VISVESVARAYA TECHNOLOGICAL UNIVERSITY

"Jnana Sangama" Belagavi – 590 010

INTERNSHIP REPORT ON

1. **Embedded Systems and Sensor Interfacing at Envision Lab**
2. **Globe Satellite Model at NRSC**
3. **Emotion Analysis using Algorithms at TCS iON**

Submitted in partial fulfillment of the requirements for the award of degree

BACHELOR OF ENGINEERING

IN

ELECTRONICS & COMMUNICATION ENGINEERING

Submitted By

ABHISHEK M SHASTRY K

4AL17EC002

Under the Guidance of

Mrs. NISHMA K

Assistant Professor

Department of E&C Engineering

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

ALVA'S INSTITUTE OF ENGINEERING & TECHNOLOGY
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MOODBIDRI-574225, KARNATAKA

(Affiliated to VTU, Belagavi)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that the "Internship report" submitted by ABHISHEK M SHASTRY K (4AL17EC002) is work done by him and submitted during 2020 – 2021 academic year, in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

Signature of the Coordinator	Signature of the H.O.D	Signature of the Principle
Mrs. Nishma K	Dr. D V Manjunatha	Dr. Peter Fernandes

Examiners

Name	Signature with date
1) ______________________	1) ______________________
2) ______________________	2) ______________________

ABSTRACT

Envision Lab is a research and prototyping lab set up on the campus of Alva's Institute of Engineering and Technology (AIET) at the end of 2016 by the team of Oscki Labs. The lab was set up with the help of students and follows the open learning culture. Now the lab is run independently and providing a platform for product development and manufacturing in the domain of electronics and robotics. The lab is equipped with all the necessary tools and equipment. The lab houses an industrial-grade 3-Dimensional printer and PCB manufacturing setup for aiding the in-house prototyping.

I got an opportunity to complete my Internship at Envision Lab, AIET. Internship started on 10th July 2019 and ended on 25th July 2019 which included 15 days. During the internship period with learning senser interfacing with microcontrollers using Embedded C programming and developed a prototype model of a Ball Shooter.

National Remote Sensing Centre (NRSC) has the mandate for establishment of ground stations for receiving satellite data, generation of data products, dissemination to the users, development of techniques for remote sensing applications including disaster management support, geospatial services for good governance and capacity building for professionals, faculty and students. NRSC is one of the primary centres of Indian Space Research Organisation (ISRO), Department of Space (DOS).

I got an opportunity to complete my Internship at National Remote Sensing Center (NRSC). It started on 10th January 2020 and ended on 22nd March 2020 which included 73 days. On internship period we developed a working Globe-Satellite Model. This model reflects the actual rotation of geo-stationary and polar satellite. The system is developed using Arduino UNO R3 which acts as controller and controllers the all the operation of the system. The DC motors driver is used to drive the two DC motors and control the speed of rotation with the help of potentiometer. To realize the model two separate DC motors are used for geo-stationary and polar satellites.

I got an opportunity to do online internship provided by TCS iON. It was work and learn platform where students have to learn and parallelly do a project based on the topic. TCS iON Digital Learning Platform, Remote Internships provides a structured learning environment with access to industry mentors, industry-curated learning material, projects, and videos or webinars. TCS iON provided various topics to do internship, I took Automate Detection of Different Emotions from Textual Comments and Feedback as my internship project. The objective of this project is to develop a deep learning algorithm to detect different types of emotions contained in a collection of English sentences or a large paragraph. Text classifiers such as CountVectorizer, TF-IDF Vectorizer, Word2Vec are used to classify text or count words in the text, URL's, mentions, hashtags, emoji's, capital words, etc.

ACKNOWLEDGEMENT

First, I would like to thank **Mr. Himanshu Rangadhol, Envision Lab** for giving me the opportunity to do internship in collaboration with the organisation.

I would like to thank **Mrs. Shafali Tandon, Sci/Eng, Outreach facility, NRSC Hyderabad** with their patience and openness for creating and enjoyable working environment. It was indeed a great sense of pleasure and immense sense of gratitude that I acknowledge the help of individuals. Also, I would like to thank **Dr. Dattatreya Gujjar,AIET,Mijar** who believed in us and gave us opportunity to work at NRSC.

I also would like to thank **Mr. Debashis Roy, Industry mentor, TCS iON** with their patience and openness and constant help to complete the project. It is indeed with a great sense of pleasure to do an online internship under his guidance.

I am highly indebted to Managing Trustee **Mr. Vivek Alva** and Principal **Dr. Peter Fernandes**, **Alva's Institute of Engineering and Technology, Mijar** for the facilities provided to accomplish this internship.

I would like to thank my Head of the Department, **Dr. D V Manjunatha**, **Professor, Department of Electronics and Communication Engineering** for his constructive guidance throughout my internship.

I would like to thank **Mrs. Nishma K, Assistant Professor, Department of Electronics and Communication Engineering** for her support and advices to complete internship in above said organization.

I am extremely great full to my department staff members and friends who helped me in successful completion of this internship.

Abhishek M Shastry K

4AL17EC002

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

AVR	Alf and Vegard's Reduced-instruction-set-computer
CAD	Computer Aided Design
CV	Count Vectorizer
EM	Electro-magnetic
EMF	Electro Magnetic Field
GEO	Geostationary Satellite
GPS	Global Positioning System
IDE	Integrated Development Environment
LDR	Light Dependent Resistor
MCU	Micro-controller Unit
NWP	Numerical Weather Prediction
PWM	Pulse Width Modulation
RPM	Rotations Per Minute
SAT	Satellite
TF-IDF	Term Frequency–Inverse Document Frequency
TV	Television
URL	Uniform Resource Locators
USB	Universal Serial Bus

INTERNSHIP 1

EMBEDDED SYSTEMS AND SENSOR INTERFACING

AT

ENVISION LAB

FROM 10-07-2019 to 25-07-2019

CHAPTER 1

ENVISION LAB OVERVIEW

1.1 Introduction

A research and prototyping lab set up on the campus of Alva's Institute of Engineering and Technology (AIET) at the end of 2016 by the team of Oscki Labs. The lab was set up with the help of students and follows the open learning culture. Now the lab is run independently and providing a platform for product development and manufacturing in the domain of electronics and robotics. The lab is equipped with all the necessary tools and equipment. The lab houses an industrial-grade 3-Dimensional printer and PCB manufacturing setup for aiding the in-house prototyping.

The lab will be interdisciplinary and multi-field prototyping lab, open for both students and faculties at AIET. The entire infrastructure and all the facilities for the lab being provided by AIET. Here under constant technical support and funding from Oscki Labs students will build their own prototypes from scratch. Also, Oscki Labs is getting its own live projects to AIET at Envision Lab to provide fair industrial exposure to selected students also providing internships for them. This unique Envision Lab is collaborated with the entire college and all the disciplines for providing a firm platform for students to build their prototypes. Selected projects from students will be led to publishing papers, applying patents, industrial funding and also to start their own companies.

1.2 Objectives

- Imparting valuable practical knowledge on how things work to promote a community research culture.
- Giving students various entries into different fields of research to enhance their thought process.
- Making students involved in activities to boost their presentation and communication skills.
- Providing internship opportunities to get exposure to industrial aspects.

CHAPTER 2

BALL SHOOTER

2.1 Introduction

Ball shooter is a device where we shoot plastic (ping pong) balls into the basket. Catapult or slingshot idea is used to launch the ball. The microcontroller used to control overall operation of the device is Arduino UNO. To calculate the distance between launcher and the basket, sensors and trajectory equations are used to shoot the ball into the basket. To measure the distance ultrasonic sensor is interfaced with Arduino. To pull the elastic string geared DC motor is used with its motor driver interfaced to Arduino. And servo motor is used to change angle of the launcher platform. The whole device is built using foam board since it is light in weight and also imposes less stress on servo motor while changing angles of the launcher platform.

2.2 Working

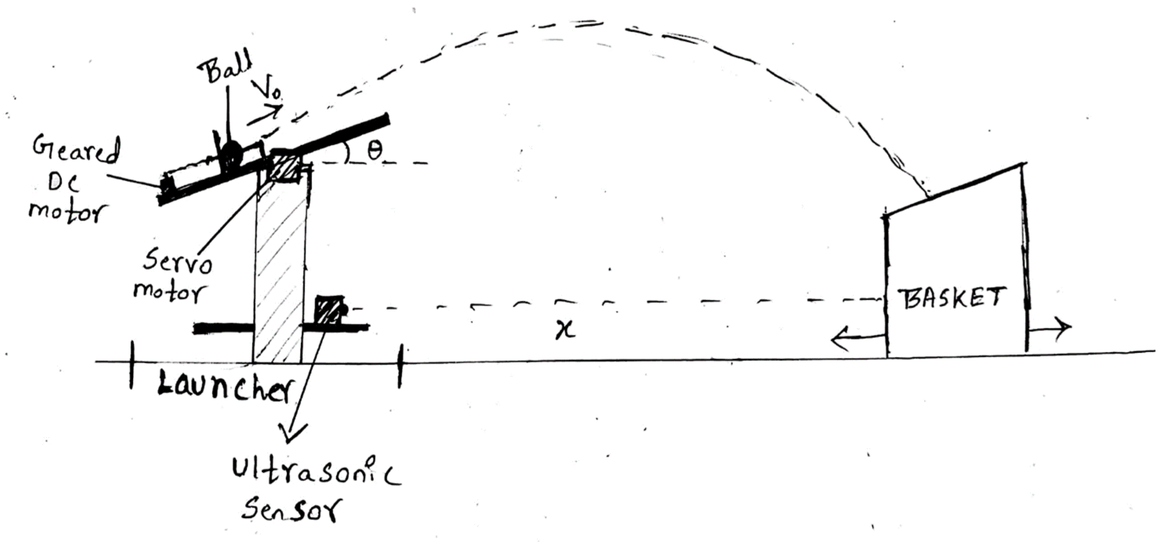

Figure 2.1: Setup for Ball Shooter

It works on the principle of projectile motion. The formula for the trajectory path is given by,

$$y = x \tan\theta - \frac{gx^2}{2{v_0}^2 \cos^2\theta}$$

- y = vertical position (m)
- x = horizontal position (m)
- V0 = initial velocity (combined components, m/s)
- g = acceleration due to gravity (9.80 m/s2)
- θ = angle of the initial velocity from the horizontal plane (radians or degrees)

Ultrasonic sensor is used to measure the distance between the launcher and the basket. From the distance measured, the required angle for the projection and the required velocity for the ball is calculated. servo motor is used to vary the required angle of the launcher. To calculate and control overall operation of the model Arduino is coded in the Arduino IDE platform using Embedded C language. The output from the ultrasonic sensor is taken to obtain distance between launcher and basket and used in the trajectory formula to get angle that has to be set for the launcher. The obtained angle value is fed to servo motor to set launcher to the desired angle. Geared DC motor is used to pull the elastic string to get the desired initial velocity for launching the ball. The ball is launched by releasing the elastic string and made to fall into the basket as shown in Figure 2.1.

2.3 Conclusion

In this course of internship learned Embedded C programming and to interface different Sensors and modules such as IR sensor, Tilt sensor, Sound sensor, Ultra sonic sensor, LDR, Servo motor, DC motor, TM1637 display, etc. with Arduino UNO. With learning, parallelly a working prototype of a Ball Shooter was completed. My role in the project was build the launcher platform for the Ball Shooter and the coding Arduino using Arduino IDE for the mode.

INTERNSHIP 2

GLOBE SATELLITE MODEL

AT

NRSC

FROM 10-01-2020 to 22-03-2020

CHAPTER 1

NATIONAL REMOTE SENSING CENTRE OVERVIEW

1.1 Introduction

National Remote Sensing Centre (NRSC) has the mandate for establishment of ground stations for receiving satellite data, generation of data products, dissemination to the users, development of techniques for remote sensing applications including disaster management support, geospatial services for good governance and capacity building for professionals, faculty and students. NRSC is one of the primary centres of Indian Space Research Organisation (ISRO), Department of Space (DOS). Considering the ever-increasing demands of all stakeholders / users, a centralized Outreach Facility for NRSC is established at Jeedimetla, Hyderabad, integrating all the relevant activities namely, Training, Outsourcing, Exhibition Facility, Information Kiosks, Web Services and proposed Incubation Facility.

1.2 NRSC Campuses

- Main Campus at Balanagar,Hyderabad for Administration, Remote Sensing Applications and Aerial Services.
- The Campus at Shadnagar for Satellite Data Reception, Data Processing and Dissemination, Earth and Climate Studies and Disaster Management Support.
- Five Regional Centres in Jodhpur (Regional Centre-West), Sadhiknagar at New Delhi (Regional Centre-North), New Salt Lake City in Kolkata (Regional Centre-East), Amaravathy Road in Nagpur (Regional Centre-Central), Karthik Nagar in Bangalore (Regional Centre-South) for promoting remote sensing applications for various states.
- Outreach facility at Jeedimetla in Hyderabad for providing training for professionals, faculty and students and for general outreach.
- Aircraft operations facility at Begumpet Airport, Hyderabad.

CHAPTER 2

GLOBE SATELLITE MODEL

2.1 Introduction

A satellite is an object in space that orbits or circles around a bigger object. There are two kinds of satellites: Natural (such as the moon orbiting the Earth) or Artificial (such as the International Space Station orbiting the Earth). There are dozens upon dozens of natural satellites in the solar system, with almost every planet having at least one moon. Saturn, for example has at least 53 natural satellites and between 2004 and 2017, it also had an artificial one, the Cassini spacecraft, which explored the ringed planet and its moons. Artificial satellites, however, did not become a reality until the mid-20th century. The first artificial satellite was Sputnik, a Russian beach-ball-size space probe that lifted off on Oct 4, 1957.

2.2 Why Are Satellites Important?

The bird's-eye view that satellites have allows them to see large areas of Earth at one time. This ability means satellites can collect more data, more quickly, than instruments on the ground. Satellites also can see into space better than telescopes at Earth's surface. That's because satellites fly above the clouds, dust and molecules in the atmosphere that can block the view from ground level. Before satellites, TV signals didn't go very far. TV signals only travel in straight lines, so they would quickly trail off into space instead of following Earth's curve. Sometimes mountains or tall buildings would block them.

2.3 Objectives

- To understand the concept of Geo-stationary and Polar orbits.
- Design 3D satellite-globe model using Autodesk (Fusion 360).
- Controlling operations of the model using microcontroller Arduino UNO Rev3 and L298N Motor Driver IC.
- To illustrate how the Satellites, revolve in their respective orbits around the Earth.

CHAPTER 3

FUNDEMENTALS

A satellite is a moon, planet or machine that orbits a planet or star. For example, Earth is a satellite because it orbits the sun. Likewise, the moon is a satellite because it orbits Earth. Usually, the word "satellite" refers to a machine that is launched into space and moves around Earth or another body in space.

Earth and the moon are examples of natural satellites. Thousands of artificial or man-made satellites orbit Earth. Some take pictures of the planet that help meteorologists predict weather and track hurricanes. Some take pictures of other planets, the sun, black holes, dark matter or faraway galaxies. These pictures help scientists better understand the solar system and universe.

3.1 Classification of artificial satellites

Satellites can be classified by their function since they are launched into space to do a specific job. The satellite must be designed specifically to fulfil its role. There are nine different types of satellites:

- Communications Satellite
- Remote Sensing Satellite
- Navigation Satellite
- Geocentric Orbit type satellites - LEO, MEO, HEO
- Global Positioning System (GPS)
- Geostationary Satellites (GEOs)
- Drone Satellite
- Ground Satellite
- Polar Satellite

In general, there are two groups of artificial satellites: The satellites that orbit the equator (Geo-stationary satellites), and those that orbit from pole to pole (polar satellites).

3.1.1 Geo-stationary Satellites

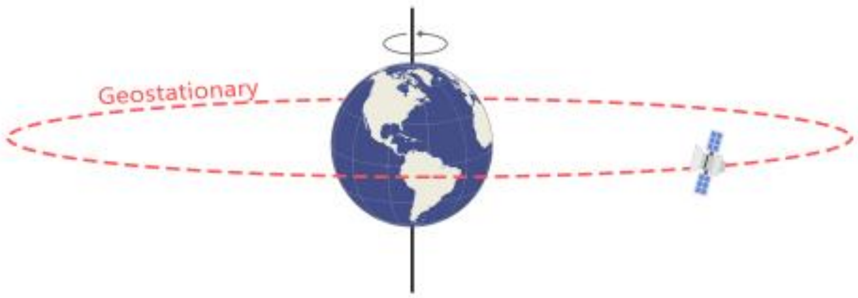

Figure 3.1: Orbit of Geo-Stationary satellite

A geo-stationary satellite is an earth-orbiting satellite, placed at an altitude of approximately 35,800 kilometres (22,300 miles) directly over the equator, that revolves in the same direction the earth rotates (west to east) as shown in Figure 3.1. At this altitude, one orbit takes 24 hours, the same length of time as the earth requires to rotate once on its axis. The term “geostationary” comes from the fact that such a satellite appears nearly stationary in the sky as seen by a ground-based observer.

Geo-stationary satellites have two major limitations. First, because the orbital zone is an extremely narrow ring in the plane of the equator, the number of satellites that can be maintained in geostationary orbits without mutual conflict (or even collision) is limited. Second, the distance that an electromagnetic (EM) signal must travel to and from a geostationary satellite is a minimum of 71,600 kilometres or 44,600 miles. Thus, a latency of at least 240 milliseconds is introduced when an EM signal, traveling at 300,000 kilometres per second (186,000 miles per second), makes a round trip from the surface to the satellite and back.

Some of the advantages of geo-stationary satellites are to get high temporal resolution data, tracking of the satellite by its earth stations is simplified, Satellite always stays in the same position. The disadvantage of geo-stationary satellites is the incomplete geographical coverage, since ground stations at higher than roughly 60 degrees latitude have difficulty reliably receiving signals at low elevations. Satellite dishes at such high latitudes would need to be pointed almost directly towards the horizon. The signals would have to pass through the largest amount of atmosphere, and could even be blocked by land topography, vegetation or buildings. Broadcasting (Mainly Television), Point to Multi point communications, Mobile services are some of the applications of geo-stationary satellites.

3.1.2 Polar Satellites

Figure 3.2: Orbit of Polar satellite

Polar satellite is a satellite whose orbit is perpendicular or at right angles to the equator or in simple words it passes over the north and south poles as it orbits the earth as shown in Figure 3.2. It can be at any height from the earth, typically at 500–800 Kms. As the earth rotates under it, the earth presents a different face at every pass, making it possible to map / scan the entire earth surface with Polar satellite over time. This property makes them excellent tool as earth observation or spy satellite.

A polar orbit travels north-south over the poles and takes approximately an hour and a half for a full rotation. As the satellite is in orbit, the Earth is rotating beneath it. As a result, a satellite can observe the entire Earth’s surface in the time span of 24 hours.

Some of the advantages of polar satellites are the orbit is lower than Geostationary satellites, so the data resolution is higher, they provide global coverage, necessary for NWP models and climatic studies. The main disadvantage of polar satellites is that it cannot provide continuous viewing of one location. Polar satellites are often used for applications such as monitoring crops, forests and even global security.

3.2 Geo-stationary Orbit

A geostationary orbit, also referred to as a geosynchronous equatorial orbit (GEO), is a circular geosynchronous orbit 35,786 kms (22,236 miles) above Earth's equator and following the direction of Earth's rotation.

The concept of a geostationary orbit was popularized by Arthur C. Clarke in the 1940s as a way to revolutionize telecommunications, and the first satellite to be placed in this kind of orbit was launched in 1963.

A typical geostationary orbit has the following properties:

- Inclination: 0°
- Period: 1436 minutes (one sidereal day)
- Eccentricity: 0
- Argument of perigee: undefined
- Semi-major axis: 42,164 km

Inclination

An inclination of zero ensures that the orbit remains over the equator at all times, making it stationary with respect to latitude from the point of view of a ground observer.

Period

The orbital period is equal to exactly one sidereal day. This means that the satellite will return to the same point above the Earth's surface every (sidereal) day, regardless of other orbital properties. For a geostationary orbit in particular, it ensures that it holds the same longitude over time. This orbital period, T is directly related to the semi-major axis of the orbit through the formula

$$T = 2\pi\sqrt{\frac{a^3}{\mu}}$$

- **a** is the length of the orbit's semi-major axis
- **μ** is the standard gravitational parameter of the central body

Eccentricity

The eccentricity is zero, which produces a circular orbit. This ensures that the satellite does not move closer or further away from the Earth, which would cause it to track backwards and forwards across the sky.

3.2.1 Derivation of geostationary altitude

For circular orbits around a body, the centripetal force required to maintain the orbit (F_c) is equal to the gravitational force acting on the satellite (F_g)

$$F_c = F_g$$

From Isaac Newton's Universal law of gravitation,

$$F_g = G\frac{M_E m_s}{r^2}$$

- $\mathbf{F_g}$ is the gravitational force acting between two objects
- $\mathbf{M_E}$ is the mass of the Earth, 5.9736×10^{24} kg
- $\mathbf{m_s}$ is the mass of the satellite,
- **r** is the distance between the centres of their masses
- **G** is the gravitational constant, $(6.67428 \pm 0.00067) \times 10^{-11}$ m^3 kg^{-1} s^{-2}.

The magnitude of the acceleration (a) of a body moving in a circle is given by:

$$a = \frac{v^2}{r}$$

Where, **v** is the magnitude of the velocity (i.e., the speed) of the satellite. From Newton's Second law of Motion, the centripetal force $\mathbf{F_c}$ is given by:

$$F_c = m_s\frac{v^2}{r}$$

As $\boldsymbol{F_c = F_g}$,

$$m_s \frac{v^2}{r} = G \frac{M_E m_s}{r^2}$$

so that,

$$v^2 = G \frac{M_E}{r}$$

Replacing **v** with the equation for the speed of an object moving around a circle produces:

$$\left(\frac{2\pi r}{T}\right)^2 = G \frac{M_E}{r}$$

where T is the orbital period (i.e., one sidereal day), and is equal to 86164.09054s. This gives an equation for **r**:

$$r = \sqrt[3]{\frac{GM_E T^2}{4\pi^2}}$$

The product GME is known with much greater precision than either factor alone; it is known as the geocentric gravitational constant μ = 398,600.4418 ± 0.0008 km3 s−2. Hence

$$\mathbf{r} = \sqrt[3]{\frac{\boldsymbol{\mu}\mathbf{T}^2}{\mathbf{4}\boldsymbol{\pi}^2}}$$

The resulting orbital radius is 42,164 kms (26,199 miles). Subtracting the Earth's equatorial radius, 6,378 kms (3,963 miles), gives the altitude of 35,786 kms (22,236 miles). The orbital speed is calculated by multiplying the angular speed by the orbital radius:

$$v = \omega r \quad \approx 3074.6 \text{ m/s}$$

3.3 Arduino IDE

3.3.1 A Brief History

In 2005, building upon the work of Hernando Barragan (creator of Wiring), Massimo Banzi and David Cuartielles created Arduino, an easy-to-use programmable device for interactive art design projects, at the Interaction Design Institute Ivrea in Ivrea, Italy. David Mellis developed the Arduino software, which was based on Wiring. Before long, Gianluca Martino and Tom Igoe joined the project, and the five are known as the original founders of Arduino. They wanted a device that was simple, easy to connect to various things (such as relays, motors, and sensors), and easy to program. They selected the AVR family of 8-bit microcontroller (MCU or µC) devices from Atmel and designed a self-contained circuit board with easy-to-use connections, wrote bootloader firmware for the microcontroller, and packaged it all into a simple integrated development environment (IDE) that used programs called “sketches”. The result was the Arduino.

3.3.2 Brief about Arduino IDE

Arduino IDE is an open-source software that is mainly used for writing and compiling the code into the Arduino Module. It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment. A range of Arduino modules available including Arduino Uno, Arduino Mega, Arduino Leonardo, Arduino Micro and many more. Each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module. This environment supports both C and C++ languages.

3.4 Arduino Uno Rev3

Arduino Uno is a microcontroller board based on the ATmega328P as shown in Figure 3.3. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything which are needed to support the microcontroller. The Arduino Uno has a number of facilities for communicating with a computer, another Arduino board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1).

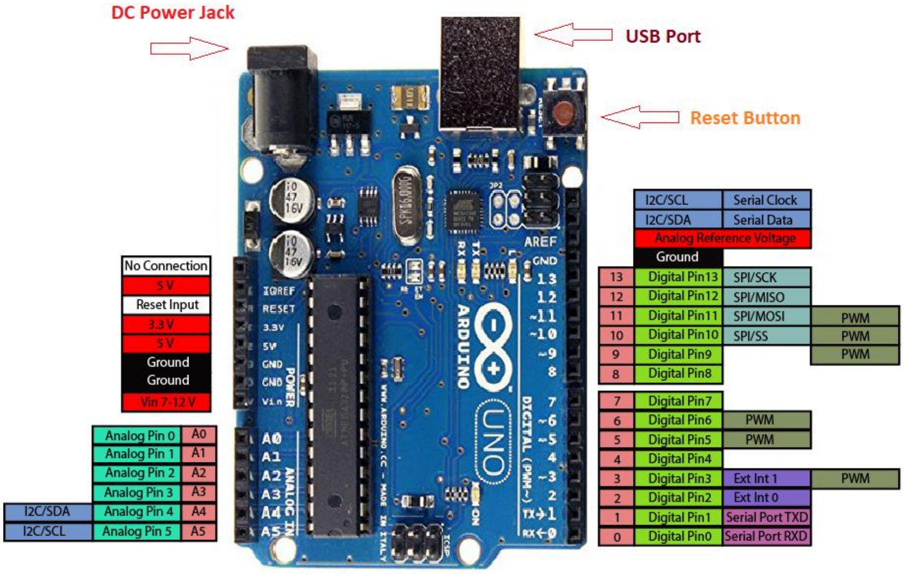

Figure 3.3: Pin diagram of Arduino UNO Rev3

3.4.1 Specifications of Arduino Uno Rev3

Table 3.1 Specifications of Arduino Uno Rev3

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g

3.4.2 Components of Arduino Uno R3

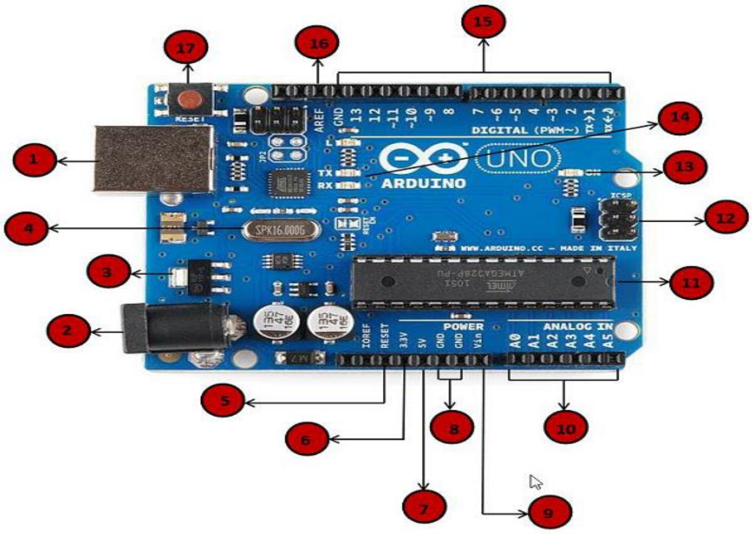

Figure 3.4 Pinout of Arduino UNO R3

1	**Power USB** Arduino board can be powered by using the USB cable from your computer. All you need to do is connect the USB cable to the USB connection.
2	**Power (Barrel Jack)** Arduino boards can be powered directly from the AC mains power supply by connecting it to the Barrel Jack.
3	**Voltage Regulator** The function of the voltage regulator is to control the voltage given to the Arduino board and stabilize the DC voltages used by the processor and other elements.
4	**Crystal Oscillator** The crystal oscillator helps Arduino in dealing with time issues. How does Arduino calculate time? The answer is, by using the crystal oscillator. The number printed on top of the Arduino crystal is 16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16 MHz.

5,17	**Arduino Reset** You can reset your Arduino board, i.e., start your program from the beginning. You can reset the UNO board in two ways. First, by using the reset button (17) on the board. Second, you can connect an external reset button to the Arduino pin labelled RESET (5).
6,7 8,9	**Pins (3.3, 5, GND, Vin)** • 3.3V (6) − Supply 3.3 output volt • 5V (7) − Supply 5 output volt • GND (8) (Ground) − There are several GND pins on the Arduino, any of which can be used to ground your circuit. • Vin (9) − This pin also can be used to power the Arduino board from an external power source, like AC mains power supply.
10	**Analog pins** The Arduino UNO board has six analog input pins A0 through A5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.
11	**Main microcontroller** Each Arduino board has its own microcontroller (11). You can assume it as the brain of your board. The main IC (integrated circuit) on the Arduino is slightly different from board to board. The microcontrollers are usually of the ATMEL Company. You must know what IC your board has before loading up a new program from the Arduino IDE.
12	**ICSP pin** Mostly, ICSP (12) is an AVR, a tiny programming header for the Arduino consisting of MOSI, MISO, SCK, RESET, VCC, and GND. It is often referred to as an SPI (Serial Peripheral Interface), which could be considered as an "expansion" of the output. Actually, you are slaving the output device to the master of the SPI bus.

13	**Power LED indicator** This LED should light up when you plug your Arduino into a power source to indicate that your board is powered up correctly. If this light does not turn on, then there is something wrong with the connection.
14	**TX and RX LEDs** On your board, you will find two labels: TX (transmit) and RX (receive). They appear in two places on the Arduino UNO board. First, at the digital pins 0 and 1, to indicate the pins responsible for serial communication. Second, the TX and RX led (13). The TX led flashes with different speed while sending the serial data. The speed of flashing depends on the baud rate used by the board.
15	**Digital I/O** The Arduino UNO board has 14 digital I/O pins (15) (of which 6 provide PWM (Pulse Width Modulation) output. These pins can be configured to work as input digital pins to read logic values (0 or 1) or as digital output pins to drive different modules like LEDs, relays, etc. The pins labeled "~" can be used to generate PWM.
16	**AREF** AREF stands for Analog Reference. It is sometimes, used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

3.5 Geared DC Motor

3.5.1 What is a Geared DC Motor?

Geared DC motors can be defined as an extension of DC motor. A geared DC Motor has a gear assembly attached to the motor as shown in Figure 3.5. The speed of motor is counted in terms of rotations of the shaft per minute and is termed as RPM. The gear assembly helps in increasing the torque and reducing the speed. Using the correct combination of gears in a gear motor, its speed can be reduced to any desirable figure. This concept where gears reduce the speed of the vehicle but increase its torque is known as gear reduction as shown in Table 3.1.

Figure 3.5: Geared DC Motor

3.5.2 Specifications

Table 3.2 Specifications of Geared DC Motor

Motor Type	DC with Gear Box, Metal Gears
Shaft Type	Circular 6mm diameter with internal hole for coupling, 23 mm shaft length.
Maximum Torque	~3 Kg-cm at 12V
RPM	60 RPM at 12V
Weight	130 Grams
Max Load Current	~330mA at 12V

3.6 Potentiometer

A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat as shown in Figure 3.6.

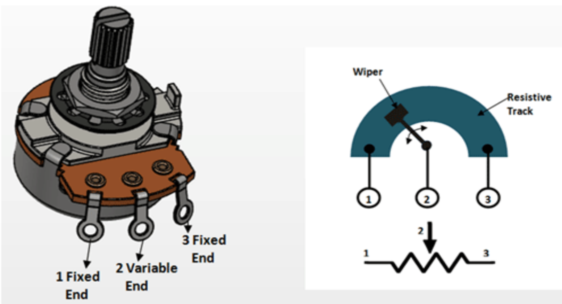

Figure 3.6: Three Pin Potentiometer

3.6.1 How Does a Potentiometer Work?

A potentiometer is a passive electronic component. Potentiometers work by varying the position of a sliding contact across a uniform resistance. In a potentiometer, the entire input voltage is applied across the whole length of the resistor, and the output voltage is the voltage drop between the fixed and sliding contact as shown in Figure 3.7.

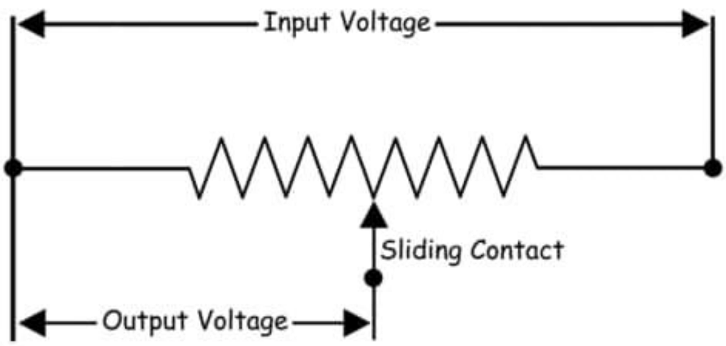

Figure 3.7: Schematic of Potentiometer

A potentiometer has the two terminals of the input source fixed to the end of the resistor. To adjust the output voltage the sliding contact gets moved along the resistor on the output side. This is different to a rheostat, where here one end is fixed and the sliding terminal is connected to the circuit, as shown in Figure 3.8.

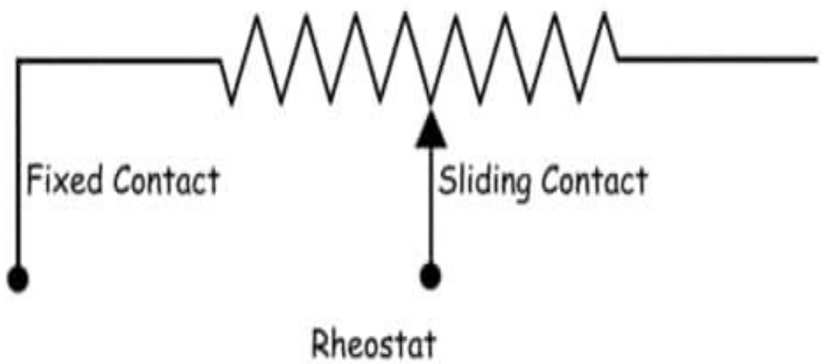

Figure 3.8: Schematic of Rheostat

3.6.2 Working Principle of Potentiometer

The potentiometer consists of L which is a long resistive wire and a battery of known EMF V whose voltage is known as driver cell voltage. Assume a primary circuit arrangement by connecting the two ends of L to the battery terminals. One end of the primary circuit is connected to the cell whose EMF E is to be measured and the other end is connected to galvanometer G. This circuit is assumed to be a secondary circuit as shown in Figure 3.9.

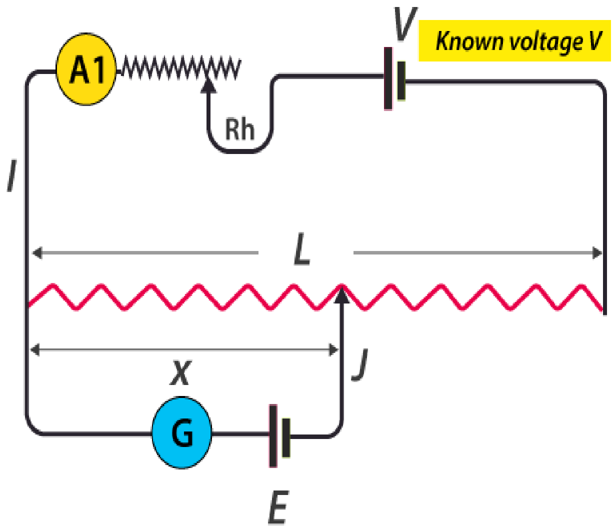

Figure 3.9: Working of Potentiometer

The working principle depends on the potential across any portion of the wire which is directly proportional to the length of the wire that has a uniform cross-sectional area and current flow is constant. Following is the derivation of used to explain the potentiometer working principle:

$V = I * R$ (Ohm's law)

- I: Current
- R: Total resistance
- V: Voltage
- $R = \rho / (L * A)$
- $V = I * (\rho / (L * A))$
- ρ: Resistivity
- A: Cross-sectional area

With ρ and A constant, I is constant too for a rheostat.

(L * ρ) / A = K

V = K * L

E = (L * ρ * x) / A = K * x

- x: Length of potentiometer wire
- E: Cell with Lower EMF
- K: Constant

The galvanometer G has null detection as the potential difference is equal to zero and there is no flow of current. So, x is the length of the null point. Unknown EMF can be found by knowing x and K.

Since the EMF has two cells, let L1 be the null point length of the first cell with EMF E1 and L2 be the null point length of the second cell with EMF E2.

Therefore,

E1 / E2=L1 / L2

3.7 L298N Motor Driver IC

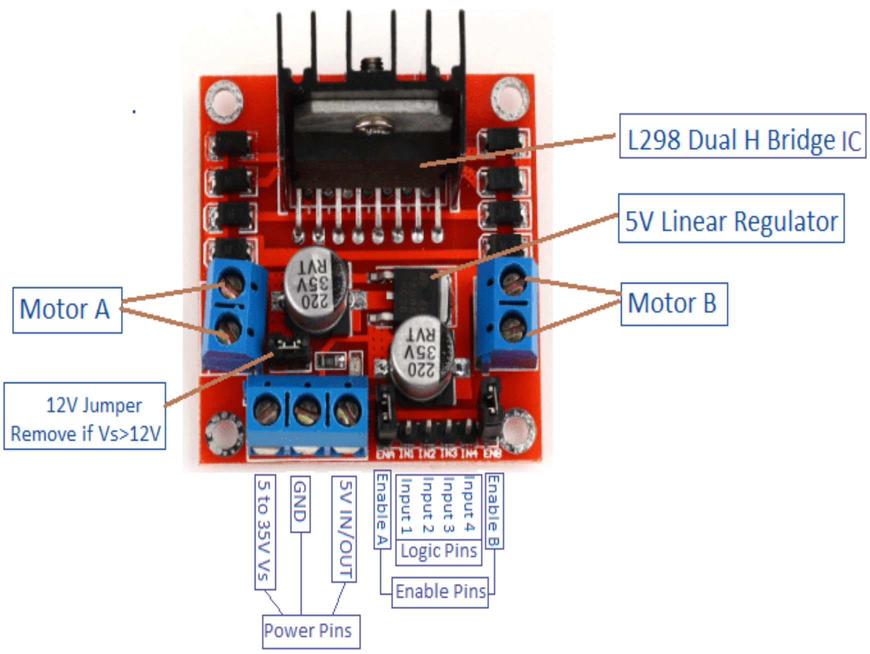

Figure 3.10: Pin configuration of L298N Motor Driver IC

The L298N is a dual H-Bridge motor driver which allows speed and direction control of two DC motors at the same time as shown in Figure 3.10. The module can drive DC motors that have voltages between 5 and 35V, with a peak current up to 2A.

3.7.1 Specifications

- Operating voltage: 5V (All logic pins)
- Working current: 0.35mA
- Motor Voltage: 5V to 35V
- Motor current: 2A per H-Bridge
- Maximum Power: 25W

3.7.2 How Does H-Bridge Work?

An H-bridge is an electronic circuit that switches the polarity of a voltage applied to a load. These circuits are often used in robotics and other applications to allow DC motors to run forwards or backwards. Most DC-to-AC converters (power inverters), most AC/AC converters, the DC-to-DC push–pull converter, isolated DC-to-DC converter most motor controllers, and many other kinds of power electronics use H bridges. In particular, a bipolar stepper motor is almost always driven by a motor controller containing two H bridges. A common use of the H-bridge is an inverter. The arrangement is sometimes known as a single-phase bridge inverter. The H-bridge with a DC supply will generate a square wave voltage waveform across the load. For a purely inductive load, the current waveform would be a triangle wave, with its peak depending on the inductance, switching frequency, and input voltage. A solid-state H-bridge is typically constructed using opposite polarity devices, such as PNP bipolar junction transistors (BJT) or P-channel MOSFETs connected to the high voltage bus and NPN BJTs or N-channel MOSFETs connected to the low voltage bus.

This is a dual H-Bridge controller, which means it can control up to two motors simultaneously. Each motor has its respective positive and negative terminal to which it has to be connected. These are usually labelled OUT_1 and OUT_2 as shown in Figure 3.11 and Figure 3.12. The direction of each motor can individually be controlled with two input pins:

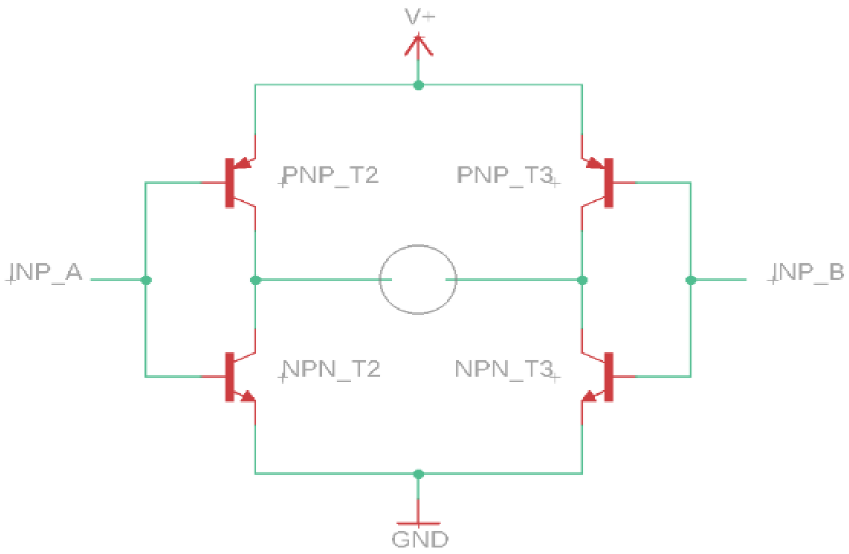

Fig 3.11: The H-Bridge circuit diagram

When both, INP_A and INP_B, are low, the motor is off. If either of the pins is HIGH while the other one is LOW, the motor will spin in one direction. To reverse the motor, reverse the states of the inputs. If both pins are pulled high, the motor will stop again.

3.7.3 Structure of H-Bridge

S1	S2	S3	S4	Result
1	0	0	1	Motor moves right
0	1	1	0	Motor moves left
0	0	0	0	Motor coasts
1	0	0	0	
0	1	0	0	
0	0	1	0	
0	0	0	1	
0	1	0	1	Motor brakes
1	0	1	0	
x	x	1	1	Short circuit
1	1	x	x	

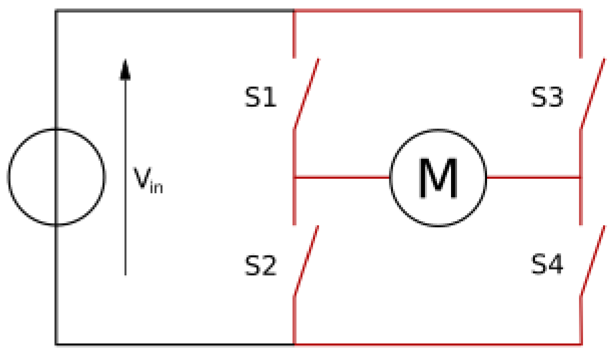

Figure 3.12: Truth table and switch diagram of H-Bridge

CHAPTER 4

DESIGN

The design of the whole model is done using AutoCAD (Computer Aided Design) tool of student version, developed by Autodesk (Fusion 360). It is computer-aided design (CAD) software that architects, engineers and construction professionals rely on to create precise 2D and 3D drawings. Draft and edit 2D geometry and 3D models with solids, surfaces and mesh objects. Annotate drawings with text, dimensions, leaders and tables.

4.1 Advantages of Autodesk (Fusion 360)

Autodesk (Fusion 360) is a computer-aided software drafting program. It is used for a number of applications like creating blueprints for buildings, mechanical designs, bridges and computer chips, etc. It is 2D and 3D computer aided drafting software application. It is commercial and developer software.

4.2 Applications of Autodesk (Fusion 360)

- Autodesk (Fusion 360) as an architectural planning tool.
- It can be used as engineering drafting tool.
- Used as a graphic design tool.
- Used in 3D Printing.
- Used in industrial design tool.

4.3 Features of Autodesk (Fusion 360)

- 3D Modeling and Visualization.
- Photorealistic Rendering.
- Solid, Surface and Mesh Modeling.
- PDF and DGN Import/Export/Underlay.
- 3D Scanning and Point Clouds.

CHAPTER 5

METHODOLOGY

5.1 3D diagram of the Model

Figure 5.1: 3D representation of Globe-Satellite model

The 3D visualization helps to match the design with the real product. It gives an overall view of how the product looks. The Three-dimensional model of the future mechanism accelerates and facilitates the work of the design engineer, saving him from the drafting process. The visualization process helps to demonstrate the design solution as shown in Figure 5.1, Figure 5.2, Figure 5.3 and Figure 5.4.

5.2 Individual design scale

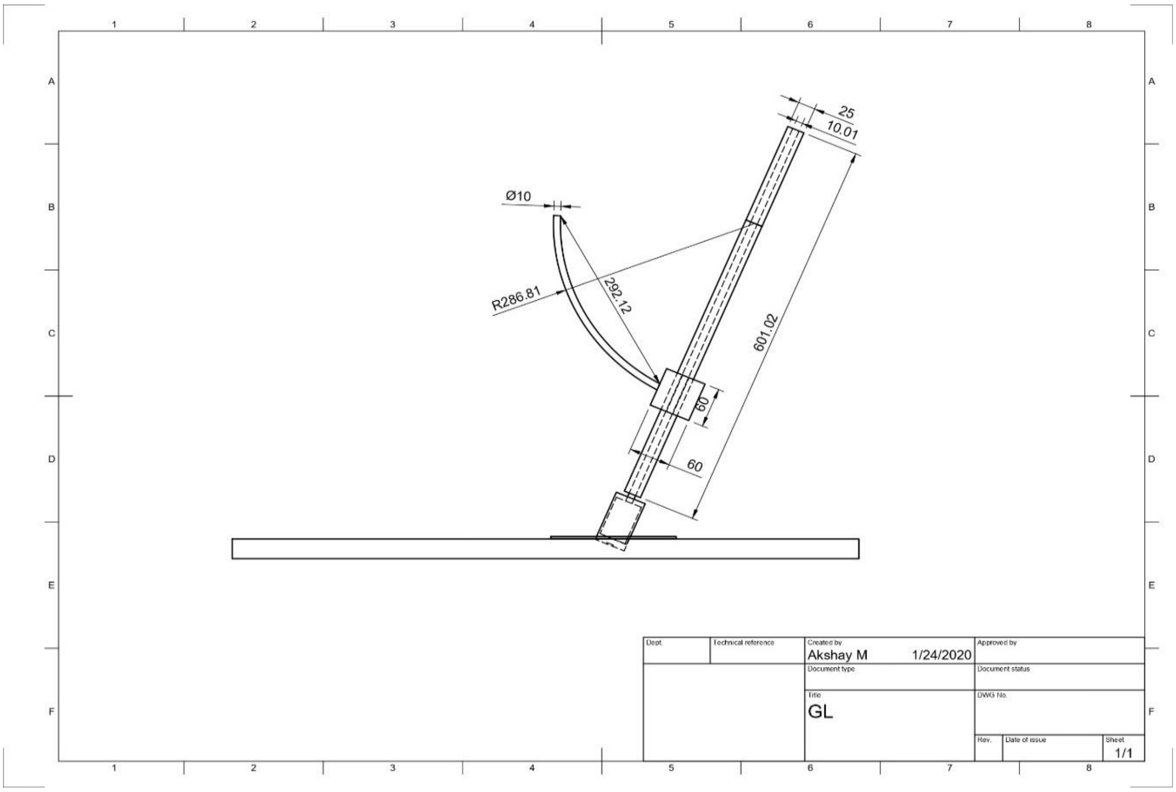

Figure 5.2: Arrangement to place Geo-Stationary SAT

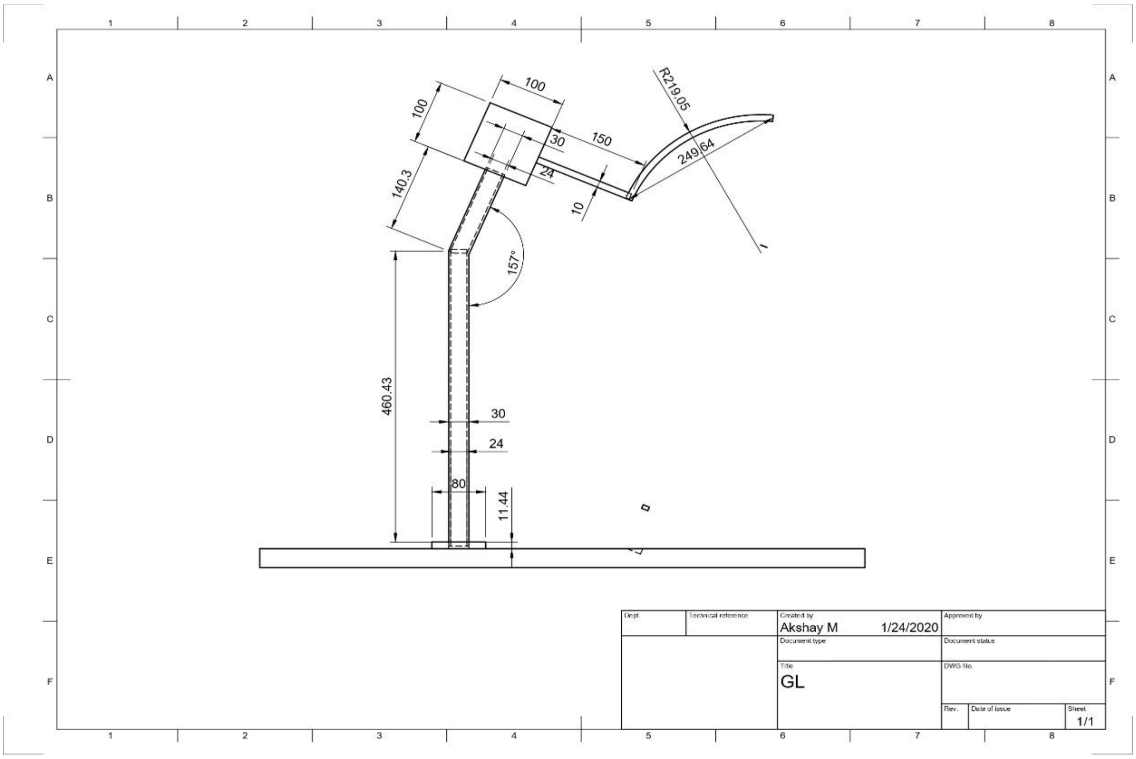

Figure 5.3: Arrangement to place polar SAT

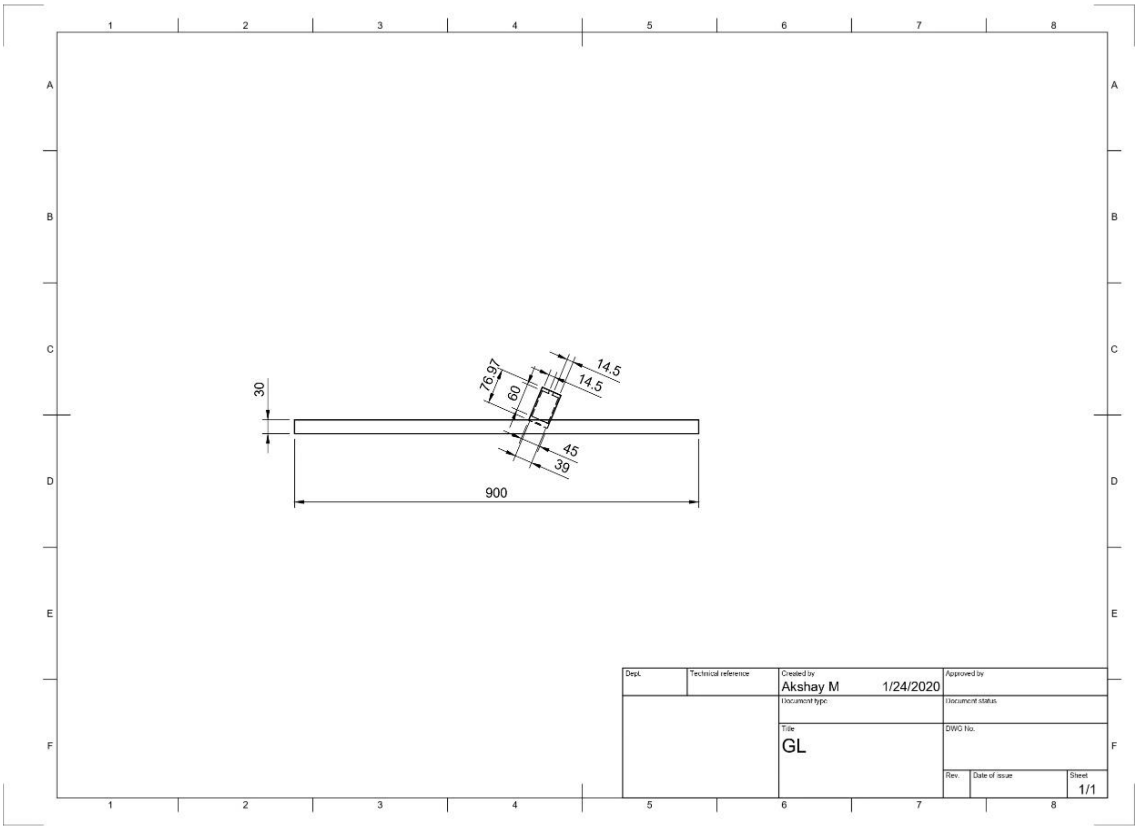

Figure 5.4: Container setup for Geo-Stationary SAT

5.3 Block diagram of GS-Model Circuit

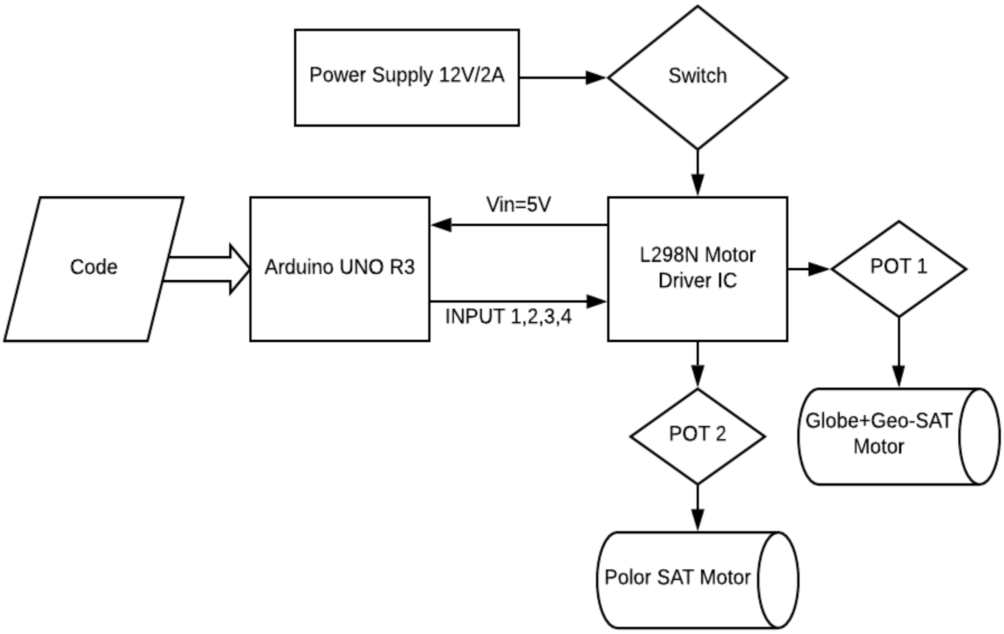

Figure 5.5: Block diagram of GS-Model

Figure 5.5 shows arrangement and the interconnections between different components included in the model. The 12V/2A power supply is given to L298N Motor driver, the Arduino UNO R3 is used as microcontroller which controls overall operation and is powered by L298N motor driver with 5V. The motor driver IC is used to drive two geared DC motors of 60 RPM for Geo SAT and of 45 RPM for Polar SAT which helps to illustrate the working of Geo-stationary and Polar satellite. One of the Geared DC motor is used to drive both globe and geo-satellite since the orbital period of the Geo-Stationary satellite is same as the Earth's rotation period, other Geared DC motor is used to drive polar satellite alone. The input pins present in the Motor Driver IC (IN1, IN2, IN3, IN4) are connected to Arduino uno which sets the speed and direction of rotation of the Geared DC Motors. The two 1K potentiometers POT 1 and POT 2 are used to control the speed of the motors manually. The switch block represents the Toggle Switch which is used to on /off the supply to the model.

5.4 Circuit diagram of GS-Model

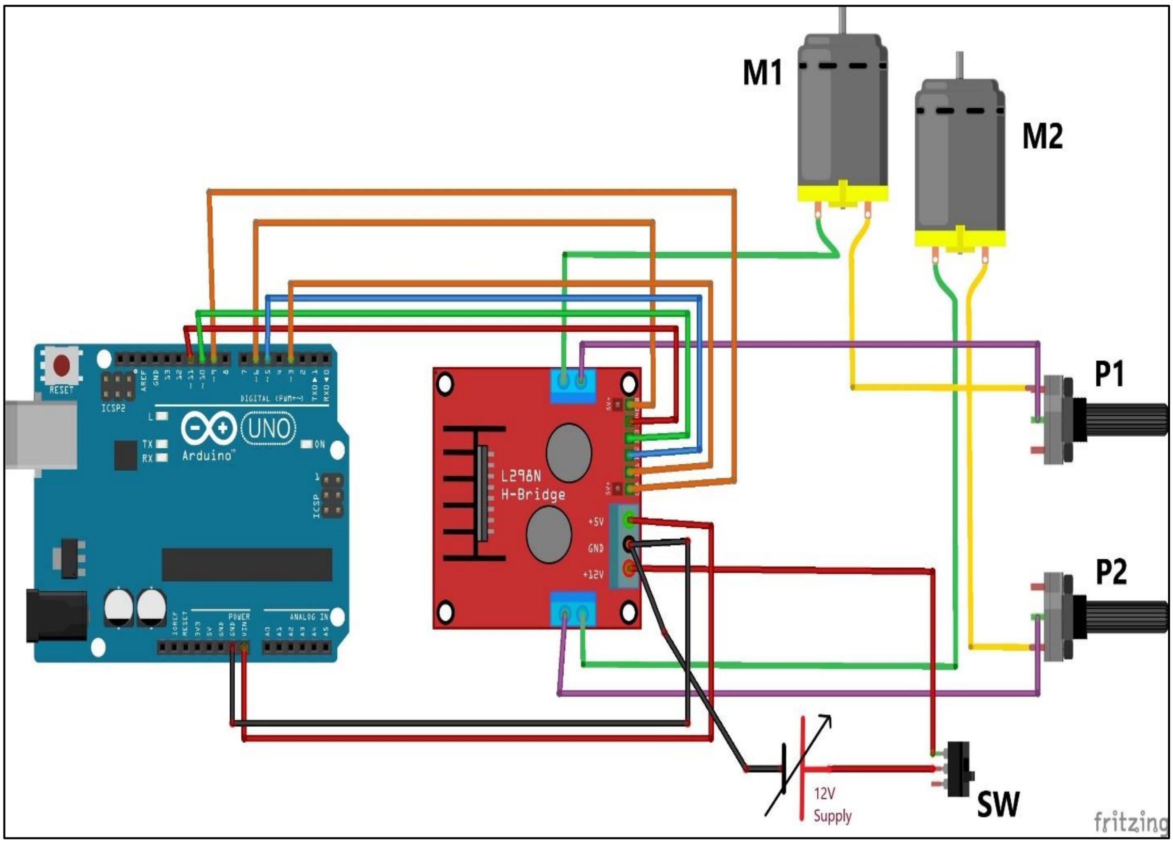

Figure 5.6: Circuit diagram of GS-Model

5.4.1 Pin Connections

- Enable pins of motor M1 and M2 in L298N IC are connected to the pins 6 and 9 of Arduino respectively as shown in Figure 5.6.
- The input pins IN1, IN2, IN3, IN4 in L298N IC are connected to the pins 11, 10, 5 and 3 of Arduino respectively.
- 5V supply for Arduino is given by L298N IC from +5V pin.
- One end of the motor M1 and M2 are connected to M1 slot and M2 slot respectively in L298N IC and the other end of motors M1 and M2 are connected to Potentiometers P1 and P2 respectively, now the other end of potentiometers P1 and P2 are connected to the slots M1 and M2 in L298N IC.
- The 12V supply from Adaptor is given to L298N IC with the help of Barrel jack.
- The Toggle switch SW is connected in series with the supply for on/off operation.

5.4.2 Circuit Explanation

- The enable pins for both the motors are made high for enabling and controlling speed of the motors.
- In two input pins for each motor, one of the pins is made high and the other one made low.
- Since Arduino requires 5V supply for its operation, the +5V supply pin is given to Vin pin of Arduino from L298N IC.
- By using Arduino speed and direction of motor can be set using the input pins and by varying potentiometers P1 and P2, the speed of the motor M1 and M2 can increased/decreased accordingly.
- To make any changes in the code, the updated code must be dumped to the Arduino board through USB port, so that the previous code will be replaced by new updated code.
- The power consumed by a motor is around 4 Watts and for Arduino is around 5 Watts, So the Total power consumption by the circuit is around 13 Watts
  i.e.
  $P = V * I$
  $P = (12*0.33) *2 + (5*1) = 13$ Watts.

5.5 LED-Battery circuit for Satellite

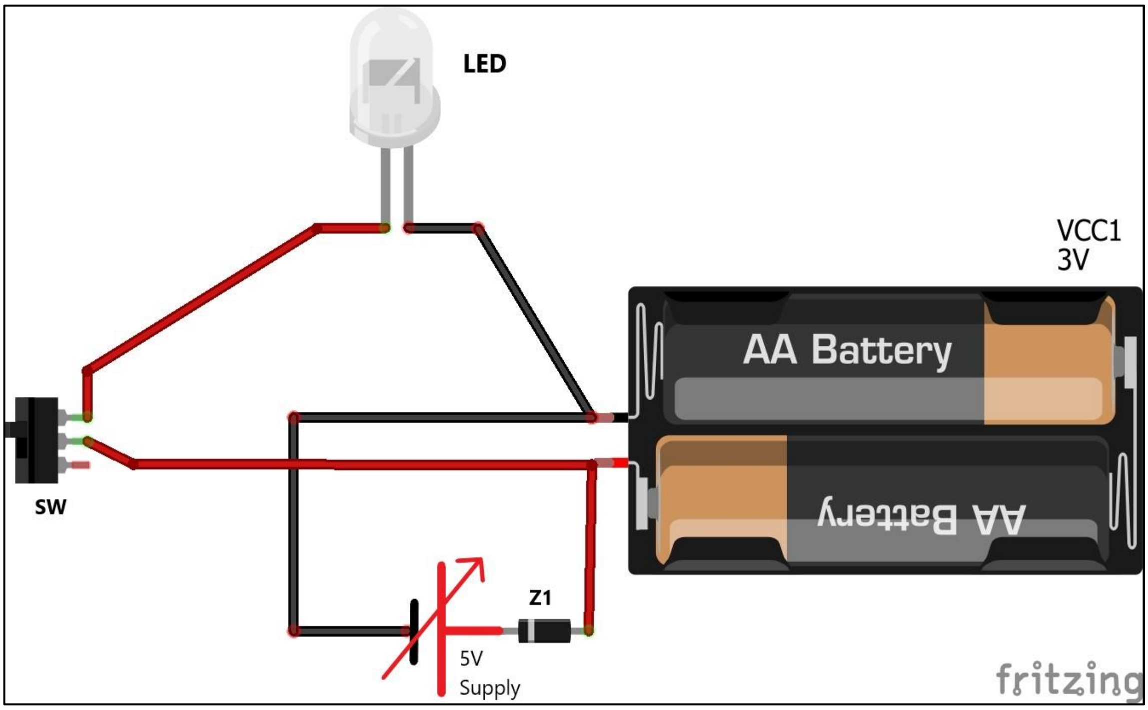

Figure 5.7 LED-Battery circuit for satellite

5.5.1 Circuit Explanation

- Anode (-ve) end of the LED is connected to negative terminal of the 3V battery as shown in Figure 5.7.
- One end of toggle switch SW is connected to positive terminal of the battery and other end is connected to the cathode (+ve) end of led to on/off the led.
- 5V supply is connected across the rechargeable battery through Barrel jack.
- The negative terminal of IN4007 Diode is connected the supply and other end to the positive terminal of the battery.
- The battery will take about half an hour to fully charge and will take about 2 to 3 hours to drain by keeping led in on state.
- Separate charging circuit is given for Geo-stationery satellite (Green led) and Polar satellite (Red led).

5.6 Code for GS-Model

```
int en1 = 9; //Enable pin for G motor1
int en2 = 6; //Enable pin for G motor2
int in1 = 3; //G motor1 clockwise
int in2 = 5; //G motor1 Anticlockwise
int in3 = 10; //G motor2 clockwise
int in4 = 11; //G motor2 Anticlockwise
void setup ()
{
//All the above pins are of OUTPUT configuration, so pinmode is of the type OUTPUT
pinMode (en1, OUTPUT);
pinMode (en2, OUTPUT);
pinMode (in1, OUTPUT);
pinMode (in2, OUTPUT);
pinMode (in3, OUTPUT);
pinMode (in4, OUTPUT);
}
void loop ()
{
analogWrite (en1,255); //Enable1 pin is made high which is of pwm range (0 - 255)
analogWrite (en2,255); //Enable2 pin is made high which is of pwm range (0 - 255)
analogWrite (in1,1023); //in1 is made high which is of the range (0 - 1023)
analogWrite (in2,0); //in2 is made low
analogWrite (in3,1023); //in3 is made high which is of the range (0 - 1023)
analogWrite (in4,0); //in4 is made low
}
```

The code is written in embedded C language with Arduino IDE for Arduino UNO Rev3 Board. The code uses 1024 bytes of 32K bytes memory (3% of Total memory) present in the Arduino UNO Rev3. The speed of two Geared DC Motors (Mot1 & Mot2) can be varied with the help of two potentiometers (Pot1 & Pot2) respectively.

CHAPTER 6

RESULTS

The Globe-Satellite working model has met with the all major and minor specifications provided satisfactorily. The globe-satellite model approximately replicates the satellite revolving around the Earth considering the time and angle of rotation as a factor as shown in Figure 6.1. The model met their standards with a very low budget.

Figure 6.1: Globe- Satellite Model

CHAPTER 7

CONCLUSION

This model illustrates and helps us understand the concept of Geo-stationary satellite and Polar satellite. The geo-stationary satellite is one which when observed from the Earth looks stationary that is it has time period same as Earth, hence it can be seen all day long, while a polar satellite revolves around Earth near the poles and has time period of 100 minutes, hence it can be seen twice a day at a same position by an observer on the Earth. The design is stimulated on Autodesk (Fusion 360) software and analysed the different parameters. This also helps others to understand the theory behind different orbits in which satellites revolve around us. The electronic circuit for this model consists of two Geared DC Motors, two Potentiometers, L298N Motor Driver IC to drive the motors, Arduino UNO Rev3 microcontroller which controls the overall operation of the model and a switch to on/off the supply. The material used for this model is Aluminium because of that load applied to the Geared DC Motor is reduced. Autodesk Fusion 360 and Arduino IDE were able solve the problems whenever countered one. With the completion of the model the concept behind Geo-stationary satellite and the polar satellite can be understood clearly.

INTERNSHIP 3

EMOTION ANALYSIS USING ALGORITHMS

AT

TCS iON

FROM 24-09-2020 to 03-10-2020

CHAPTER 1

TCS iON OVERVIEW

1.1 Introduction

TCS iON is a strategic unit of Tata Consultancy Services focused on Manufacturing Industries (SMB), Educational Institutions and Examination Boards. TCS iON provides technology by means of a unique IT-as-a-Service model, offering end-to-end business solutions. It caters to the needs of multiple industry segments, through innovative, easy-to-use, secured, integrated, hosted solutions in a build-as-you-grow, pay-as-you-use business model. TCS iON serves its clients with the help of best practices gained through TCS global experience, domestic market reach, skills, and delivery capabilities. TCS iON's Cloud Based Solution is highly modular, scalable and configurable giving businesses and educational institutions the benefits of increased efficiencies, faster go to market, predictability of technology as well as spend and better business results.

1.2 TCS iON Remote Internship

TCS iON Remote Internships helps companies post internship opportunities online. Students can browse through the listed internships, see what project themes are trending, and apply for the relevant ones. Credits will be awarded depending on the kind of projects chosen. This unique product offers students internship opportunities round the year, even during the pandemic, while providing companies with a structured digital framework that is compliant with AICTE guidelines.

Powered by the TCS iON Digital Learning Platform, Remote Internships provides a structured learning environment with access to industry mentors, industry-curated learning material, projects, and videos or webinars. Interns can also interact and share ideas with peers and the mentors through a social format. Academic guides can track each student’s progress for award of academic credits. It includes a feature to conduct exit tests and integrate the viva voce score as well.

CHAPTER 2

EMOTION ANALYSIS

2.1 Introduction

Detecting emotional state of a person by analysing a text document written by him/her appear challenging but also essential many times due to the fact that most of the times textual expressions are not only direct using emotion words but also result from the interpretation of the meaning of concepts and interaction of concepts which are described in the text document. Recognizing the emotion of the text plays a key role in the human-computer interaction. Emotions may be expressed by a person's speech, face expression and written text known as speech, facial and text-based emotion respectively. Sufficient amount of work has been done regarding to speech and facial emotion recognition but text-based emotion recognition system still needs attraction of researchers.

Emotion Detection and Recognition from text is a field of research that is closely related to Sentiment Analysis. Sentiment Analysis aims to detect positive, neutral, or negative feelings from text, whereas Emotion Analysis aims to detect and recognize types of feelings through the expression of texts, such as anger, fear, joy, sadness, love and surprise. Emotion Analysis provides a deeper insight of consumer emotions. Categorizing feedback and analysing its emotion by picking up words, contexts, patterns, behaviours. This can be even taken to the level of individual's expressive capability of a particular situation.

2.2 Objective

- To develop an algorithm to detect different types of emotions contained in a collection of English sentences or a large paragraph.
- To calculate the attributes such as CV Score, Accuracy, Precision, Recall and F1 Score.

2.3 Solution Approach

- Plot the graph showing different emotions and its count.
- Text cleaning operation is done on the data. Text cleaning includes:
  - ✓ Set all words to lowercase.
  - ✓ Removing mentions.
  - ✓ Removing hashtags.
  - ✓ Removing URL's.
  - ✓ Convert the emojis into one word.
  - ✓ Removing punctuations, digits and stopwords.
  - ✓ Apply the PorterStemmer to keep the stem of the words.
- Apply Text classifiers on the data. Classifiers used are:
  - ✓ CountVectorizer.
  - ✓ TF-IDF Vectorizer.
  - ✓ Word2Vec.
- Use grid-search method for selecting the best parameters for the model.
- Use Text Classification Algorithms:
  - ✓ MultinomialNB.
  - ✓ LogisticRegression.
- Calculate performance metrics which are Accuracy, Precision, Recall and F1 score.

2.4 Assumptions

- Different words in the text represent different emotions. The maximum count of a particular emotion in the text is considered as final one.
- Document focuses on a single object (not true in discussion posts, blogs, etc.) and contain opinion from a single opinion holder.

2.5 Project Flow

- Textual comments and feedback are given as input to the Tokenization and Text cleaning process to remove mentions, hashtags, URL's, digits, stopwords, etc.

- Text classifiers such as CountVectorizer, TF-IDF Vectorizer, Word2Vec are used to classify text or count words in the text, URL's, mentions, hashtags, emoji's, capital words, etc.
- Grid-search method is used for selecting the best parameters for the model along with the Text classification algorithm such as MultinomialNB and LogisticRegression.
- Performance metrics will be the output from the model obtained, which are CV score of the model, accuracy, precision, recall and F1 score.

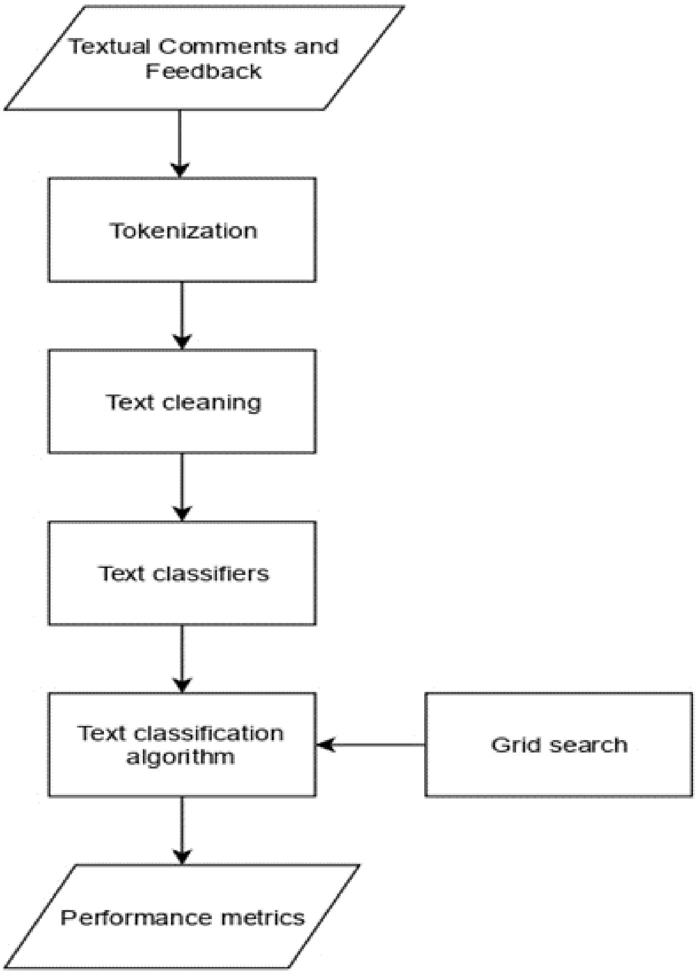

Figure 2.1: Flow diagram for the model

CHAPTER 3

ALGORITHMS

3.1 MultinomialNB

The multinomial Naive Bayes classifier is suitable for classification with discrete features (e.g., word counts for text classification). The multinomial distribution normally requires integer feature counts. However, in practice, fractional counts such as tf-idf may also work. In spite of their apparently over-simplified assumptions, naive Bayes classifiers have worked quite well in many real-world situations, famously document classification and spam filtering. They require a small amount of training data to estimate the necessary parameters. Naive Bayes learners and classifiers can be extremely fast compared to more sophisticated methods. The decoupling of the class conditional feature distributions means that each distribution can be independently estimated as a one-dimensional distribution. This in turn helps to alleviate problems stemming from the curse of dimensionality.

Syntax:

class sklearn.naive_bayes.MultinomialNB(*, alpha=1.0, fit_prior=True, class_prior=None)

3.1.1 Methods

fit(X, y[, sample_weight])	Fit Naive Bayes classifier according to X, y
get_params([deep])	Get parameters for this estimator.
partial_fit(X, y[, classes, sample_weight])	Incremental fit on a batch of samples.
predict(X)	Perform classification on an array of test vectors X.
predict_log_proba(X)	Return log-probability estimates for the test vector X.
predict_proba(X)	Return probability estimates for the test vector X.

score(X, y[, sample_weight])	Return the mean accuracy on the given test data and labels.
set_params(**params)	Set the parameters of this estimator.

3.2 Logistic Regression

Logistic regression is a supervised learning classification algorithm used to predict the probability of a target variable. The nature of target or dependent variable is dichotomous, which means there would be only two possible classes. In simple words, the dependent variable is binary in nature having data coded as either 1 (stands for success/yes) or 0 (stands for failure/no).

Syntax:

class sklearn.linear_model.LogisticRegression(penalty='l2', *, dual=False, tol=0.0001, C=1.0, fit_intercept=True, intercept_scaling=1, class_weight=None, random_state=None, solver='lbfgs', max_iter=100, multi_class='auto', verbose=0, warm_start=False, n_jobs=None, l1_ratio=None)

3.2.1 Methods

decision_function(X)	Predict confidence scores for samples.
densify()	Convert coefficient matrix to dense array format.
fit(X, y[, sample_weight])	Fit the model according to the given training data.
get_params([deep])	Get parameters for this estimator.
predict(X)	Predict class labels for samples in X.
predict_log_proba(X)	Predict logarithm of probability estimates.
predict_proba(X)	Probability estimates.
score(X, y[, sample_weight])	Return the mean accuracy on the given test data and labels.
set_params(**params)	Set the parameters of this estimator.
sparsify()	Convert coefficient matrix to sparse format.

CHAPTER 4

RESULTS

Table 4.1: Using Count Vectorizer and MultinomialNB

Emotion	Precision	Recall	F1 score
Anger	0.87	0.77	0.81
Fear	0.80	0.76	0.78
Joy	0.82	0.91	0.86
Love	0.73	0.61	0.66
Sadness	0.86	0.89	0.87
Surprise	0.77	0.39	0.52

Macro Avg	0.81	0.72	0.75
Weighted Avg	0.83	0.83	0.82
Accuracy	0.83		
Best CV Score		0.823	
Test score with best estimator		0.829	

Table 4.2: Using Count Vectorizer and Logistic Regression

Emotion	Precision	Recall	F1 score
Anger	0.85	0.81	0.83
Fear	0.85	0.79	0.82
Joy	0.84	0.89	0.86
Love	0.73	0.68	0.70
Sadness	0.90	0.90	0.90
Surprise	0.73	0.66	0.69

Macro Avg	0.82	0.79	0.80
Weighted Avg	0.85	0.85	0.85
Accuracy	0.85		
Best CV Score		0.839	
Test score with best estimator		0.848	

Usage of Count vectorizer with Logistic Regression algorithm provides more accuracy than MultinomialNB as shown in Table 4.1 and Table 4.2. Logistic Regression provides more precision while detecting sadness emotion.

Table 4.3: Using TF-IDF Vectorizer and MultinomialNB

Emotion	Precision	Recall	F1 score
Anger	0.96	0.61	0.74
Fear	0.88	0.58	0.70
Joy	0.70	0.97	0.81
Love	0.93	0.25	0.39
Sadness	0.79	0.89	0.89
Surprise	1.00	0.10	0.18

Macro Avg	0.88	0.58	0.61
Weighted Avg	0.81	0.77	0.74
Accuracy	0.77		
Best CV Score		0.761	
Test score with best estimator		0.769	

Table 4.4: Using TF-IDF Vectorizer and Logistic Regression

Emotion	Precision	Recall	F1 score
Anger	0.90	0.46	0.61
Fear	0.78	0.55	0.65
Joy	0.71	0.92	0.80
Love	0.74	0.36	0.49
Sadness	0.74	0.83	0.78
Surprise	0.04	0.03	0.04

Macro Avg	0.65	0.53	0.56
Weighted Avg	0.73	0.72	0.70
Accuracy	0.72		
Best CV Score		0.727	
Test score with best estimator		0.722	

Usage of TF-IDF vectorizer with MultinomialNB algorithm provides more accuracy than Logistic Regression as shown in Table 4.3 and Table 4.4. MultinomialNB provides very high precision while detecting anger, love and surprise emotion. Logistic Regression using TF-IDF vectorizer fails to detect surprise emotion.

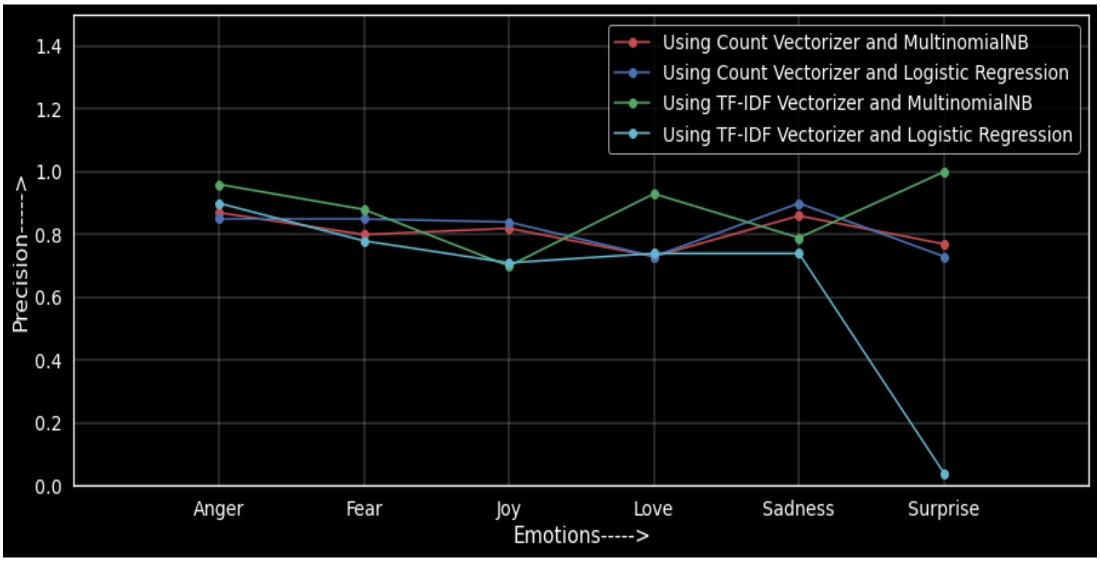

Figure 4.1: Plot showing precisions of different models

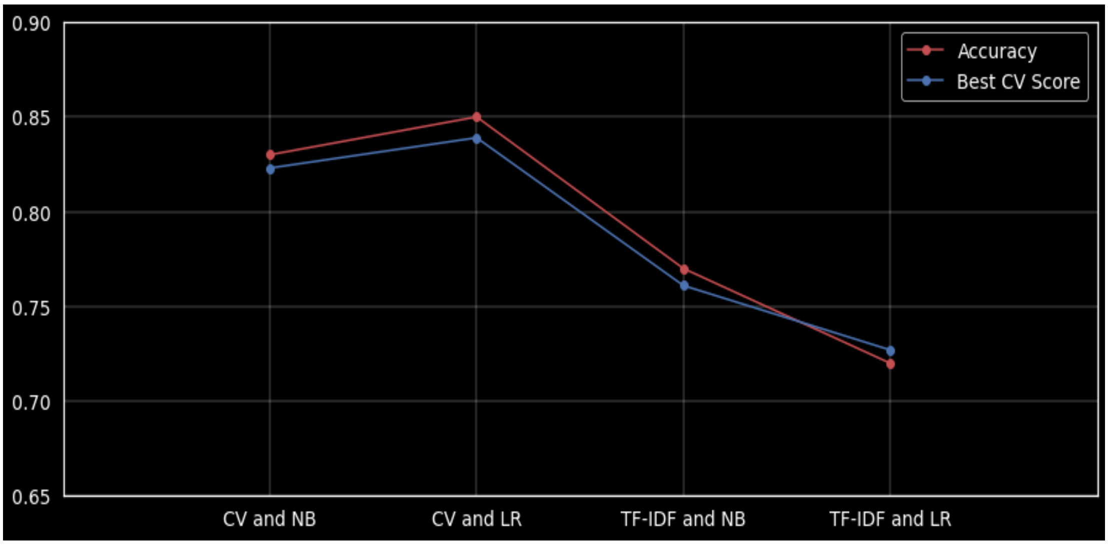

Figure 4.2: Plot showing Accuracy and Best CV Score of different models

Plots showing precisions, accuracy and best CV score for different models is shown in the Figure 4.1 and Figure 4.2.

CHAPTER 5

CONCLUSION

Emotion analysis bases its results on factors that are so inherently humane, it is bound to become one of the major drivers for many business decisions in future. Improved accuracy and consistency in text mining techniques can help overcome some current problems faced in Emotion analysis. The cultural affiliations or mother tongue of an individual greatly influence their expressed emotions toward situations. The availability of resources in other languages such as French, Spanish, Hindi, and so on can greatly change the narrative and encourage research in the field of natural language processing.

Following points can be inferred from the project

- Usage of Count vectorizer with Logistic Regression algorithm provides more accuracy than MultinomialNB. Logistic Regression provides more precision while detecting sadness emotion.
- Usage of TF-IDF vectorizer with MultinomialNB algorithm provides more accuracy than Logistic Regression. MultinomialNB provides very high precision while detecting anger, love and surprise emotion.
- Logistic Regression using TF-IDF vectorizer fails to detect surprise emotion.

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APPENDIX

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Internship Certificate

This is to certify that *Mr. Abhishek M Shastry K*
has successfully completed the internship and training
on ***Embedded Systems and Sensor Interfacing*** with a
working prototype.

The internship was carried under Envision Lab at AIET campus
from **10th July** to **25th July 2019**.

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Certificate

This is to certify that the project work entitled "**Globe - Satellite Model**" is a bonafide work done by **Abhishek M Shastry K,** B.E student of **Alva's Institute of Engineering and Technology,** Karnataka, India during the period Jan 10, 2020 to March 22, 2020.

This is a record of work carried out under my guidance and supervision.

Shafali Tandon

Shafali Tandon
Sci./Engr. 'SE'
Outreach Facility
National Remote Sensing
Centre, Hyderabad

TCS iON TATA

CERTIFICATE Of INTERNSHIP

This is to certify that

Abhishek M Shastry K

has successfully completed Remote Internship

for ***45*** ***hours*** *in project titled*

Automate Detection of Different Emotions from Textual Comments and Feedback

by TCS iON from 24 Sep 2020 to 10 Nov 2020.

TCS iON REMOTE INTERNSHIPS
Academic Credits with Industry Mentors
Cert. ID.: 298-8261259-1016
Dated: 10 Nov 2020

CERTIFIED

Mehul Mehta

Mehul Mehta
Global Delivery Head - TCS iON,
Tata Consultancy Services