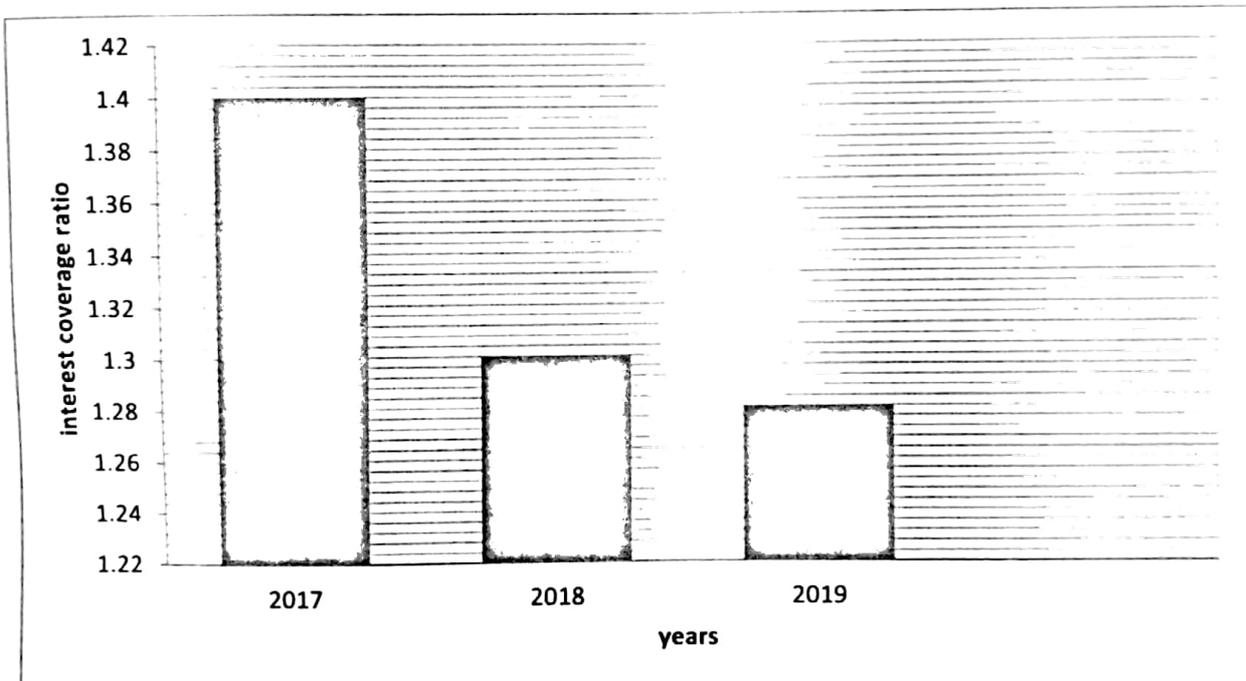
It additionally shows the adequacy of long haul money related strategies of an organization. On the off chance that a proportion of 1:1 imply that lenders and investors equally contribute to the benefits of the business. For the year 2017 the proportion was 4.18:1 it imply that loan bosses and investors similarly contributing. For the year 2018 the proportion was 3.67 it implies that both are not similarly contributing. For the year 4.04:1 it implies that both are contributing more than the year.

- Interest coverage ratio:

A STUDY ON CAPITAL STRUCTURE

The interest inclusion proportion is used to determine how efficiently a company can pay its advantage expenses on significant obligation. Table no 1.3 showing interest coverage ratio

particulars	2017	2018	2019
Interest coverage ratio	1.46	1.30	1.28



Interpretation:-

It covers under inclusion proportion which demonstrates how well the organization capacity to meet its advantage installments.

It demonstrates the organization capacity to manage the cost of the enthusiasm on the obligation for the year 2017 the intrigue inclusion proportion is more where the organization can meet its advantage installments. For the year the intrigue inclusion proportion is less where the organization can't meets its advantage installments. For the year 2019 the intrigue inclusion proportion is not exactly the earlier years.

A STUDY ON CAPITAL STRUCTURE

Capital Structure of Aditya Birla Sun Life Insurance Company Limited:-

Period	Instrument	Authorized Capital (Rs. cr)	Issued Capital (Rs. cr)	- P A I D U P -		
				Shares (nose)	Face Value	Capital
2018/2019	Equity Share	4000	2,201.40	2,201,404,363	10	2,201.40
2017/2018	Equity Share	4000	2,201.04	2,201,039,348	10	2,201.04
2016/2017	Equity Share	2200	1,232.24	1,232,240,000	10	1,232.24

A STUDY ON CAPITAL STRUCTURE

Particulars	Note No.	Year ended 31st March, 2020	Year ended 31st March, 2019
REVENUE FROM OPERATIONS			
Interest Income	19	18.45	14.63
Dividend Income	20	162.21	111.26
Net (Loss)/Gain on Fair Value Changes	21	(2.88)	38.14
Total Revenue from Operations		177.78	164.03
Other Income	22	0.71	0.60
Total Income		178.49	164.63
EXPENSES			
(a) Finance Costs	23	88.53	25.38
(b) Impairment on Financial Instruments	24	0.18	0.91
(c) Employee Benefits Expense	25	27.05	36.80
(d) Depreciation and Amortization	26	0.87	0.49
(e) Other Expenses	27	43.18	64.88
Total Expenses		159.81	128.46
Profit Before Exceptional Items and Tax		18.68	36.17
Exceptional Items (Refer Note No. 48)		(30.32)	-
(Loss)/Profit Before Tax		(11.64)	36.17
Tax Expenses			

A STUDY ON CAPITAL STRUCTURE

(Excess) Provision for Tax related to earlier years (net)		(2.43)	-
Deferred Tax		0.39	-
Total Tax Expenses		(2.04)	-
(Loss)/Profit For The Year		(9.60)	36.17
Other Comprehensive Income			
(I) Items that will not be reclassified to profit or loss (net of tax)		0.03	0.53
Total Comprehensive Income For The Year		(9.57)	36.70
Basic Earnings Per Share - (₹)	28	(0.04)	0.19
Diluted Earnings Per Share - (₹)		(0.04)	0.18
(Face Value of ₹ 10 each)			

CHAPTER 5

FINDINGS AND SUGGESTIONS

A STUDY ON CAPITAL STRUCTURE

- ✓ Most of the speculators are budgetary ignorant people.
- ✓ 71% of the individuals favored interest temporarily and medium term.
- ✓ The speculators choices depend on their own drives.

SUGGESTIONS:-

- ✓ Increasing mindfulness level by expanding number of hoardings in prime regions, for example, Bank square division and modern regions.
- ✓ The organization ought to seriously advance the items.
- ✓ It is suggested that financial specialists choice ought to be founded on their dealer counsel
- ✓ The organization should cover different dangers in a single strategy with same premium.
- ✓ Risk and return ought to be assessed before settling on a speculation choices.
- ✓ They need to refresh their portfolio appropriately.
 - ✓ Aditya birla sun life coverage Company ought to have appropriate division of offices under heads.

RECOMMENDATIONS:-

- ✓ Even however a large portion of the approach holders are happy with strategies, plans they have yet some new alluring protection plans ought to be actualized to tie them not to switch over to different organizations protection plans.
- ✓ The organization should discover the no, which are not having any of the protection plans through a serious statistical surveying and inspire them to get guaranteed.
- ✓ Leveraging innovation to support clients rapidly, proficiently and helpfully
- ✓ Developing and executing prevalent hazard the executives and venture and stable comes back to our policyholders.
- ✓ Company should focus on every single class of society.

CONCLUSION: -

The market potential for private insurance agencies is seen as more prominent over the long haul as the greater part of the Indians are of the feeling that, private insurance agencies would have the option to perform well later on. The insurance agency likewise keeps up capital structure to maintain their business effectively. The ideal capital structure causes the insurance agency to gain benefit and to develop in the market. The private protection need to focus on the components like "counteraction of misfortune", guaranteed returns and long haul speculations. The private insurance agencies that are making prompt strides can tap it effectively and quickly.

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✓ Company ought to give full data to the clients before focusing on so they can take intrigue.


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