AI Smart Glasses

(Face Detection/Obstacle Detection)

An interim capstone report submitted in partial fulfilment of the requirement for the award of the degree of

Bachelor of Engineering

in

Electronics and Communication Engineering

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(March-December 2021)

CERTIFICATE

TO WHOM IT MAY CONCERN This is to certify that the Capstone project report entitled “AI SMART GLASSES(FACE DETECTION/OBSTACLE DETECTION)”, submitted by:

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Students of Thapar Institute of Engineering, in partial fulfilment of requirements for the award of the degree of Bachelor of Technology in Electronics and Communication Engineering, is a bona fide work carried out under the supervision and guidance of Dr. Harpreet Vohra and Dr. Rajneesh Sharma during the pre-final year and final year of the academic session of 2018-2022. It is further certified that work is entirely original and its performance has been found to be quite satisfactory.

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ACKNOWLEDGEMENT

We express our deep sense of gratitude to our respected and learned guides Assistant Professor Dr Harpreet Vohra and Dr Rajneesh Sharma, Department of Electronics and Communication Engineering,Thapar Institute of Engineering and Technology for their valuable help and guidance. We are thankful to them for the encouragement they are giving to us in pursuing this project.

ABSTRACT

It is well known that visually challenged as well as old aged people find it difficult to properly recognize any object or person . Priorily walking sticks with sensors have been used to tackle the problem but the method failed to perform in certain situations as it is not capable of detecting the object or person incoming nor were they able to differentiate between living and non living strata .

The project aims in designing AI BASED Face recognition and object detection glasses . This will not only help to recognize the familiar faces but also will warn if obstacles are near so that no harm is caused to the person.

The face recognition shall be done through a predefined library developed using programming languages. System learns about the obstacles and alerts the user with warning using ultrasonic sensors

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Chapter 1

INTRODUCTION

To build communities and bring the world closer together, the barriers prevent communities from participating in social interactions online or offline. One of these communities are people with visual impairments. Human visual system plays an important role in recognizing information regarding surroundings. Since visual signals provide more data than auditory information, visual signals are more effective than auditory signals when the human being perceives information. However, in case of blind people the lack of visual information constrains them in recognizing information. For a visually disabled person to recognize a subject in surroundings depends on the subject to speak something. Hence, visually challenged people are sensitive in an auditory sense and do not want to undergo disturbance in listening. To solve this problem and constraints, the system proposes for face recognition through smart glasses .This system detects and recognizes the face of a human and then informs the user, of the person standing in front.

1.1 Need Analysis

It is estimated that 285 million people globally are visually impaired, and without additional interventions, these numbers are predicted to increase significantly. One of the most difficult tasks faced by the visually impaired is identification of people. The inability to recognize known individuals in the absence of audio or haptic cues severely limits the visually impaired in their social interactions and puts them at risk from a security perspective. Having to deal with sight loss or low vision is merely one of the most difficult challenges a person faces when living life. Such people are just like anyone else but they just have weakened

vision. We have built a world around us that serves the majority . That means that any individual different from the average, such as visually challenged people, faces difficulties because they are not what is considered to be average .

The project helps to overcome such problems . The glasses will become BLIND'S EYE. It will help to recognize people in surroundings and warn about obstacles hence increasing their social participation .

1.2 Objectives

- To create a friendly environment for people having low vision or no vision.
- To make it easy in recognizing faces that they are exposed to more often.
- To make use of AI BASED technology and programming languages.
- To make use of a predefined library for face recognition.

1.3 Technological Aspects

The camera will capture the images which will be processed / matched with the previous dataset with the help of raspberry pi . The user will be informed about the image description through an earphone connected with raspberry pi .An ultrasonic sensor will be used to detect the obstacles and alert the user through the same earphones. Hence the system will work as Blind's Eye.

Chapter-2

LITERATURE SURVEY

2.1 Theory Associated With Problem Area

Face Recognition has always been one of the most fascinating and intriguing technologies as it deals with human faces. Covid-19 outbreak has propelled the world to move towards touchless facial recognition technology. It is gaining huge traction worldwide owing to its contactless biometric features. Companies are getting rid of traditional fingerprinting scanners and creating massive business opportunities by adopting AI-based facial recognition technology. Some of the applications where its usage has become crucial are security & surveillance, authentication/access control systems, digital healthcare, photo retrieval, etc.

In the last twenty years, the computer-based facial recognition field has expanded rapidly. A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or video frame from a video source. One of the ways to do this is by comparing selected facial features from the image and a facial database . Some facial recognition algorithms identify facial features by extracting landmarks, or features, from an image of the subject's face. For example, an algorithm may analyze the relative position, size, and/or shape of the eyes, nose, cheekbones, and jaw. These features are then used to search for other images with matching features; other algorithms normalize a gallery of face images and then compress the face data, only saving the data in the image that is useful for face recognition. A probe image is then compared with the face data. One of the earliest successful system is based on template matching technique applied to a set of salient facial features, providing a sort of compressed face representation

Existing System And Solutions

Currently there are thousands of blind people all over the globe. These include people from low sightseeing to complete loss of vision. They find it very difficult while crossing the road or reaching their respective destination with the help of any other individual. Therefore a smart stick equipped with sensors was developed to help detect the obstacles in front or the potholes in the way.But the stick failed to accommodate people socially as they were not able to identify people in the surrounding environment. Hence there is a need to update it using today's technology so we propose a system where the user will not only learn about obstacles but people in their surroundings .

Related Works

There is a lot of research that had been done in this field such as;

- In Sinha et al. outlined nineteen basic results regarding human facial recognition, including many of the methods that humans use to identify faces. They showed that the study of human processes involved in facial recognition and the artificial algorithms being used for facial recognition systems are inextricably linked together.
- A study by Krishna, Little, Black, and Panchanathan also evaluated PCA and LDA algorithms. With respect to changes in

illumination and pose. The LDA and PCA algorithms were found to be superior. LDA was fastest while PCA was the most accurate.

- Songetal. applied a different approach on image preprocessing/enhancement. They calculated the illumination difference between the right and left part of the face. If there was a large amount of difference then the mirror of the average illuminated part was considered.

SURVEY OF TOOLS AND TECHNOLOGY HARDWARE

2.1.1 Raspberry pi 3 Model B+ : (Main Board)

The Raspberry Pi 3 Model B+ is the latest product in the Raspberry Pi 3 range, boasting a 64-bit quad core processor running at 1.4 GHz, dual-band 2.4 GHz and 5 GHz wireless LAN, Bluetooth 4.2/BLE, faster Ethernet, and PoE capability via a separate PoE HAT

The dual-band wireless LAN comes with modular compliance certification, allowing the board to be designed into end products with significantly reduced wireless LAN compliance testing, improving both cost and time to market.

2.1.2 Camera : (Face recognition)

The minimum resolution for any standard image should be 16*16 . We

must procure a camera capable of giving a resolution of more than 16*16. Camera will be integrated to Raspberry pi using the Raspberry pi integrating module .

2.1.3 Ultrasonic sensor HC-SR04 : (Distance Finder) This is the HC-SR04 ultrasonic distance sensor. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit. There are only four pins that you need to worry about on the HC-SR04: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground). You will find this sensor very easy to set up and use for your next range-finding project!

2.1.4 USB Cable : The USB interface is self-configuring, eliminating the need for the user to adjust the device's settings for speed or data format, or configure interrupts, input/output addresses, or direct memory access channels.Small devices can be powered directly from the USB interface, eliminating the need for additional power supply cables such as Raspberry pi.

Some Other Hardware : earphones , wires and a power supply.

SOFTWARE

2.1.5 Python 3 :

Python is a high-level, interpreted, interactive and object-oriented scripting language. It is designed to be highly readable. It uses English keywords frequently whereas the other languages use punctuations. It has fewer syntactic constructions than other languages.

2.1.6 OPENCV

It is a library of Python bindings designed to solve computer vision problems. Compared to languages like C/C++, Python is slower. That said, Python can be easily extended with C/C++, which allows us to write computationally intensive code in C/C++ and create Python .wrappers that can be used as Python modules. This gives us two advantages: first, the code is as fast as the original C/C++ code (since it is the actual C++ code working in the background) and second, it is easier to code in Python than C/C++. OpenCV-Python is a Python wrapper for the original OpenCV C++ implementation.

IEEE STANDARDS USED:

- **IEEE 610.4-1990**– IEEE Standard Glossary of Image Processing

and Pattern Recognition Terminology. This glossary identifies terms currently in use in the field of image processing and pattern recognition. Standard definitions for those terms are established.

- **IEEE 208-1995 -** IEEE standard on Video Techniques.

This standard was used to limit the size of the input video data as well as scaling, color contrasts, brightness, input data that had to be trained and tested upon.

- **IEEE 1115-2014** - IEEE Recommended Practice for Sizing Nickel-Cadmium Batteries for Stationary Applications.

This standard was used to power up the buggy as well as the Raspberry pi with +5V/9V capacity. It was maintained in a manner so as to prevent any power loss/failure or any kind of mis- happenings.

- **IEEE 2841-2019 –** IEEE Framework and Process for Deep Learning Evaluation This document defines best practices for developing and implementing deep learning algorithms and defines a framework and criteria for evaluating algorithm reliability and quality of the resulting software systems.

Chapter-3

FLOW CHART

3.1 Procedural Workflow

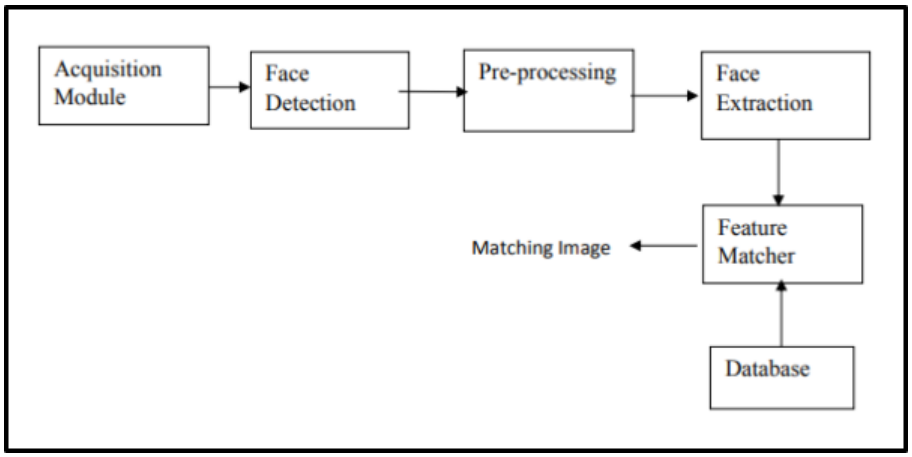
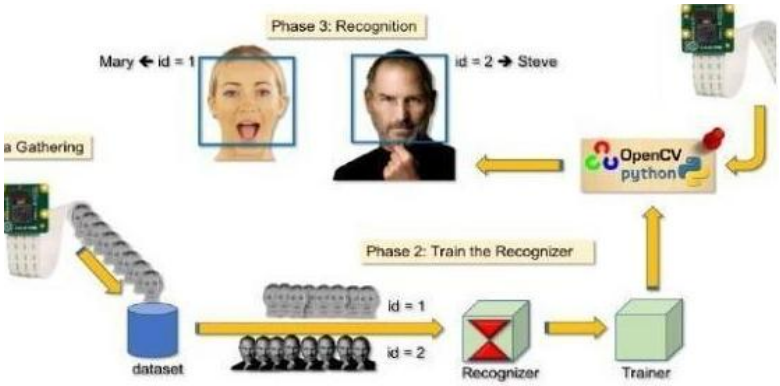


Figure 3.1

The user will have to put on these glasses and as soon as a familiar face appears , it gets recognized . In this project, we will be making a prototype of a smart eyeglass that can help a visually challenged person to recognize the person in front of him and learn about obstacles ahead. This will be enabled by face recognition and distance detection features.

First, open RPi SSH or Terminal and install the required libraries and modules. Then install the espeak module, followed by the espeak library for Python. The project was deployed in two parts: Coding and Hardware. For this project we will make two different codes in Python 3, one to tell the distance of obstacles ahead and others for face recognition. The first code measures the distance of obstacles and alerts the user using voice output.

The hardware part includes connecting all the components i.e. inserting the camera ribbon in the camera module and soldering the wires of the ultrasonic sensor.



3.2 Testing

Power the Raspberry Pi using a battery or power bank. Window of Pi desktop in remote desktop or VNC (If you do not know how to enable VNC and remote desktop on Pi follow the instructions online.) Next run the distance.py and facerecogination.py code and you are ready to go. When any known or unknown person comes in front of the
user (visually challenged person), it will detect the face and tell them about it. If the user comes closer to any obstacles like walls or any other object, the device will alert it to avoid accidents. .

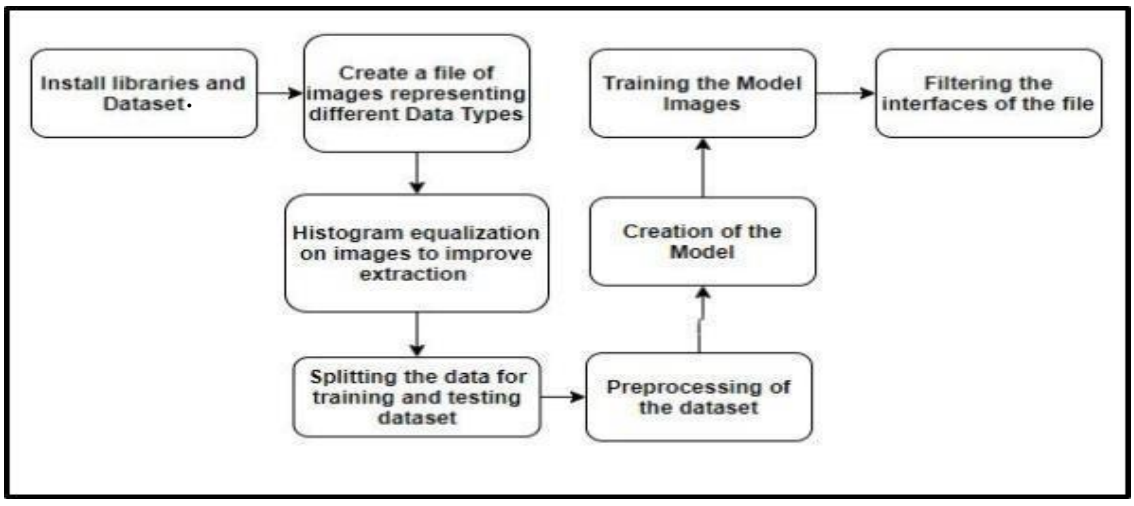


Fig 3.2

Chapter-4

PROJECT DESIGN AND DESCRIPTION

4.1 Purpose

The purpose of the chapter is to provide a detailed description of software and hardware that will be used during the project. It also describes different constraints and standards that apply to this domain's software.

4.2 Methodology

- **Designing eyeglasses using AI BASED technology:**

The methodology is based on the idea of designing glasses for face recognition and object detection using AI technology . This will not only help them to recognize the familiar faces but also get warned if obstacles are near so that these do not harm them.

- **Use of a predefined library:**

The main purpose of the project can be demonstrated by using a predefined library which can be developed using programming languages. System learns about obstacles and alerts the user with warning.

4.3 Hardware & Software

Component Name	Specifications
Camera	5 megapixels 1080p sensor mini module
Main Board	Raspberry pi 3v or 4
Ultrasonic Sensor	HC-SR04 or More sensitive and powerful

Table 4.3.1 - Hardware Requirements

Software Component	Specifications
Programming Language	Python
Public Libraries	Numpy, OpenCV, Face_Recognition, Pandas, eSpeak

Table 4.3.2 - Software Requirements

Chapter-5

Implementation and Experimental Results

IMPLEMENTATION SCREENSHOTS

Assembly of the required hardware -

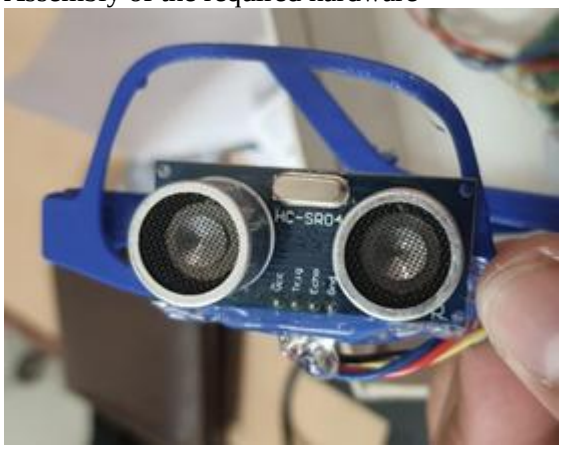


Figure 5.1

Figure 5.2

The AI glasses were successfully able to recognise face of a team member -

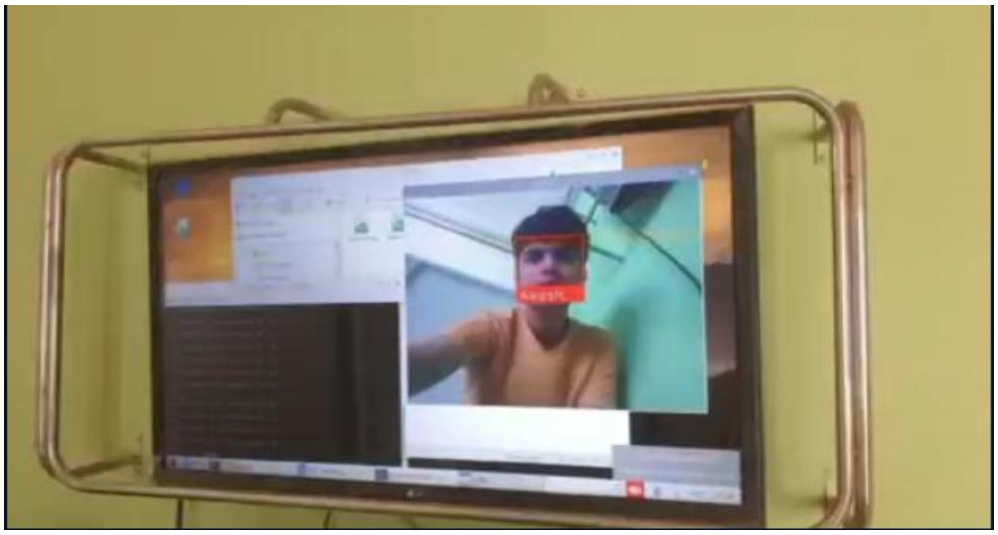


Figure 5.3

The AI glasses were successfully able to tell the distance between glasses and object in front with the help of ultrasonic sensor -

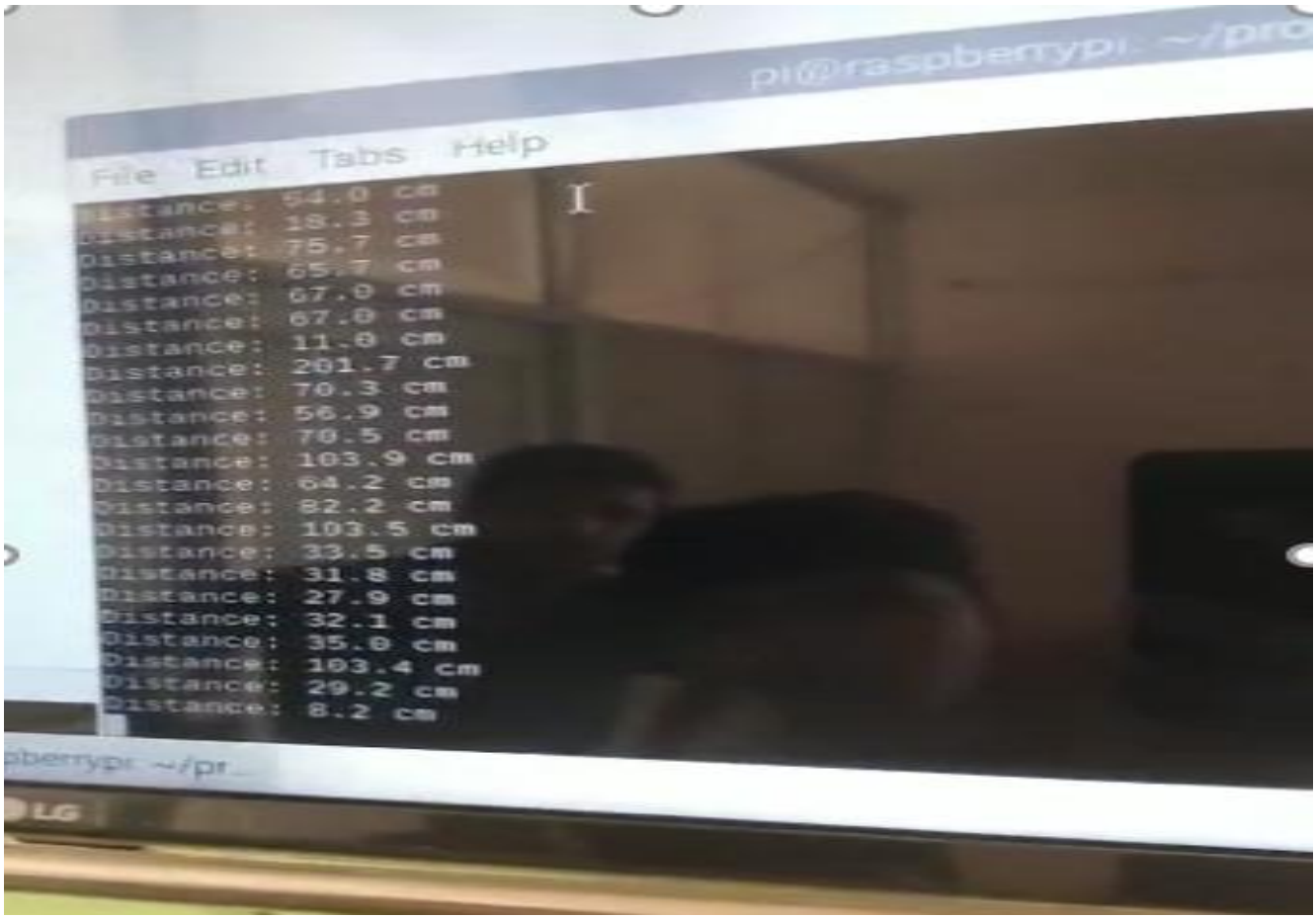


Figure 5.4

Chapter 6

Outcomes And Prospective Learning

6.1 Mapping to Students Learning Outcomes

NOTE: Which of the following students' outcomes you have achieved till the end of present semester (please answer Yes/No).	
For Capstone project the students of undergraduate program in Electronics and Communication Engineering/Electronics and Computer Engineering will have	
C. an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	
	Yes/No
C1. Analyze needs to produce problem definition for electronics and communication systems.	Yes
C2. Carries out design process to satisfy project requirement for electronics and communication systems	Yes
C3. Can work within realistic constraints in realizing systems.	Yes
C4. Can build prototypes that meet design specifications.	Yes
D. an ability to function on multidisciplinary teams.	
D1. Shares responsibility and information schedule with others in team	Yes
D2. Participates in the development and selection of ideas.	Yes
G. an ability to communicate effectively.	
G1. Produce a variety of documents such as laboratory or project reports using appropriate formats and grammar with discipline specific conventions including citations.	Yes
G2. Deliver well organized, logical oral presentation, including good explanations when questioned.	Yes

H. the broad education necessary to understand the impact of engineering solutions in a global. economic. environmental. and societal context.	
H1. Aware of societal and global changes that engineering innovations may cause.	Yes
H2. Examines economics trade-offs in engineering systems.	Yes
H3. Evaluates engineering solutions that consider environmental factors.	Yes
I. a recognition of the need for. and an ability to engage in life-long learning.	
I1. Able to use resources to learn new devices and systems. not taught in class.	Yes
I2. Ability to list sources for continuing education opportunities.	Yes
I3. Recognizes the need to accept personal responsibility for learning and of the importance of lifelong learning.	Yes
K. an ability to use the techniques. skills. and modern engineering tools necessary for engineering practice.	
K1. Able to operate engineering equipment	Yes
K2. Able to program engineering devices.	Yes
K3. Able to use electronic devices. circuits and systems modeling software for engineering applications	Yes
K4. Able to analyze engineering problems using software tools	Yes

Table 6.1.1: Table for mapping student course learning outcomes

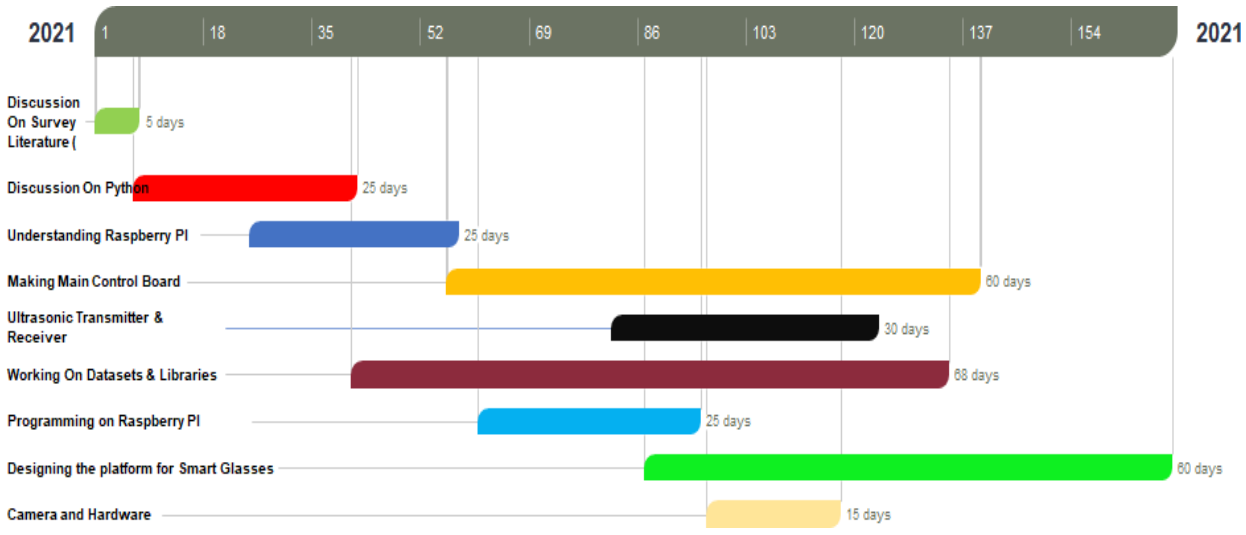
6.2 MAPPING TO COURSE LEARNING OUTCOMES:

Course Learning Outcomes	Rate between 1-5 (5: achieved, 1: not achieved)
Developing new/multidisciplinary technical skills.	5
Using professional and technical terminology appropriately.	4
Effectively utilizing and troubleshooting a tool for development of a technical solution.	4
Analyzing or visualizing data to create information.	3
Creating technical report with usage of international standards.	4
Acquiring and evaluating information.	4

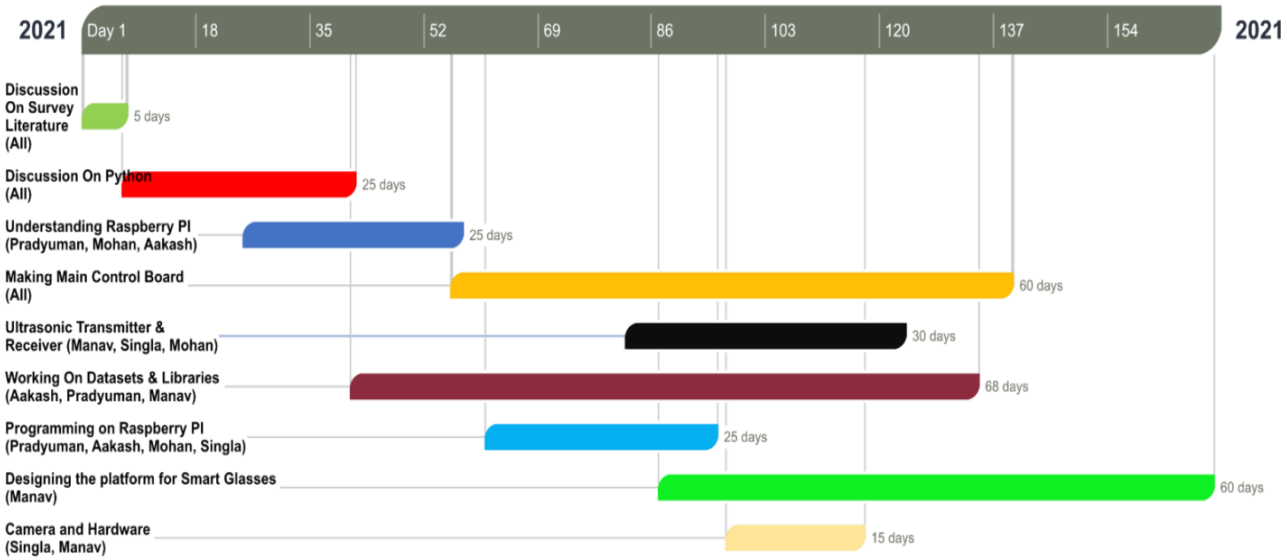
Chapter 7

Project timeline

7.1 Group Gantt Chart



7.2 Individual Gantt Chart



CHAPTER 8
FUTURE SCOPE

With the detection of facial features, the next goal is to research the ability for more precise details, like some individual points, of the facial features to be gathered. Those will be use to differentiate general human emotions, like happiness and sadness and other emotions. Recognition of human emotions would require accurate detection and analysis of the various elements of a human face, like the brow and the mouth, to determine an individual's current expression. The expression can then be compared to what is considered to be the basic signs of an emotion in all human beings. This research will be used in the field human-computer interaction to analyze the emotions one exhibits while interacting with a user interface which was not yet experimented before in the world of science and advancement.

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