A HOLISTIC VISIONARY AID FOR VISUALLY IMPAIRED PEOPLE

CO8811 – PROJECT REPORT

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in partial fulfillment for the award the degree

of

BACHELOR OF ENGINEERING

in

COMPUTER AND COMMUNICATION ENGINEERING

PANIMALAR ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

MARCH 2024

BONAFIDE CERTIFICATE

Certified that this project report **"A HOLISTIC VISIONARY AID FOR VISUALLY IMPAIRED PEOPLE"** is the bonafide work of **AJITHA R (211420118003), BAVEDRA S (211421118010), SWATHI K (211421118050) AND** who carried out the project work under my supervision.

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ACKNOWLEDGEMENT

We express our deep gratitude to our respected Secretary and Correspondent **Dr.P.CHINNADURAI, M.A., Ph.D.** for his kind words and enthusiastic motivation, which inspired us a lot in completing this project.

We would like to extend our heartfelt and sincere thanks to our Directors Tmt. **C.VIJAYARAJESWARI, Dr. C. SAKTHIKUMAR, M.E., Ph.D**., and **Dr.SARANYASREE SAKTHIKUMAR B.E., M.B.A., Ph.D**., for providing us with the necessary facilities for completion of this project.

We also express our gratitude to our Principal **Dr.K.MANI, M.E., Ph.D.,** for his timely concern and encouragement provided to us throughout the course.

We thank our HOD of Computer and Communication Engineering Department, **Dr. B. ANNI PRINCY, M.E., Ph.D**., Professor, for the support extended throughout the project.

We would like to thank our supervisor, **Mr. R. ANAND BABU, M.TECH., Ph.D.**., Assistant Professor (Grade-1), and all the faculty members of the Department of Computer and Communication Engineering for their advice and suggestions for the successful completion of the project.

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ABSTRACT

This research introduces an innovative assistive system tailored to empower visually impaired individuals by integrating embedded systems and Python OpenCV technology. The primary focus is on facilitating accurate detection of familiar faces such as parents, addressing a significant challenge within the visually impaired community. The hardware architecture of the embedded system prioritizes compactness and efficiency, ensuring both portability and real-time processing capabilities. At the heart of this system are sophisticated algorithms from Python OpenCV, which utilize image processing and machine learning techniques to achieve robust people detection. Through a sequence of image preprocessing stages, including edge detection and feature extraction, the system identifies human outline with remarkable precision. Additionally, deep learning models contribute to enhancing accuracy, enabling the system to differentiate between individuals based on facial features. The user interface is thoughtfully designed for simplicity and accessibility, incorporating auditory cues and haptic feedback to facilitate intuitive interaction. During testing, the system demonstrated impressive accuracy rates in detecting and distinguishing between fathers and mothers, highlighting its potential as a dependable aid for the visually impaired. Future improvements may involve expanding the dataset to encompass a broader range of facial recognition scenarios and integrating voice commands for seamless operation. In summary, this visionary assistive system merges embedded systems and Python OpenCV capabilities to deliver a portable, efficient, and precise solution for visually impaired individuals to identify significant figures like parents.

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LIST OF ABBREVIATIONS

GPS	Global Positioning System
SMS	Short Message Service
OPENCV	Open-Source Computer Vision Library
GSM	Global System for Mobile Communications
LCD	Liquid Crystal Display
GPRS	General Packet Radio Service
M2M	Machine To Machine
TCP	Transmission Control Protocol
EEPROM	Electrically Erasable Programmable Read-Only Memory
SRAM	Static Random Access Memory

CHAPTER 1

INTRODUCTION

1.1 OVERVIEW

The visually impaired community faces daily challenges in recognizing familiar faces, such as those of their fathers and mothers, which are crucial for their independence and social interactions. This project aims to bridge this gap by introducing a visionary aid system that utilizes an embedded system architecture and Python OpenCV for people detection. By combining the compactness and efficiency of embedded systems with the advanced image processing capabilities of OpenCV, this system offers real-time and accurate identification of individuals. Assistive technologies are rapidly evolving to enhance the quality of life for visually impaired individuals, and this project contributes to this endeavor. The system's intuitive interface, including auditory and haptic feedback, ensures ease of use for the target users. Through this research, we strive to provide a comprehensive solution that not only detects people but specifically focuses on recognizing fathers and mothers, fostering greater independence and social engagement for the visually impaired.

1.2 PROBLEM STATEMENT

The problem addressed in this research is the challenge faced by visually impaired individuals in recognizing important individuals in their lives, such as parents. Despite the availability of various assistive technologies, there remains a significant gap in providing visually impaired individuals with reliable tools for identifying familiar faces. Existing solutions often lack accuracy, portability, or real-time processing capabilities, limiting their effectiveness in everyday scenarios.

Specifically, the research aims to develop a visionary aid system that leverages embedded systems and Python OpenCV technology to overcome these limitations. The system's primary objective is to empower visually impaired individuals by accurately detecting and distinguishing between familiar faces like fathers and mothers. This entails addressing several key challenges:

Accuracy: Existing face recognition systems may struggle with accuracy, especially in complex environments or with varying lighting conditions. Achieving high precision in identifying familiar faces is essential for ensuring the reliability of the assistive system.

Portability: Many assistive technologies are bulky or cumbersome, hindering their practical use in daily life. Creating a solution that is compact and portable allows visually impaired individuals to carry it with them wherever they go, ensuring continuous support.

Real-time Processing: Time is often of the essence in social interactions, particularly when recognizing individuals in dynamic environments. The aid system must be capable of processing images in real-time to provide timely feedback to the user.

User Interface Accessibility: The user interface plays a crucial role in the usability of the system. Designing an intuitive interface that accommodates the needs of visually impaired users, with features such as auditory cues and haptic feedback, enhances the overall user experience.

1.3 OBJECTIVE OF THE PROJECT

1. Implementing an embedded system architecture for portability and real-time processing.

2. Utilizing Python OpenCV for advanced image processing and machine learning algorithms.

3. Developing algorithms for accurate people detection and differentiation, with a focus on fathers and mothers.

4. Designing an intuitive user interface with auditory cues and haptic feedback for ease of use.

5. Testing the system for reliability and accuracy in detecting and distinguishing between individuals.

6. Contributing to the field of assistive technologies by providing an inclusive solution for the visually impaired community.

7. Exploring future enhancements such as expanding the dataset for diverse facial recognition and integrating voice commands for seamless operation.

1.4 METHODOLOGY

The methodology employed in this research involves several key steps to develop and evaluate the visionary aid system for visually impaired individuals. These steps include:

Problem Definition: The research begins by clearly defining the problem statement, identifying the challenges faced by visually impaired individuals in recognizing familiar faces like parents.

Literature Review: A comprehensive review of existing literature is conducted to understand the state-of-the-art in assistive technologies for the visually impaired, particularly focusing on face recognition systems and their limitations.

System Design: Based on the identified challenges and existing research, the system architecture is designed. This involves determining the hardware specifications for the embedded system, selecting appropriate algorithms from Python OpenCV for people detection and facial recognition, and designing the user interface for accessibility.

Data Collection and Preparation: A dataset of images containing familiar faces, including fathers and mothers, is collected and pre-processed. This may involve image cropping, resizing, and augmentation to enhance the diversity and quality of the dataset.

Algorithm Implementation: The selected algorithms from Python OpenCV are implemented to perform people detection and facial recognition tasks. This may include edge detection, feature extraction, and the training of deep learning models for improved accuracy.

System Integration: The developed algorithms are integrated into the hardware architecture of the embedded system. This involves programming and configuring the system components to ensure compatibility and optimal performance.

User Interface Development: The user interface is developed, incorporating auditory cues and haptic feedback for accessibility. User testing and feedback may be conducted to refine the interface design and improve usability.

Evaluation: The performance of the visionary aid system is evaluated through rigorous testing. This includes assessing accuracy rates in detecting and differentiating between fathers and mothers, as well as evaluating factors such as portability, real-time processing capabilities, and user satisfaction.

Results Analysis: The results of the evaluation are analyzed to assess the effectiveness of the developed system in addressing the identified challenges. Insights gained from the analysis may inform future enhancements or modifications to the system.

CHAPTER 2

LITERATURE SURVEY

2.1 OVERVIEW

Title 1: Shortest Path Based Trained Indoor Smart Jacket Navigation System for Visually Impaired Person

Authors: Munmun Biswas1,, Tanni Dhoom, Refat Khan Pathan1

Year: 2020

Description:

Visually impaired people face a lot of challenges in their day-by-day life. Due to blindness most of the time they depend on others for their daily movements. Many assistive technologies have been developed for blind people; most of them are expensive and designed in a complicated way. So in this paper, we represent a complete wearable navigation system for blind people based on the low expanse and truly subtle sensors, for example, Pi camera and Ultrasonic sensor. Live video analysis has been done to detect human faces and ultrasonic sensors are used to detect objects as obstacles. Raspberry Pi has been used as the main controller board. The indoor path has been pre-trained and saved in a database for blind assistance by voice command using Google Text To Speech (gTTS) API so that blind people can navigate independently. In an emergency, the blind person can seek help from the specific person by sending SOS short message service (SMS) through pressing an integrated button. This system has been tested continuously by both blindfolded and visually impaired people at various indoor locations. The outcome shows that it operates more efficiently than other assistive systems.

Title 2: Shortest Path Based Trained Indoor Smart Jacket Navigation System for Visually Impaired Person

Authors: Munmun Biswas1, * , Tanni Dhoom , Refat Khan Pathan1

Year: 2020

Description:

Visually impaired people face a lot of challenges in their day-by-day life. Due to blindness most of the time they depend on others for their daily movements. Many assistive technologies have been developed for blind people; most of them are expensive and designed in a complicated way. So, in this paper, we represent a complete wearable navigation system for blind people based on the low expanse and truly subtle sensors, for example, Pi camera and Ultrasonic sensor. Live video analysis has been done to detect human faces and ultrasonic sensors are used to detect objects as obstacles. Raspberry Pi has been used as the main controller board. The indoor path has been pre-trained and saved in a database for blind assistance by voice command using Google Text to Speech (gTTS) API so that blind people can navigate independently. In an emergency, the blind person can seek help from the specific person by sending SOS short message service (SMS) through pressing an integrated button. This system has been tested continuously by both blindfolded and visually impaired people at various indoor locations. The outcome shows that it operates more efficiently than other assistive systems.

Title 3: Assistive Navigation Application for Blind People using a White Cane Embedded System

Authors: Adrian Mocanu, Valentin Sita, Camelia Avram

Year: 2020

Description:

The need to move independently is one of the most important factors conditioning an active life. A relative reduced number of devices and applications proved to have a real utility in this field, many of them presenting limitations and requiring improvements. The present paper proposes a system capable to assist impaired visual people to travel independently in smart cities. It is based on the enhancing of white canes with capabilities to read and interpret codes of colors special created to express previously elaborated routes for a given area. A decision part of the system compares the translated route with the real trial detected by sensors and transmits to the blind person guiding and warning coded tactile signals. The main functionalities of the system were modeled and tested in a laboratory environment, it proving to be reliable and easy to use.

Title 4: Braille Assistance System for Visually Impaired, Blind & DeafMute people in Indoor & Outdoor Application

Authors: Sunil Kumar KN **,** Vinayak S

Year: 2019

Description:

Navigation in outdoor and indoor is certainly an challenging task for visually impaired, blind and deaf-mute people, indoor navigation itself is certainly becoming an harder task for blind, visually impaired people and dead-mute peoples. As far as observed for the non-visually impaired, it is even worse for the visually impaired. People with visual disabilities or blinds are often depending up on external assistance like trained dogs, humans, or special devices as support systems for making decisions. Hence blind people need an assistive device that will allow blind user to navigate freely and this requirement has become crucial. Here the interfacing of different sensors and actuators along with Braille keypad which is user friendly application to these peoples is done with ARM LPC-2148 and it helps in minimizing the problems faced by blind people by maximizing the use of technology.

Title 5: An Evaluation of a Wearable Assistive Device for Augmenting Social Interactions

Authors: Shi Qiu, Jun Hu, Ting Han, Hirotaka Osawa, Matthias Rauterberg

Year: 2020

Description:

Gaze behaviors contain rich information regarding a person's emotions and engagements. Reciprocal eye contact can invoke feelings of liking between two strangers. But blind people cannot perceive and establish the eye contact with sighted counterparts, causing their feelings of social isolation and low confidence in conversations. Thus, our research purpose is to let blind people perceive and react gaze behaviors in social interactions. A Social Glasses system has been implemented iteratively to deliver the multisensory feedback channels of the ‘‘eye contact’’, integrating both visual and tactile feedback. Specifically, the system consists of a Social Glasses device and a tactile wristband, which are worn by a blind person. The Social Glasses simulates the natural gaze for the blind person, aiming at establishing the ‘‘eye contact’’ between blind and sighted people. The tactile wristband enables the blind person to perceive the corresponding tactile feedback when an ‘‘eye contact’’ happens.

2.2 EXISTING SYSTEM

In the existing system, there is a lack of automatic assistive technology specifically designed to aid blind individuals in their day-to-day activities. The absence of such systems creates significant challenges and limitations for blind people. There are several existing systems and technologies that can be incorporated into such a project. Here's a basic outline of how you could develop an Arduino-based system for the visually impaired:

Ultrasonic sensor: Use ultrasonic sensors to detect obstacles in the surroundings. These sensors emit ultrasonic waves and measure the time it takes for the waves to bounce back, which helps in calculating the distance to nearby objects.

Vibrating motor: Connect vibrating motors or a buzzer to the Arduinoboard. These components can provide haptic or auditory feedback to the user, alerting them when an obstacle is detected.

Arduino board: Choose an appropriate Arduino board for your project, such as Arduino Uno or Arduino Nano. This board will act as the main controller for processing sensor data and controlling output devices.

Battery Power: Ensure that the system can be powered by rechargeable batteries for portability and convenience.

2.2.1 Limitations

- Existing systems lack automated assistance for blind individuals
- Existing systems do not provide automated assistance for blind individuals to identify objects or recognize faces.
- Many existing systems may focus on general obstacle detection and navigation aids rather than specific recognition of familiar faces like parents. This limitation can lead to a lack of personalized assistance,

making it challenging for visually impaired individuals to identify important individuals in their surroundings.

- Existing systems may lack real-time processing capabilities, leading to delays in providing feedback or assistance to users. Your abstracted system prioritizes compactness and efficiency in its hardware architecture, ensuring both portability and real-time processing capabilities. This advantage allows for timely recognition of familiar faces, enhancing the user experience and independence of visually impaired individuals.
- The user interface of existing systems may lack simplicity and accessibility, making it challenging for visually impaired users to interact intuitively with the device. In contrast, our system's user interface is thoughtfully designed for simplicity and accessibility, incorporating auditory cues and haptic feedback to facilitate intuitive interaction. This design consideration improves the usability and overall user experience of the system.

CHAPTER 3

SYSTEM DEVELOPMENT

3.1 PROPOSED SYSTEM

1. Enhanced Facial Recognition: The proposed system employs advanced algorithms in Python OpenCV for precise and reliable detection of familiar faces, such as fathers and mothers, crucial for the visually impaired.

2. Portable Embedded System: Utilizing an embedded system architecture ensures the device is compact, lightweight, and portable, allowing users to carry it conveniently in various social and daily life settings.

3. Real-time Processing: The system offers real-time processing capabilities, providing instant feedback to the user upon detecting a person, enhancing their interaction and independence.

4. Intuitive User Interface: Featuring auditory cues and haptic feedback, the system's user interface is designed for easy and intuitive interaction, catering to the needs of visually impaired individuals.

5. Customized for Inclusivity: This system is tailored to address the specific needs of visually impaired individuals in recognizing important individuals like fathers and mothers, promoting independence and social engagement.

6. Future Expandability: The system is designed with scalability in mind, enabling future enhancements such as integrating additional facial recognition datasets and voice commands for expanded functionality.

3.2 BLOCK DIAGRAM

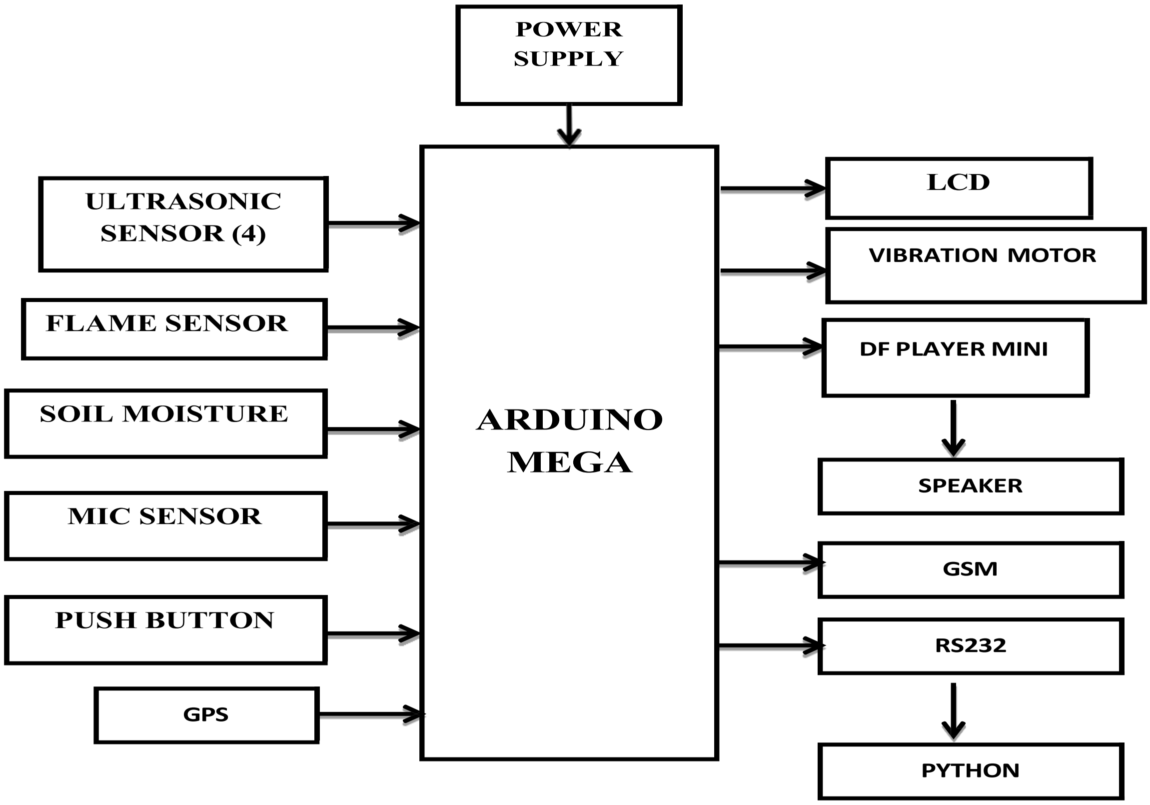

Figure 3.1 Proposed System block diagram

Our system utilizes an Arduino Mega microcontroller Figure 3.1 as the central processing unit, serving as the intelligent core of our setup. Python image processing algorithms are employed to identify authorized individuals, providing a reliable method for visually impaired persons to recognize familiar faces. To ensure the safety of the visually impaired person, a 4 ultrasonic sensor is integrated into the system. This sensor accurately detects obstacles. The MIC sensor captures ambient sound in its surroundings, serving as an acoustic sensor to detect and analyze environmental noise. Furthermore, our system incorporates a flame sensor that actively scans the surroundings for the presence of fire. To monitor the soil conditions for gardening or outdoor activities, we utilize a soil moisture sensor. This sensor detects and analyzes the moisture content of the soil, indicating whether it is wet or dry. To ensure the user's physical well-being, a gyroscope sensor is implemented in our system. This sensor accurately detects the angle or tilt of the blind person, enabling it to identify instances of imbalance or falls. In cases of emergencies or urgent situations, a dedicated push button is incorporated for immediate response. For conveying essential information, a liquid crystal display (LCD) screen is utilized. This display presents real-time updates, such as the status of detected individuals, Additionally, our system includes a vibration motor that engages when the soil moisture sensor detects dry soil conditions. To provide vocal alerts and instructions, an APR voice module is integrated into the system. This module enables the system to generate spoken messages, guiding the visually impaired person through various scenarios and notifying them of critical information or potential dangers. Furthermore, we employ a GSM module for communication purposes. This module enables our system to send SMS alerts to the designated caretaker or emergency contacts, ensuring that they are promptly notified of any critical situations or alarms raised by the system. To utilizing GPS technology, individuals can provide real-time location updates to their guardians, ensuring a reliable and accurate means of tracking their whereabouts for enhanced safety and security.

3.3 DESCRIPTION OF BLOCK DIAGRAM

3.3.1 Authentication

This project centers around aiding visually impaired individuals through the utilization of an Arduino Mega microcontroller, serving as the core intelligence of the system. The ultrasonic sensor is employed to detect objects in the vicinity, providing obstacle detection capabilities Figure 3.2. Additionally, a flame sensor is integrated to identify the presence of fire, enhancing safety measures. For activities like gardening, a soil moisture sensor determines whether the soil is wet or dry and conveys this information to the blind user through a vibration motor. To enhance situational awareness, a microphone (mic) sensor captures ambient noise in the surroundings. A DF Player is employed for voice alerts, delivering important information to the visually impaired individual.

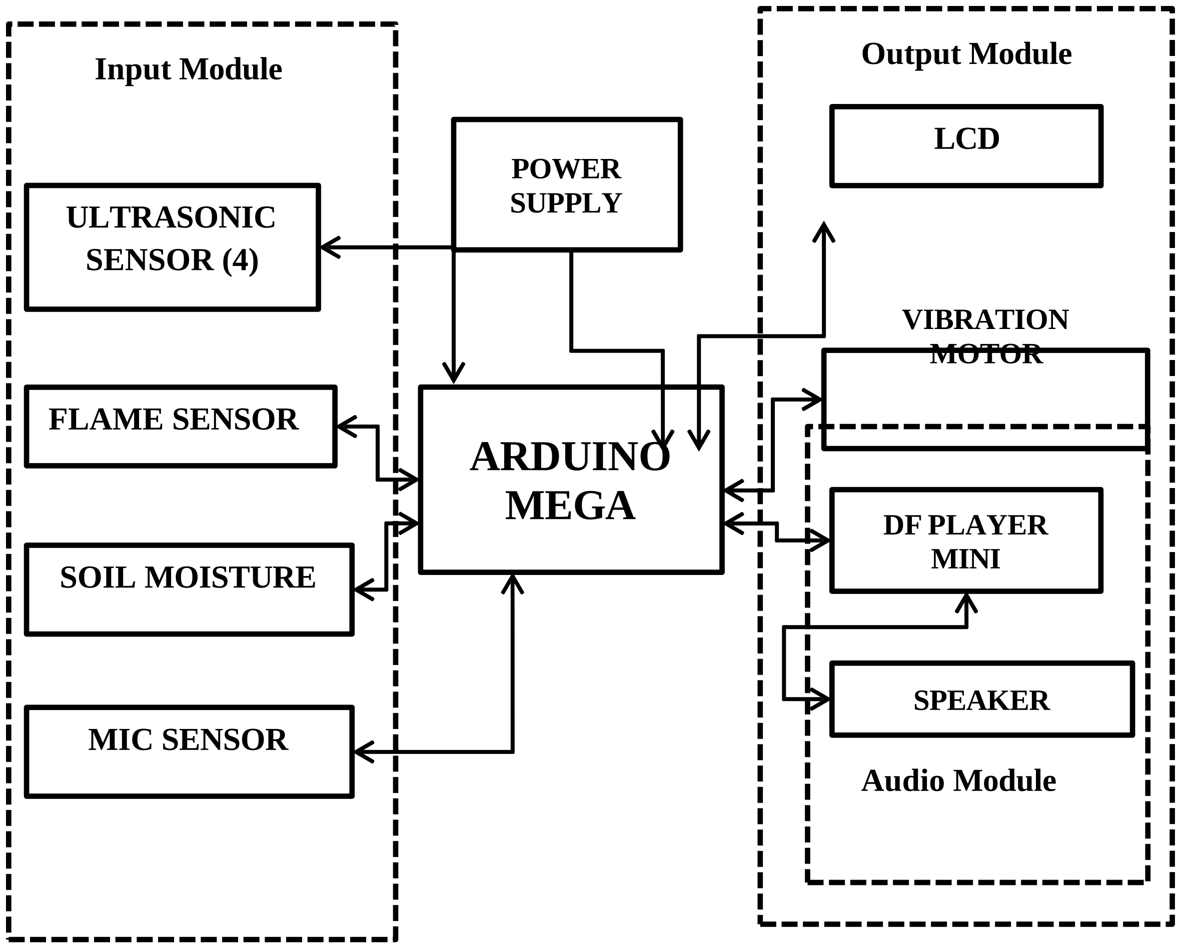

Figure 3.2 Authentication

3.3.2 Security Section

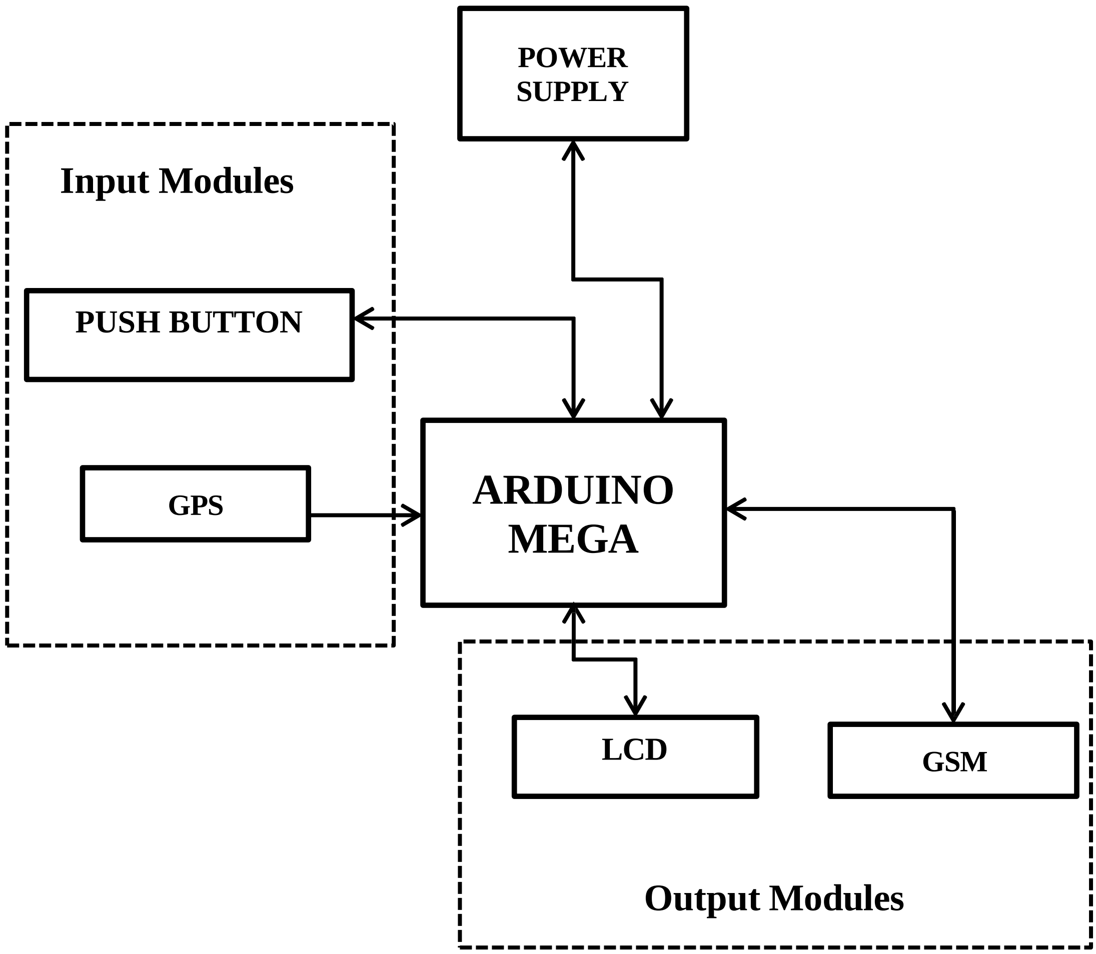

Figure 3.3 Security Section

The pivotal element of our system is the Arduino Mega microcontroller, functioning as the central processing unit. To address emergencies effectively, we've incorporated a push button that serves as an emergency trigger Figure 3.3. Upon pressing this button, the system initiates an automatic process wherein the GPS location is instantly transmitted to the designated caretaker through the GSM module. Simultaneously, the LCD screen updates in real-time, providing the current status of the situation.

3.3.3 Face Detection

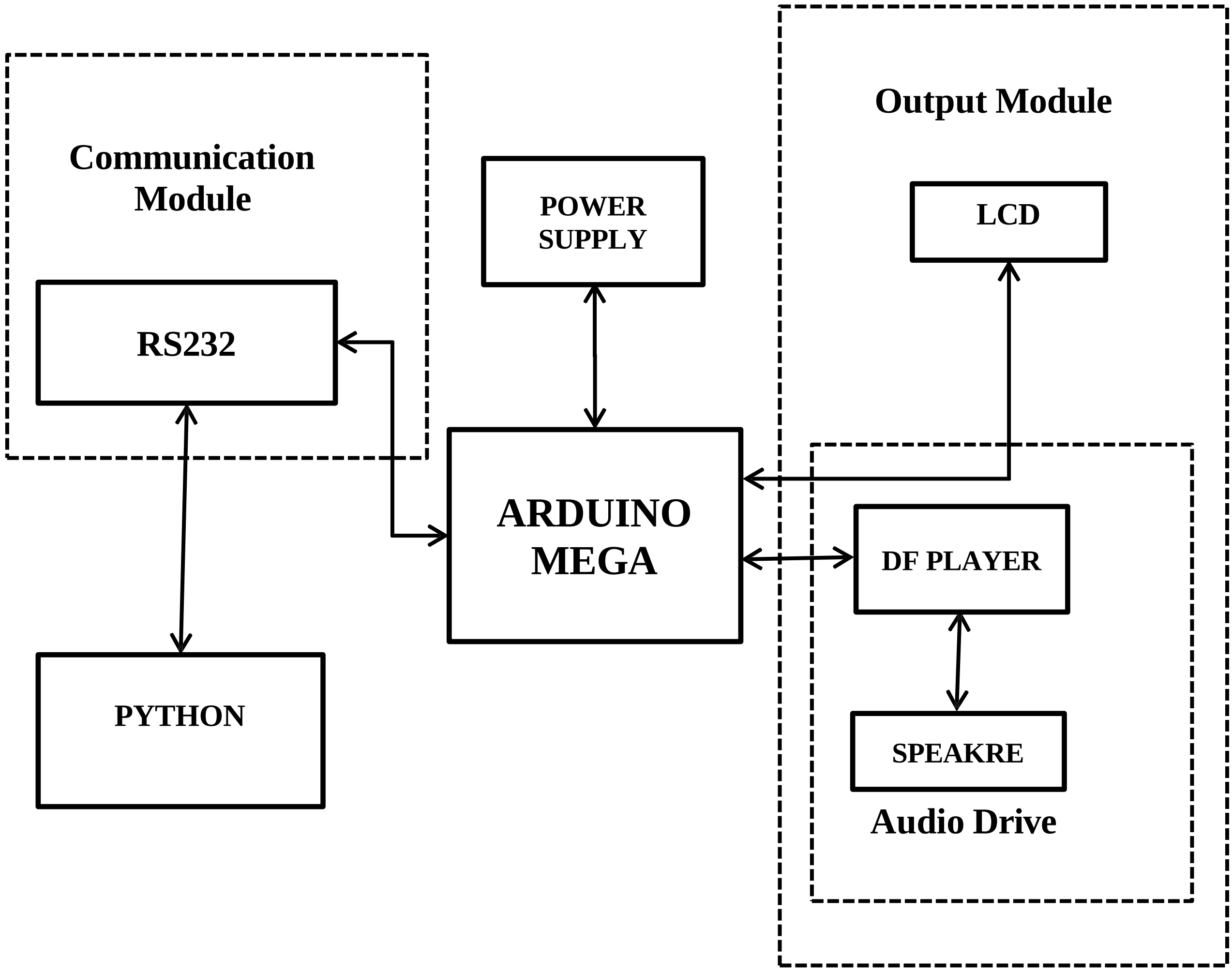

Figure 3.4 Face Detection

Within this project, the Arduino Mega microcontroller serves as the central processing unit, acting as the core intelligence of our system. Additionally, Python is employed for face detection, enhancing the system's capabilities. The Python-based face detection mechanism Figure 3.4 identifies faces and triggers voice alerts, providing valuable auditory information to assist visually impaired individuals

3.4 HARDWARE REQUIREMENTS

3.4.1 Arduino Mega

The MEGA 2560 is designed for more complex projects. With 54 digital I/O pins, 16 analog inputs and a larger space for your sketch it is the recommended board for 3D printers and robotics projects. This gives your projects plenty of room and opportunities.

Figure 3.5 Arduino Mega

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 Figure 3.5. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button Table 3.1. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.

Table 3.1 Technical Specifications Arduino Mega

Microcontroller	ATmega2560
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by boot loader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16 MHz
LED_BUILTIN	13
Length	101.52 mm
Width	53.3 mm
Weight	37 g

PROGRAMMING

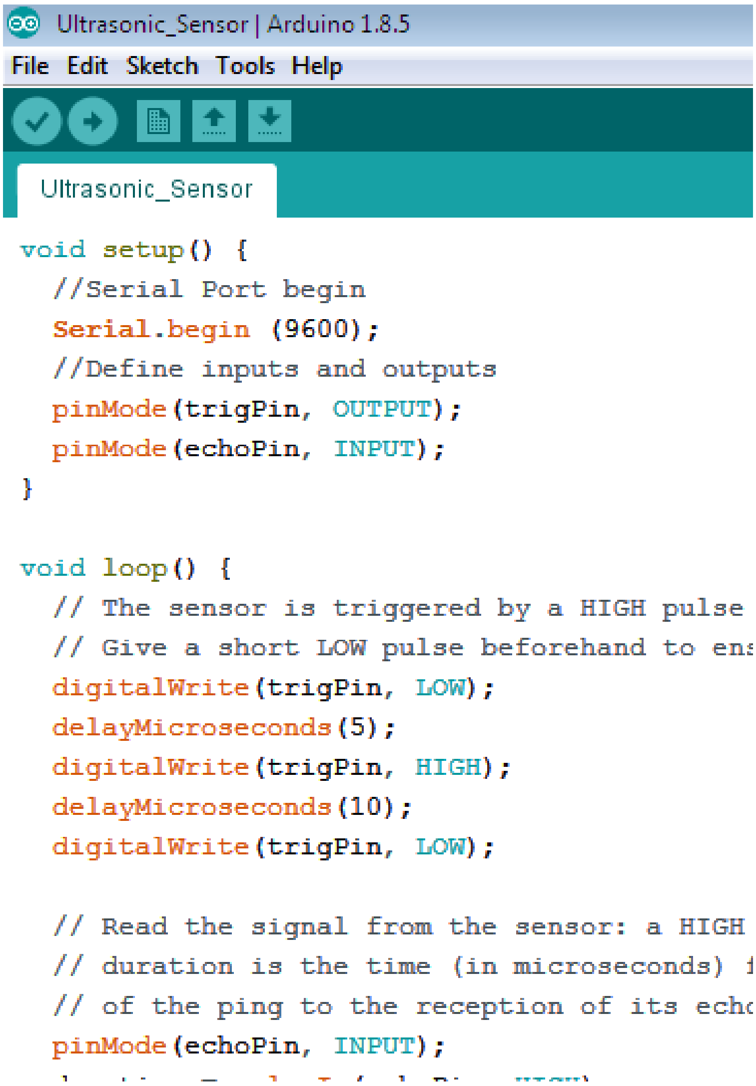

Figure 3.6 Arduino IDLE

The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available in the Arduino repository. The ATmega16U2/8U2 Figure 3.6 is loaded with a DFU boot loader, which can be activated by:

On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2.

On Rev2 or later boards: there is a resistor that pulling the 8U2/16U2 HWB line to ground, making it easier to put into DFU mode.

Serial: 0 (RX) and 1 (TX); Serial 1: 19 (RX) and 18 (TX); Serial 2: 17 (RX) and 16 (TX); Serial 3: 15 (RX) and 14 (TX). Used to receive (RX) and transmit (TX) TTL serial data. Pins 0 and 1 are also connected to the corresponding pins of the ATmega16U2 USB-to-TTL Serial chip.

External Interrupts: 2 (interrupt 0), 3 (interrupt 1), 18 (interrupt 5), 19 (interrupt 4), 20 (interrupt 3), and 21 (interrupt 2). These pins can be configured to trigger an interrupt on a low level, a rising or falling edge, or a change in level. See the attach Interrupt () function for details.

PWM: 2 to 13 and 44 to 46. Provide 8-bit PWM output with the analogWrite() function Table 3.2.

SPI: 50 (MISO), 51 (MOSI), 52 (SCK), 53 (SS). These pins support SPI communication using theSPI library. The SPI pins are also broken out on the ICSP header, which is physically compatible with the Arduino /Genuino Uno and the old Duemilanove and Diecimila Arduino boards.

LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

TWI: 20 (SDA) and 21 (SCL). Support TWI communication using the Wire library. Note that these pins are not in the same location as the TWI pins on the old Duemilanove or Diecimila Arduino boards.

AREF. Reference voltage for the analog inputs. Used with analogReference().

Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

3.4.2 Power Supply

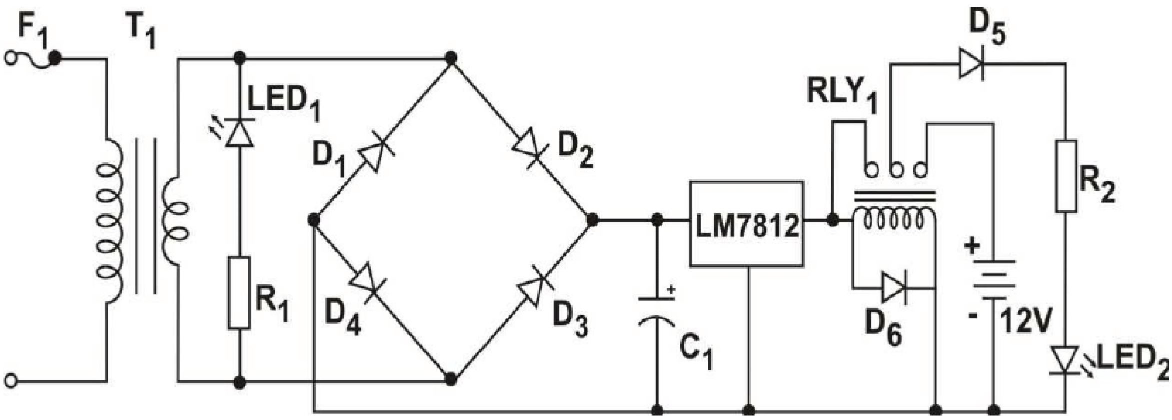

Figure 3.7 Power Supply

The power supply Figure 3.7 section is the important one. It should deliver constant output regulated power supply for successful working of the project. A 0-12V/1 mA transformer is used for this purpose. The primary of this transformer is connected in to main supply through on/off switch& fuse for protecting from overload and short circuit protection. The secondary is connected to the diodes to convert 12V AC to 12V DC voltage. And filtered by the capacitors, which is further regulated to +5v, by using IC 7805. In our project, power supplies are essential devices that provide power to a variety of components such as Arduino boards, LCD screens, ultrasonic sensors, flame sensors, and soil moisture sensors. We utilized two power supplies to effectively connect multiple devices.

3.4.3 Ultrasonic Sensor

Figure 3.8 HC-SR04

The HC-SR04 ultrasonic sensor Figure 3.8 uses sonar to determine distance to an object like bats do. It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. Ultrasonic sensors play a crucial role in detecting objects surrounding visually impaired individuals. It comes complete with ultrasonic transmitter and receiver modules. As the name indicates measure distance by using ultrasonic waves. The sensor head emits ultrasonic wave and receives the wave reflected back from the target (Object around visually impaired individuals). Ultrasonic measures Table 3.3 the distance through the target by measuring time between emission and reception. when an object is detected on any side of the blind person, it provides an auditory clue such as "Object detected on the right side."

Table 3.2 Electric Parameter HC-SR04

Working Voltage	DC 5 V
Working Current	15mA
Working Frequency	40Hz
Max Range	4m
Min Range	2 cm
Measuring Angle	15 degrees
Trigger Input Signal	10uS TTL pulse
Echo Output Signal	Input TTL lever signal and the range in proportion
Dimension	45*20*15mm
Main parts	Transmitter &receiver
Technology used	Non-contact technology

Table 3.3 Ultrasonic Sensor Pin Configuration

Pin number	Pin name	Description
1.	Vcc	The Vcc pin powers the sensor, typically with +5V
2.	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
3.	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4.	Ground	This pin is connected to the Ground of the system.

Timing diagram

The Timing diagram is shown below Figure 3.9. We only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out 8 cycles burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion. We can calculate the range through the time interval between sending trigger signal and receiving echo signal. Formula: uS / 58 = centimeters or uS / 148 =inch; or: the range = high level time * velocity (340M/S) / 2; we suggest to use over 60ms measurement cycle, in order to prevent trigger signal to the echo signal.

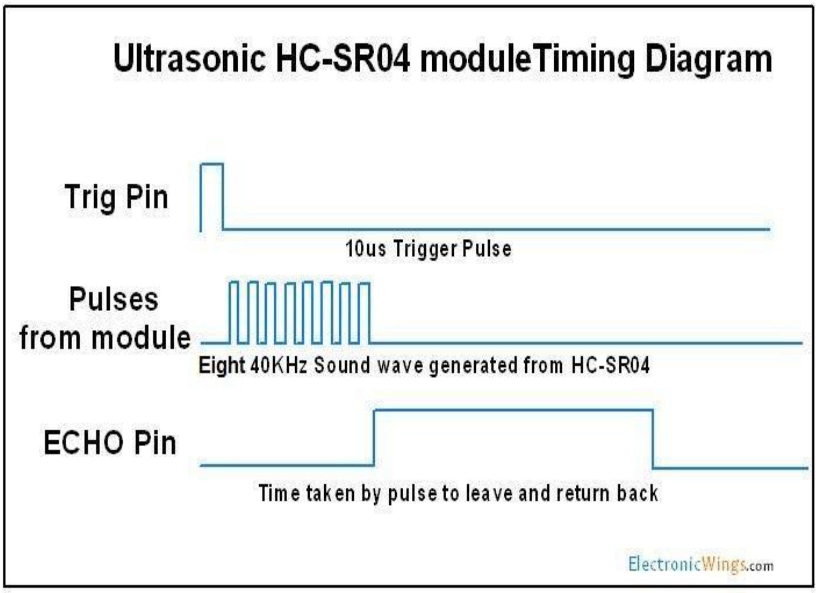

Figure 3.9 Timing diagram

The amount of time during which the Echo pin stays high is measured by the MCU/MPU as it gives the information about the time taken for the wave to return back to the Sensor Table 3.4. Using this information, the distance is measured.

3.4.4 Fire/Flame Sensor

A flame detector Figure 3.10 is a sensor designed to detect and respond to the presence of a flame or fire. Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line (such as a propane or a natural gas line), and activating a fire suppression system.

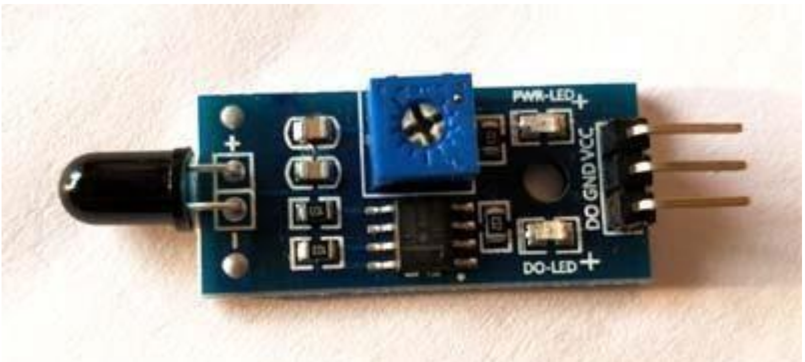

Fig 3.10 Fire/Flame Sensor

Table 3.4 Fire/Flame Sensor Pin Description

Pin	Description
V_{cc}	3.3 – 5V power supply
GND	Ground
D_{out}	Digital output

The flame sensor is integrated into our system to detect fires, particularly for the safety of visually impaired individuals who may not notice them otherwise. This fire sensor circuit exploits the temperature sensing property of an ordinary signal diode IN 34 to detect heat from fire. The distance of detection is pre-processed within Arduino IDE program, offering flexibility for further adjustments as required. The fire sensor circuit is too sensitive and can detect a rise in temperature of 10 degree or more in its vicinity**.** Ordinary signal diodes like IN 34 and OA 71 exhibits this property and the internal resistance of these devices will decrease when temperature rises. Upon detecting a fire, an immediate voice message, such as "Fire detected," is relayed to the blind person through a speaker.

3.4.4 Soil Moisture Sensor

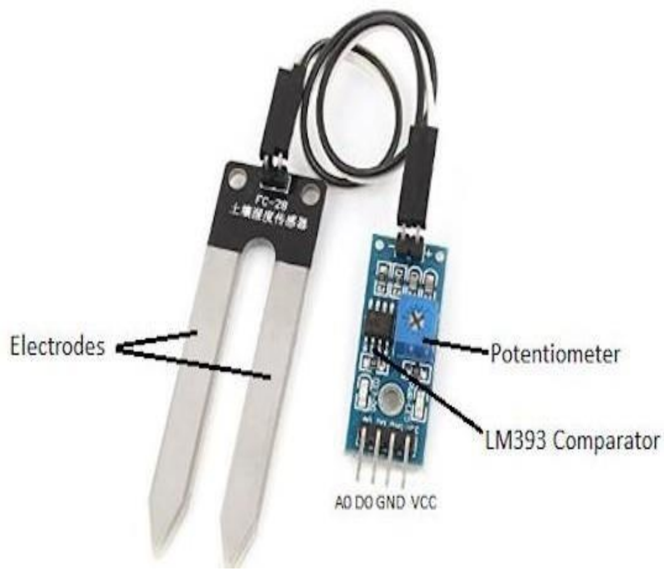

Figure 3.11 FC-28 soil moisture sensor

Incorporating a soil moisture sensor enables the system to assess water levels, a crucial aspect that may go unnoticed by blind individuals. This integration significantly enhances their safety. This sensor Figure 3.11 can be used to test the moisture of soil, when the soil is having water shortage, the module output is at high level, and else the output is at low level. By using this sensor one can automatically water the flower plant, or any other plants requiring automatic watering technique. Soil moisture sensors measure the volumetric water content in soil. Since the direct gravimetric measurement of free soil moisture requires removing, drying, and weighing of a sample, soil moisture sensors measure the volumetric water content indirectly by using some other property of the soil, such as electrical resistance, dielectric constant, or interaction with neutrons, as a proxy for the moisture content. After detecting a high moisture level, an audio message is promptly sent to the blind person, informing them with the message "Water detected," aiding them in determining their subsequent actions.

3.4.5 Sound Sensor

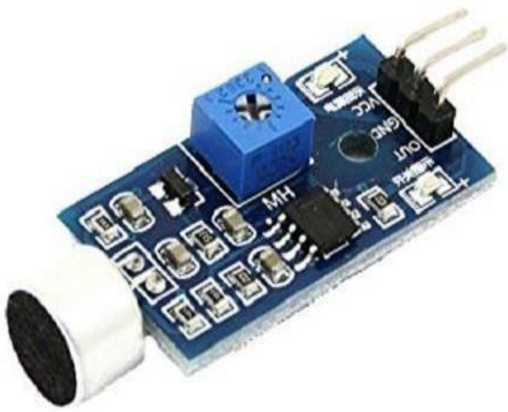

Figure 3.12 Sound-Sensor-Module

Sound sensors aiding them in navigation, environmental awareness, and accessing information. This aid blind individuals by detecting obstacles, providing auditory cues for safe navigation. The working principle of this sensor is related to human ears. Because human eye includes a diaphragm and the main function of this diaphragm is, it uses the vibrations and changes into signals. Whereas in this sensor, it uses a microphone and the main function of this is, it uses the vibrations and changes into current otherwise voltage. Generally, it includes a diaphragm which is designed with magnets that are twisted with metal wire Figure 3.12. When sound signals hit the diaphragm, then magnets within the sensor vibrates and simultaneously current can be stimulated from the coils.

3.4.6 GPS

The Global Positioning System (GPS) Figure 3.13 is a U.S. space- based global navigation satellite system. Our system utilizes GPS technology to track a Blind person's real-time location and securely transmits this information to authorized caregivers, family members, or friends at any emergency situations. It provides reliable positioning, navigation, and timing services to worldwide users on a continuous basis in all weather, day and night, anywhere on or near the Earth.

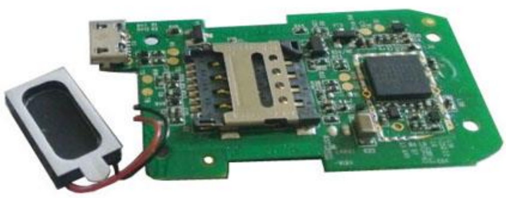

Figure 3.13 GPS

GPS is made up of three parts: between 24 and 32 satellites orbiting the Earth, four control and monitoring stations on Earth, and the GPS receivers owned by users. GPS satellites broadcast signals from space that are used by GPS receivers to provide three-dimensional location (latitude, longitude, and altitude) plus the time.

3.4.7 LCD (Liquid Crystal Display)

LCD screen is an electronic display module and find a wide range of applications. A 16x2 LCD display Figure 3.14 is very basic module and is very commonly used in various devices and circuits. While an LCD screen can be helpful for sighted users to view real-time information, for blind users, our system provides this information through text-to-speech or other accessible audio. This ensures everyone can receive the information they need. Our system integrates with various devices, displaying real-time information on the LCD screen. This includes alerts like "water detected" for comprehensive monitoring. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on A **16x2 LCD** means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD.

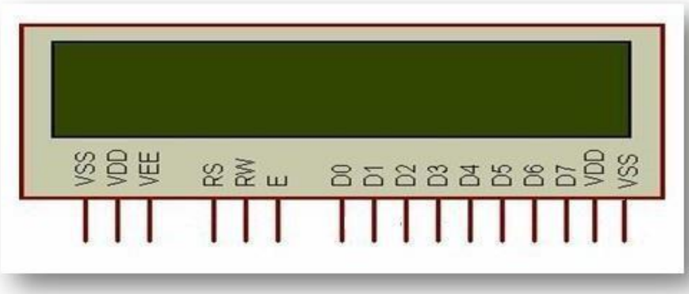

Figure 3.14 LCD (Liquid Crystal Display) Pin Diagram

Table 3.5 LCD Pin Description

Pin No	Function	Name
1	Ground (0V)	Ground
2	Supply voltage; 5V (4.7V – 5.3V)	Vcc
3	Contrast adjustment; through a variable resistor	V_{EE}
4	Selects command register when low; and data register when high	Register Select
5	Low to write to the register; High to read from the register	Read/write
6	Sends data to data pins when a high to low pulse is given	Enable
7	8-bit data pins	DB0
8		DB1
9		DB2
10		DB3
11		DB4
12		DB5
13		DB6
14		DB7
15	Backlight V_{CC} (5V)	Led+
16	Backlight Ground (0V)	Led-

3.4.8 Coin Vibration Motors

A vibrating device could use vibrations to signal obstacles or upcoming turns. Our system utilizes vibrating motors to provide directional guidance for blind users. When ultrasonic sensors detect objects on all four sides, the user receives a vibration cue, indicating they've reached a stopping point. Precision Micro drives currently produces coin vibration motors Figure 3.15, also known as shaftless or pancake vibrator motors, generally in Ø8mm - Ø12mm diameters for our Pico Vibe range. Pancake motors are compact and convenient to use. They integrate into many designs because they have no external moving parts, and can be affixed in place with a strong permanent self- adhesive mounting system. Enclosures can easily be moulded to accept the coin form of our shaftless vibration motors. Within the coin motor range, we offer both leaded and spring & pad mountable versions. Like all of our vibration motors, we are happy to quote for variations to the base design such as a modification to the lead length and also connectors.

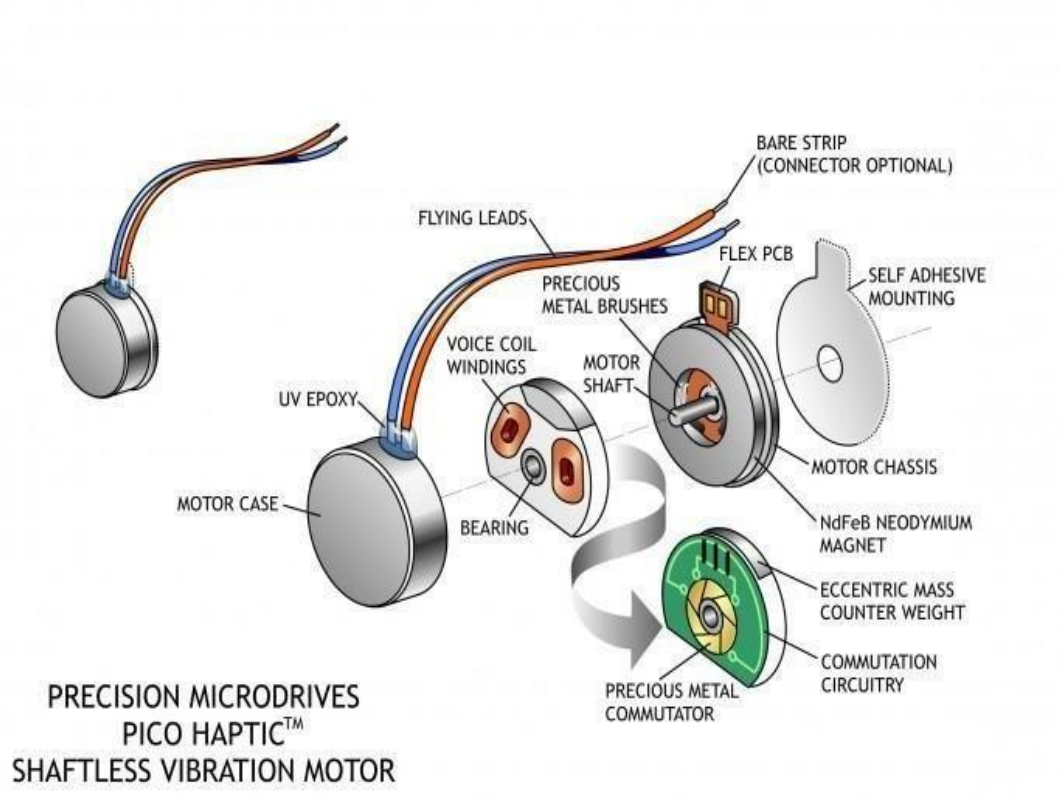

Figure 3.15 Coin Vibration Motors

3.4.9 SIM 900 GSM/GPRS Module

Figure 3.16 SIM 900 GSM/GPRS Module

A device with a GSM module and a push button can be used by a blind person to send an emergency SMS with their location (using GPS integration) to designated caregivers or emergency services. With their consent, a GSM module can be used in a tracking device to allow caregivers to monitor a blind person's location remotely, providing peace of mind and potentially aiding in search and rescue situations. A GSM module can be integrated into a specialized device with voice calling capabilities, allowing blind users to make and receive calls directly, promoting independence and connection.

GSM/GPRS Modem-RS232 Figure 3.16 is built with Dual Band GSM/GPRS engine- SIM900, works on frequencies 900/ 1800 MHz. The Modem is coming with RS232 interface, which allows you connect PC as well as microcontroller with RS232 Chip (MAX232) Table 3.7. The baud rate is configurable from 9600-115200 through AT command. It is suitable for SMS, Voice as well as DATA transfer application in M2M interface. The onboard Regulated Power supply allows you to connect wide range unregulated power supply. Using this modem, you can make audio calls, SMS, Read SMS, attend the incoming calls and internet through simple AT commands.

Table 3.6 SIM 900 GSM/GPRS Module Pin Specifications

PIN	NAME	DETAILS
1	GND	Power supply ground
2	TX	transmitter
3	RX	receiver
4	Line_r & Line_l	Line input
5	Spk_p & spk_n	Speaker positive & negative
6	Mic_p & mic_n	Mic positive & negative
7	DTR	Data terminal ready
8	CTS	Clear to send
9	RTS	Request to send

3.4.10 Push Button Switch

Figure 3.17 Push Button Switch

Pressing the push button can trigger an automated system that sends an SMS or calls emergency services, including the user's location (through GPS integration) to pre-programmed contacts. This allows for a quick and efficient response in critical situations. The push button can send an alert to designated caregivers (family, friends, or care providers) notifying them of the emergency and potentially providing location data. This allows for faster intervention and support from those familiar with the person's situation. Panic buttons provide blind people with a sense of security and independence, knowing they can quickly summon help when needed. By offering a way to directly connect with emergency services or trusted individuals, panic buttons can significantly improve safety and peace of mind for blind individuals.

Push Button Features

- Prevent flux rise by the insert-molded terminal
- Snap-in mount terminal
- Contact Bounce: MAX 5mS
- Crisp clicking by tactile feedback
- Dielectric Withstanding Voltage 250V AC for 1 minute

3.5 SOFTWARE REQUIREMENTS

3.5.1 Enhanced Facial Recognition Model

Our Python script appears to be a part of a project aimed at creating a facial recognition-based attendance system using a webcam, OpenCV, and a microcontroller (presumably an Arduino) connected via serial communication. Here's a breakdown of how each part contributes to the project:

Imports

- \`cv2\`: Used for capturing video from the webcam and performing image processing tasks.

- `numpy`: Provides support for working with arrays and matrices, often used in image processing tasks.
- `os`: Enables interaction with the operating system, facilitating file management operations.
- `pyttsx3`: Allows the conversion of text to speech, potentially for providing auditory feedback in the project.
- `datetime`: Helps in obtaining the current date and time, which can be useful for timestamping attendance records.
- `csv`: Provides functionality for reading from and writing to CSV files, which might be used for storing attendance data.
- `face_recognition`: Offers pre-trained models for face detection and recognition.
- `serial`: Facilitates communication with the microcontroller via a serial port.

Initialization

- `ser = serial.Serial('COM3', 9600)`: Establishes a serial connection with the microcontroller on COM3 port with a baud rate of 9600,

Data Preparation

- Images and names of individuals (presumably students) are loaded from a directory ('data').

Preprocessing

- The images are resized and converted to RGB format for processing with the `face_recognition` library.

Face Encoding

- Facial encodings are generated for each loaded image using the `face_recognition.face_encodings()` function.

Real-time Face Recognition

- The webcam captures frames in real-time.
- Faces in the frames are detected using `face_recognition.face_locations()` and their encodings are extracted.
- These encodings are compared with the precomputed encodings to recognize individuals.
- If a match is found, the name of the recognized individual is displayed on the frame.
- Additionally, if specific individuals (e.g., 'BABI', 'DEVA', etc.) are detected, certain actions are triggered (e.g., sending signals to the microcontroller).

Attendance Logging

- Attendance records are written to a CSV file with columns for serial number, name, timestamp, and voting status.

User Interface

- The webcam feed with overlaid recognized faces is displayed in a window titled 'Face Attendance System'.

Exiting the Program

- -The program exits when the 'Esc' key is pressed.

File Handling

- The CSV file is closed after attendance logging is completed.

3.5.1 Block Diagram

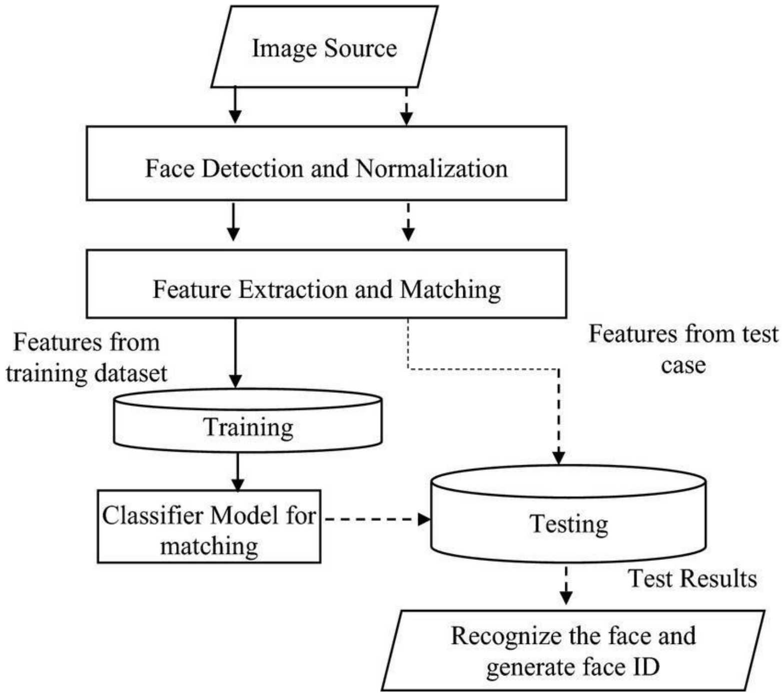

Figure 3.18 Enhanced Facial Recognition Model

The algorithm Figure 3.18 used in the code primarily revolves around face detection and recognition, implemented using the `face_recognition` library. Here's a breakdown of the key algorithms utilized:

Face Detection

- The face detection algorithm locates human faces within the input images or frames Figure 3.19.
- This is typically done using a pre-trained machine learning model, which can identify facial features and their spatial arrangement.

- In the code, face detection is performed using the `face_recognition.face_locations()` function, which returns the coordinates of bounding boxes around detected faces.

Face Encoding

- Once faces are detected, facial encodings are computed for each face.
- Facial encodings are numerical representations of facial features extracted from the detected faces.
- These encodings capture unique characteristics of each face in a compact format.
- The `face_recognition.face_encodings()` function is used in the code to compute facial encodings for each detected face.

Face Recognition

- The face recognition algorithm compares the computed facial encodings of detected faces with a database of known faces.
- This comparison is performed to identify whether the detected faces match any of the known faces in the database.
- The comparison involves measuring the similarity between the facial encodings using distance metrics.
- In the code, the `face_recognition. compare_faces()` function is used to compare facial encodings and determine if there's a match with known faces.

Serial Communication

- Another aspect of the algorithm involves serial communication with external hardware, likely a microcontroller.
- This part of the code sends signals to the microcontroller based on detected faces, possibly to trigger certain actions or responses.
- Serial communication is established using the `serial` library, allowing data to be sent over a serial port to the connected hardware device.

Figure 3.19 Sample Dataset for Facial Recognition

3.5.3 Embedded C

Embedded C is most popular programming language in software field for developing electronic gadgets. Each processor used in electronic system is associated with embedded software.

Embedded C programming plays a key role in performing specific function by the processor. In day-to-day life we used many electronic devices such as mobile phone, washing machine, digital camera, etc. These all-device working is based on microcontroller that are programmed by embedded C.

Let's see the block diagram representation of embedded system programming Figure 3.20:

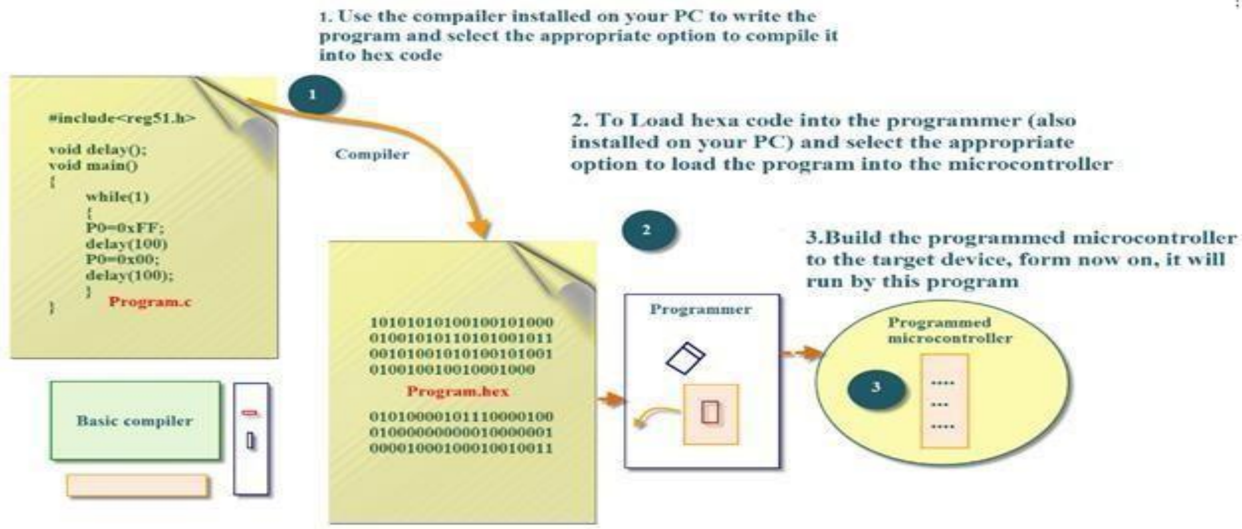

Figure 3.20 Embedded C

The Embedded C code written in above block diagram is used for blinking the LED connected with Port0 of microcontroller.

In embedded system programming C code is preferred over other language. Due to the following reasons:

- Easy to understand
- High Reliability
- Portability
- Scalability

Embedded System Programming

Basic Declaration

Let's see the block diagram of Embedded C Programming development:

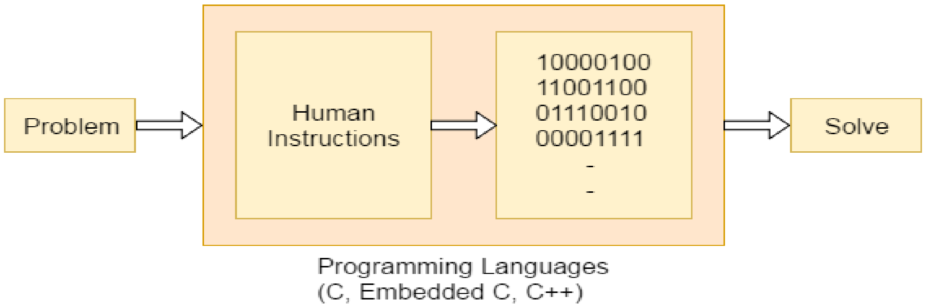

Figure 3.21 Block diagram of Embedded C Programming Development

Function is a collection of statements that is used for performing a specific task Figure 3.21 and a collection of one or more functions is called a programming language. Every language is consisting of basic elements and grammatical rules. The C language programming is designed for function with variables, character set, data types, keywords, expression and so on are used for writing a C program.

The extension in C language is known as embedded C programming language. As compared to above the embedded programming in C is also have some additional features like data types, keywords and header file etc is represented by #include<**microcontroller** name.h>.

Basic Embedded C Programming Steps

Let's see the block diagram Figure 3.22 representation of Embedded C Programming Steps:

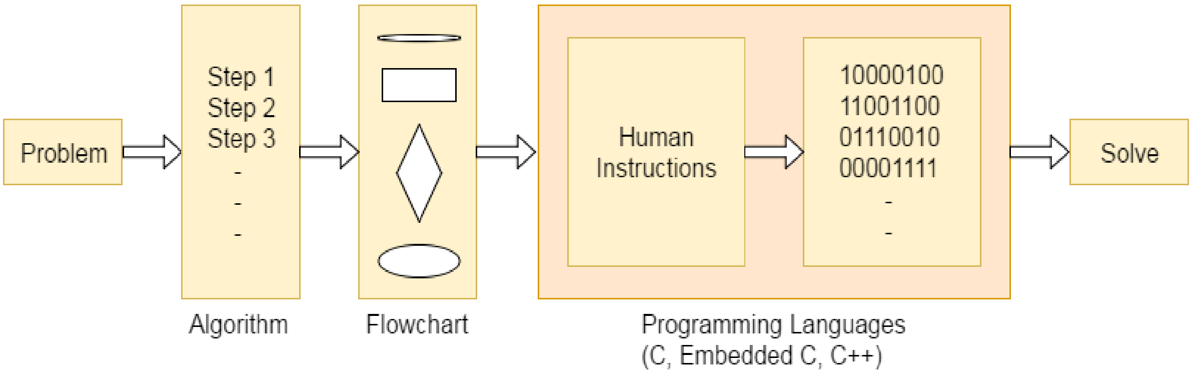

Figure 3.22 Block diagram of Embedded C Programming Steps

The microcontroller programming is different for each type of operating system. Even though there are many operating system is existed such as Windows, Linux, RTOS, etc but RTOS has several advantages for embedded system development.

Embedded Systems

Embedded System is a system composed of hardware, application software and real time operating system. It can be small independent system or large combinational system.

Our Embedded System tutorial includes all topics of Embedded System such as characteristics, designing, processors, microcontrollers, tools, addressing modes, assembly language, interrupts, embedded c programming, led blinking, serial communication, lcd programming, keyboard programming, project implementation etc.

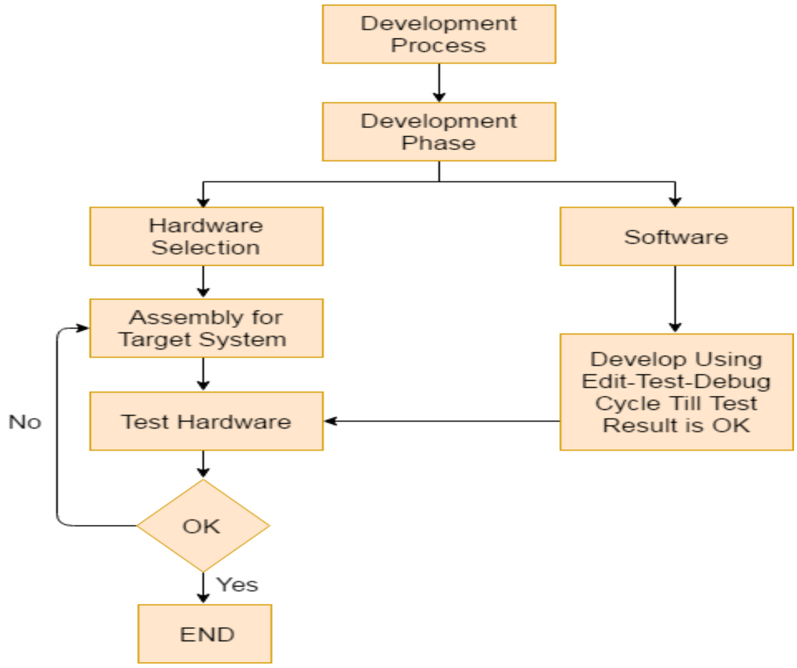

Figure 3.23 System Composed

Debugging Tools in An Embedded System

Debugging Figure 3.23 is a tool used for reducing the number of error or bugs inside a computer program or an assembled electronic hardware.

Debugging of a compact subsystem is difficult because a small change in one subsystem can create bugs in another system. The debugging used inside embedded system differs in terms of their development time and debugging features.

Let's see the different debugging tools used in embedded system are:

Simulators:

Simulator is a tool used for simulation of an embedded system. Code tested for microcontroller unit by simulating code on the host computer. Simulator is used for model the behavior of the complete microcontroller in software.

Functions of simulators:

Let's see the functions performed by simulator are:

- It defines the processing or processor device family with various version of target system.
- It monitors the detailed information of a source code and symbolic arguments as the execution goes for each single step of operation.
- It simulates the ports of target system for each single step of execution.
- It provides the working status of RAM.
- It monitors the response of system and determines the throughput.
- It provides the complete meaning of the present command.
- It monitors the detailed information of the simulator commands entered from the keyboard or selected from the menu.

Microcontroller Starter Kit

For developing an embedded system-based project a complete microcontroller starter kit is required. The major advantage of this kit over simulator is that they work in real-time operating condition. Therefore, it allows the easy input/output functional verification. Consider a microcontroller starter kit consists of: -

- Hardware Printed Circuit Board (PCB)
- In-System Programmer (ISP)
- Some embedded system tools like compiler, assembler, linker, etc
- Sometimes, there is a requirement of an Integrated Development Environment (IDE)

The above component available in microcontroller starter kit is completely enough and the cheapest option available for developing simple microcontroller projects.

Emulators:

An emulator is a software program or a hardware kit which emulates the functions of one computer system into another computer system. Emulators have an ability to support closer connection to an authenticity of the digital object.

It can also be defined as the ability of a computer program in electronic device to emulate another program or device. It focusing on recreating the original computer environment and helps a user to work on any type of application or operating system.

Peripheral Devices in Embedded Systems

Communication of an embedded system with an outside environment is done by using different peripheral devices as a combination with microcontroller.

Let's see the different peripheral devices in embedded system are: -

- Universal Serial Bus (USB)
- Networks like Ethernet, Local Area Network (LAN) etc
- Multi Media Cards (SD Cards, Flash memory, etc)
- Serial Communication Interface (SCI) like RS-232, RS-485, RS-422, etc
- Synchronous Serial Communication Interface like SPI, SSC and ESSI
- Digital to Analog/ Analog to Digital (DAC/ADC)
- General Purpose Input/Output (GPIO)
- Debugging like In System Programming (ISP), In Circuit Serial Programming (ICSP), BDM Port, etc

\

3.6.4 Arduino Software Ide

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code Figure 3.24, 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.

Figure 3.24 Arduino Software Ide

Writing Sketches

Programs written using Arduino Software (IDE) are called **sketches** Figure 3.25. 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) Table 3.8, 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.

NB: Versions of the Arduino Software (IDE) prior to 1.0 saved sketches with the extension .pde. It is possible to open these files with version 1.0, you will be prompted to save the sketch with the .ino extension on save.

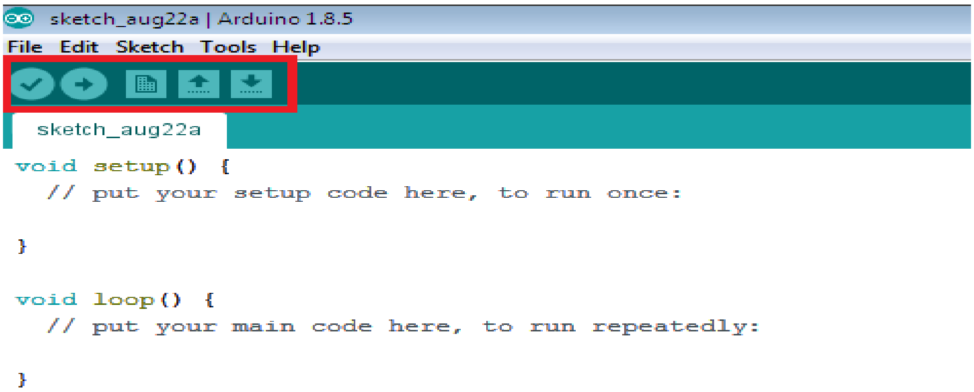

Figure 3.25 Writing Sketches

Table 3.8 Writing Sketches

	Verify Checks your code for errors compiling it.
	Upload Compiles your code and uploads it to the configured board. See uploading below for details.
	New Creates a new sketch.
	Open Presents a menu of all the sketches in your sketchbook. Clicking one will open it within the current window overwriting its content. Note: due to a bug in Java, this menu doesn't scroll; if you need to open a sketch late in the list, use the **File | Sketchbook** menu instead.
	Save Saves your sketch.
	Serial Monitor Opens the serial monitor.

Additional commands are found within the five menus: **File**, **Edit**, **Sketch**, **Tools**, and help. The menus are context sensitive, which means only those items relevant to the work currently being carried out are available.

Serial Monitor

This displays serial sent from the Arduino or Genuino board over USB or serial connector. To send data to the board, enter text and click on the "send" button or press enter. Choose the baud rate from the drop-down Figure 3.26 menu that matches the rate passed to **Serial.begin** in your sketch. Note that on Windows, Mac or Linux the board will reset (it will rerun your sketch) when you connect with the serial monitor. Please note that the Serial Monitor does not process control characters; if your sketch needs a complete management of the serial communication with control characters, you can use an external terminal program and connect it to the COM port assigned to your Arduino board.

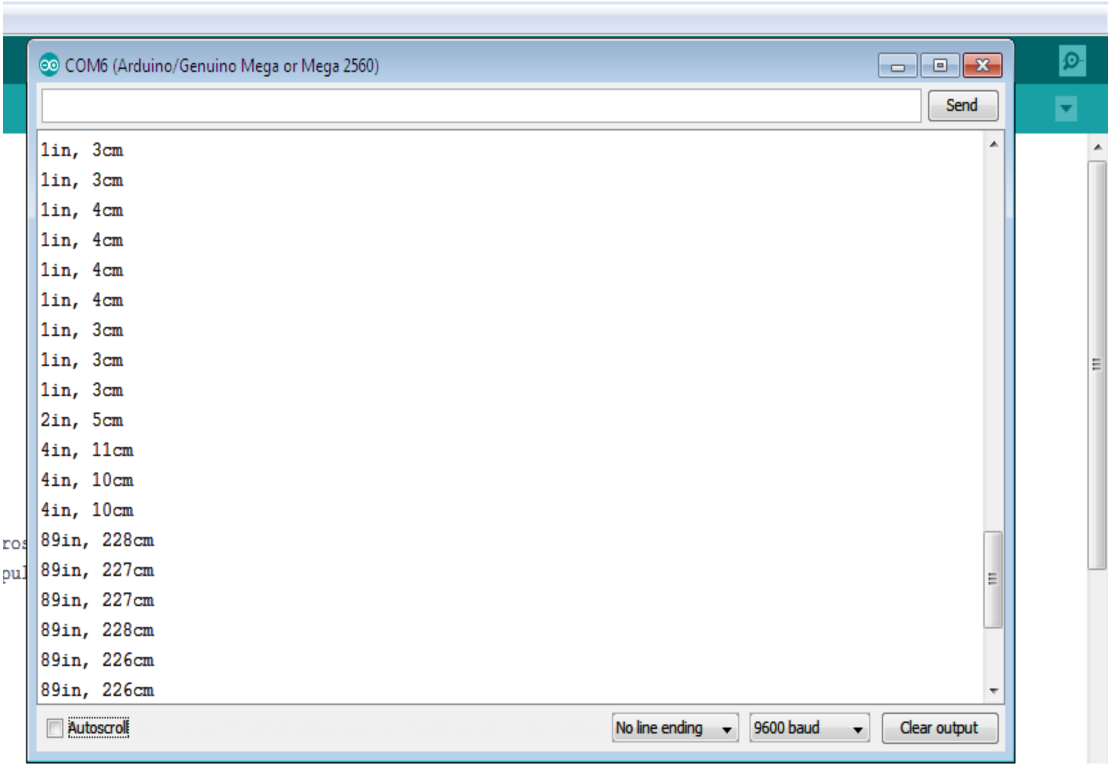

Figure 3.26 Serial Monitor

CHAPTER 4

PERFORMANCE ANALYSIS

The expected result of our system is to provide comprehensive support and safety measures for visually impaired individuals, enhancing their independence and well-being in various environments. By integrating advanced technologies such as Python image processing algorithms, ultrasonic sensors, environmental sensors (such as MIC sensor for ambient noise and flame sensor for fire detection), soil moisture sensor for gardening activities, gyroscope sensor for detecting imbalance or falls, and emergency response mechanisms (such as a dedicated push button), our system aims to:

1. Enable visually impaired individuals to recognize familiar faces through image processing algorithms, facilitating easier navigation and interaction with their surroundings.
2. Ensure safety by accurately detecting obstacles with ultrasonic sensors and monitoring environmental conditions for potential hazards like fire or dry soil.
3. Provide real-time updates and alerts through a liquid crystal display (LCD) screen, vocal messages via an APR voice module, and SMS notifications to designated caretakers or emergency contacts via a GSM module.
4. Facilitate tracking and communication through GPS technology, allowing individuals to share their real-time location with guardians or emergency responders for enhanced security and assistance when needed.

Ultimately, the expected outcome is to empower visually impaired individuals with a reliable, intelligent system that enhances their situational awareness, safety, and overall quality of life.

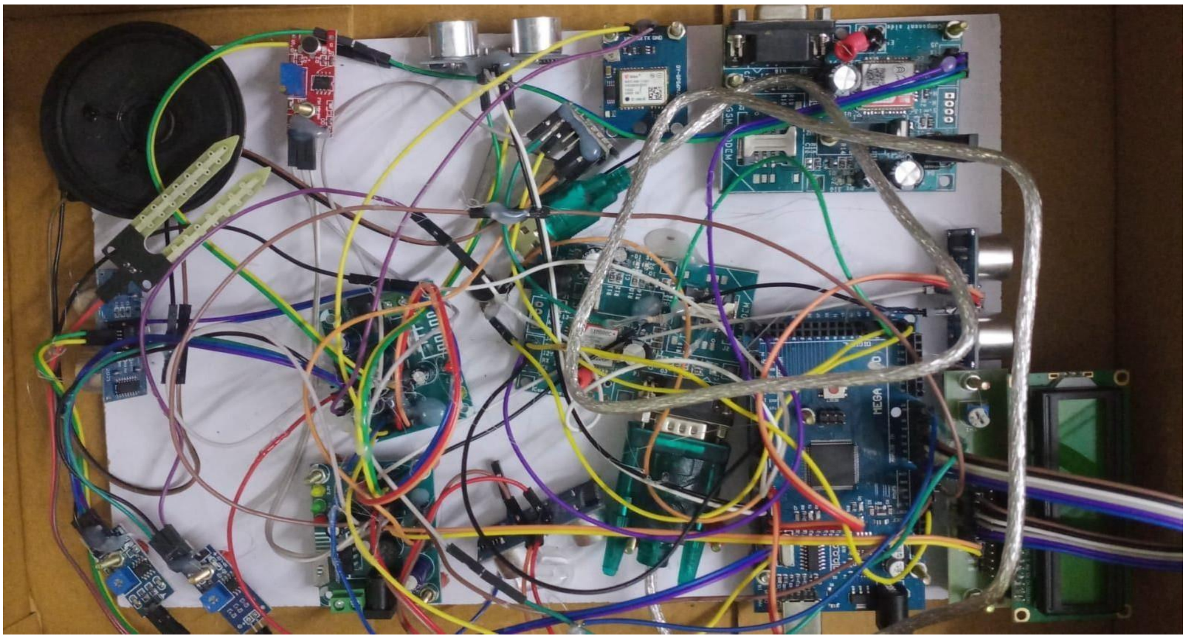

Figure 4.1 A Holistic Visionary Prototype

Table 4.1 Comprehensive VisionaryPrototype

Scenario	Result
Face recognized	Welcome [Name], navigating path is clear.
Obstacle detected	Warning: Obstacle detected ahead, please change direction.
Fire detected	Alert: Fire detected nearby, move to a safe location.
Dry soil condition	Attention: Soil moisture low, please water the plants.
Imbalance detected	Caution: Possible imbalance detected, adjust posture.
Emergency button pressed	Emergency: Assistance requested; SMS sent to contacts.
GPS location update	Location: [Latitude, Longitude], heading [Direction].
SMS sent to emergency contacts	Alert: [Name] has triggered an emergency, check location.

Face Recognition: Our system leverages facial recognition technology powered by OpenCV to identify pre-registered family members, such as parents, siblings, or close friends, of blind users. Upon recognition, the system transmits an audio notification through a speaker, announcing the identified person's relationship like “Mother detected”.

Obstacle detection: Our system utilizes four strategically placed ultrasonic sensors to detect objects in its immediate vicinity. This omnidirectional awareness allows the system to identify obstacles from all four sides, enhancing safety and navigation for the user. When an object is detected on any side of the blind person, it provides an auditory clue such as "Object detected on the right side" and the information’s are display in LCD Figure 4.3 screen can be helpful for sighted users to view real-time information, for blind users, our system provides this information through text-to-speech or other accessible audio.

Fire detection: our system detects fires for the safety of visually impaired individuals who may not notice them otherwise. Upon detecting a fire, an immediate voice message, such as "Fire detected," is relayed to the blind person through a speaker.

Vibrator: A vibrating device could use vibrations to signal obstacles or upcoming turns. Our system utilizes vibrating motors to provide directional guidance for blind users. When ultrasonic sensors detect objects on all four sides, the user receives a vibration cue, indicating they've reached a stopping point.

Push button: Pressing the push button can trigger an automated system that sends an SMS or calls emergency services, including the user's location (through GPS integration) to pre-programmed contacts. This allows for a quick and efficient response in critical situations. The push button can send an alert to designated caregivers (family, friends, or care providers) notifying them of the emergency and potentially providing location data. This allows for faster intervention and support from those familiar with the person's situation. Panic buttons provide blind people with a sense of security and independence, knowing they can quickly summon help when needed.

This system demonstrates how the assistive device seamlessly integrates into impaired persons daily life, providing real-time information, safety alerts, and guidance. Feel free to adapt this scenario or add more details based on specific user needs.

Simulated result of distance measurement

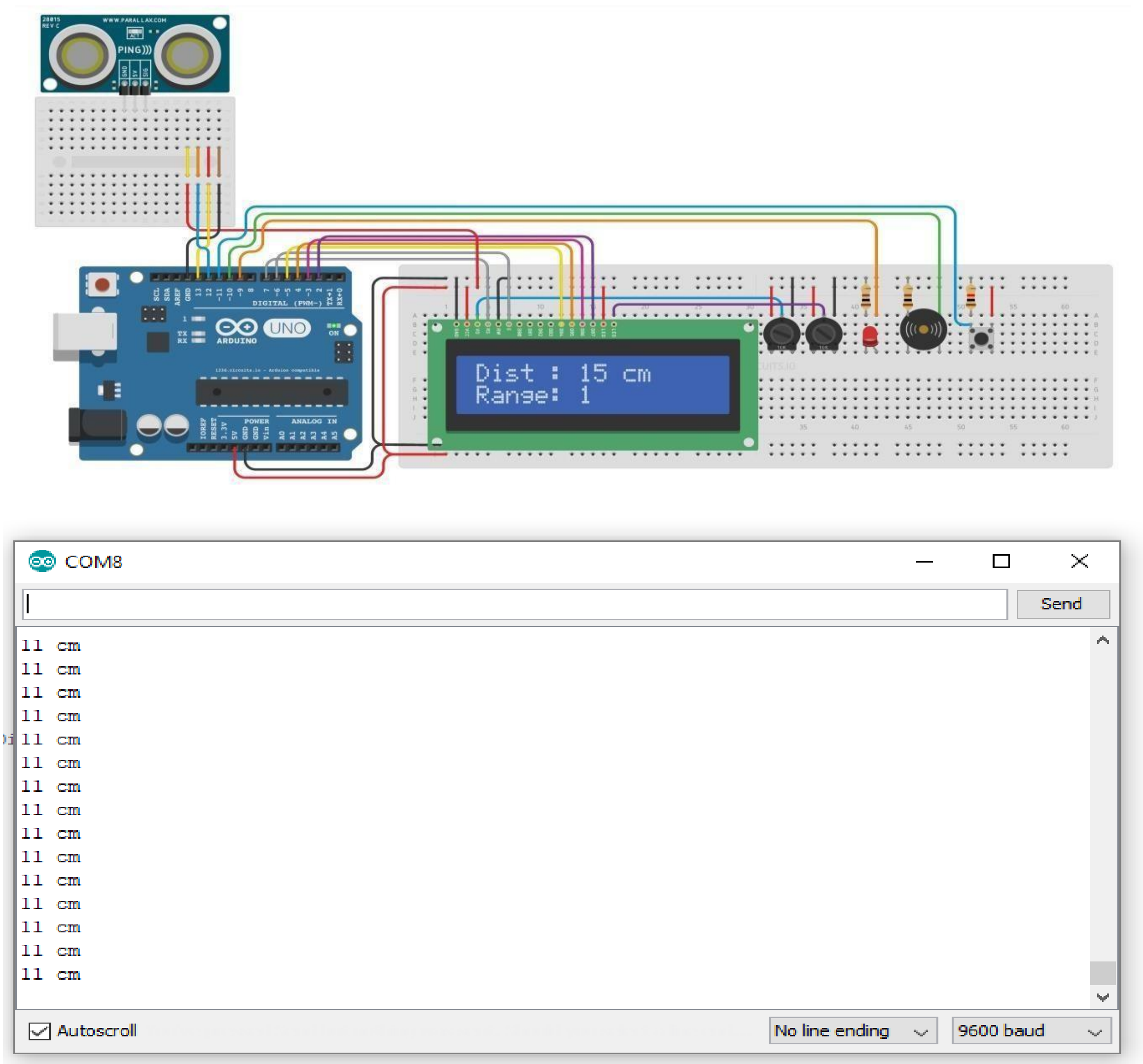

Figure 4.2 Simulated result of distance measurement

Figure 4.3 LCD output displays

CHAPTER 5

CONCULSION AND FUTURE ENHANCEMENT

5.1 CONCLUSION

In conclusion, this research project has successfully demonstrated the potential of integrating embedded systems and Python OpenCV to create a visionary aid system aimed at empowering visually impaired individuals. By focusing on the accurate detection of familiar faces like parents, the project addresses a crucial need within the visually impaired community. Through a combination of sophisticated algorithms and hardware architecture, the developed system showcases remarkable accuracy and efficiency in people detection.

This project's significance lies not only in its technical achievements but also in its broader impact on assistive technologies. By providing visually impaired individuals with a reliable and intuitive means of recognizing important individuals in their lives, the system promotes inclusivity and independence. The user interface, designed with auditory cues and haptic feedback, ensures accessibility for users with varying levels of visual impairment.

Moving forward, this research sets the stage for further advancements in assistive technologies for the visually impaired. Future work may involve expanding the dataset to encompass a wider range of facial features and integrating voice commands for enhanced user interaction. Overall, this project represents a significant step towards creating inclusive solutions that empower individuals with visual impairments to navigate the world with confidence and independence.

5.2 APPLICATIONS

The application of the developed assistive system extends to various real-world scenarios where visually impaired individuals require support in recognizing important individuals and navigating their surroundings. In daily living tasks, such as identifying family members or caregivers, the system provides invaluable assistance by accurately detecting familiar faces.

Furthermore, the system can be deployed in social settings to facilitate interaction and communication. By enabling visually impaired individuals to recognize friends, colleagues, or acquaintances, the system promotes social inclusion and enhances interpersonal connections.

In educational and professional environments, the system can aid visually impaired students or professionals in identifying classmates, teachers, or coworkers, thereby fostering independence and facilitating collaboration.

Beyond individual use cases, the project holds potential for broader societal impact. By promoting inclusivity and independence for visually impaired individuals, the system contributes to creating a more accessible and equitable society.

5.3 LIMITATIONS

Despite its significant achievements, the project also faces several limitations that warrant acknowledgment. One such limitation is the scope of the dataset used for training the facial recognition algorithms.

Additionally, the hardware constraints of the embedded system may pose limitations in terms of processing power and memory capacity. These constraints could impact the system's ability to handle complex image processing tasks in real-time or to support additional features such as voice commands.

Furthermore, the project's reliance on Python OpenCV may introduce limitations in terms of scalability and optimization.

Despite these limitations, the project's findings provide valuable insights into the development of assistive technologies for the visually impaired. By identifying and addressing these limitations.

5.4 FUTURE ENHANCEMENT

Looking ahead, there are several avenues for future work and development that can build upon the achievements of this project. Expanding the dataset to encompass a wider range of facial features and demographics would enhance the system's accuracy and inclusivity. Additionally, integrating voice commands for seamless interaction and exploring alternative hardware platforms could further improve the system's accessibility and performance.

Furthermore, future research could explore the integration of additional sensory modalities, such as tactile feedback or auditory cues, to enhance the user experience for visually impaired individuals. Collaboration with stakeholders in the visually impaired community, including users, caregivers, and advocacy groups, could provide valuable insights and feedback to inform the development of future iterations of the system.

This project's findings provide valuable insights into the development of assistive technologies for the visually impaired. By identifying and addressing these limitations, future research endeavors can build upon the project's foundations and further advance the field of inclusive technology.

In conclusion, this research project represents a significant step towards creating inclusive solutions that empower visually impaired individuals to navigate the world with confidence and independence. By addressing the challenges of people detection and recognition, the project contributes to the broader goal of creating a more accessible and equitable society for all. Moving forward, continued research and development in assistive technologies will play a crucial role in shaping a more inclusive future for individuals with visual impairments.

ANNEXURE

IMPLEMENTATION

SAMPLE CODE

```
#include "gsm.h"

#include  "SoftwareSerial.h"

#include "DFRobotDFPlayerMini.h"

#include <ultrasonic.h>

#include  <Wire.h>

#include <LiquidCrystal.h>

LiquidCrystal lcd(A0, A1, A2, A3, A4, A5);

static const uint8_t PIN_MP3_TX = 50;

static const uint8_t PIN_MP3_RX = 51;

SoftwareSerial softwareSerial(PIN_MP3_RX, PIN_MP3_TX);

DFRobotDFPlayerMini player;

#define VIBM 5

#define MIC A6

#define bottun A7

#define soil 3

#define fire 2
```

```
float MIC_SENSOR;

char data;

int FIRE1, SOIL1, BOTTUN1;

ULTRASONIC U1, U2, U3, U4;

void setup() {

  Serial1.begin(9600);

  Serial.begin(9600); U1.begin(10, 11); U2.begin(9, 8); U3.begin(13, 12);
U4.begin(6, 7);

  softwareSerial.begin(9600);

  player.begin(softwareSerial);

  pinMode(VIBM, OUTPUT);

  pinMode(MIC, INPUT);

  pinMode(bottun, INPUT_PULLUP);

  pinMode(soil, INPUT);

  pinMode(fire,  INPUT);

  lcd.begin(16, 2);

  lcd.setCursor(3, 0); lcd.print("BILND PEPOLE "); lcd.setCursor(2, 1);
lcd.print("HELPING SYSTEM"); delay(1000);

  player.volume(30);

  player.play(11);
```

```
  delay(3000);
}
void loop() {
  MIC_SENSOR = analogRead(MIC);
  Serial.print(MIC_SENSOR);
  int F = U1.ultra();
  int R = U2.ultra();
  int B = U3.ultra();
  int L = U4.ultra();
  FIRE1 = digitalRead(fire);
  SOIL1 = digitalRead(soil);
  BOTTUN1 = digitalRead(bottun);
  Serial.print(FIRE1);
  Serial.print(SOIL1);
  Serial.println(BOTTUN1);


  if (BOTTUN1 == 0) {
    lcd.clear(); lcd.setCursor(6, 0); lcd.print("emergency"); lcd.setCursor(6, 1);
lcd.print("detected");
    player.volume(30);
```

```
    player.play(10);

    delay(1500);

    GSM_SEND("6381242573", "emergency detected
13.0489101,80.0728893,17z");

    delay (1000);

    GSM_SEND("6381022511", "emergency detected
13.0489101,80.0728893,17z");

    delay (1000);

    GSM_SEND("7550184097", "emergency detected
13.0489101,80.0728893,17z");

    delay (1000);

  }

  if (SOIL1 == 1) {

    lcd.clear(); lcd.setCursor(6, 0); lcd.print("water"); lcd.setCursor(6, 1);
lcd.print("detected");

    player.volume(30);

    player.play(9);

    delay(1500);

    GSM_SEND("6381242573", "water detected 13.0489101,80.0728893,17z");

    delay (1000);

    GSM_SEND("6381022511", "water detected 13.0489101,80.0728893,17z");
```

```
    delay (1000);

    GSM_SEND("7550184097", "water detected 13.0489101,80.0728893,17z");

    delay (1000);

  }

  if (FIRE1 == 0) {

    lcd.clear(); lcd.setCursor(6, 0); lcd.print("fire"); lcd.setCursor(6, 1);
lcd.print("detected");

    player.volume(30);

    player.play(12);

    delay(1500);



    GSM_SEND("6381242573", "fire detected 13.0489101,80.0728893,17z");

    delay (1000);

    GSM_SEND("6381022511", "fire detected 13.0489101,80.0728893,17z");

    delay (1000);

    GSM_SEND("7550184097", "fire detected 13.0489101,80.0728893,17z");

    delay (1000);

  }

  Serial.print("1_"); Serial.println(F); Serial.print("1_"); Serial.println(R);
Serial.print("1_"); Serial.println(B); Serial.print("1_"); Serial.println(L);
```

```
  if ((F < 20) && (R < 20) && (R < 20) && (R < 20))
  {
    player.volume(30);
    player.play(5);
    delay(1500);
    lcd.clear(); lcd.setCursor(3, 0); lcd.print("FOUR SIDE "); lcd.setCursor(2, 1);
lcd.print("Object detected");
    digitalWrite(VIBM, HIGH);
    delay(2000);
    digitalWrite(VIBM, LOW);
  }
  if ((F > 20) && (R > 20) && (R > 20) && (R > 20))
  {
    lcd.clear(); lcd.setCursor(3, 0); lcd.print("FOUR SIDE "); lcd.setCursor(2, 1);
lcd.print("FREE PLS GO");
    player.volume(30);
    player.play(8);
    delay(1400);
  }
  else if (F < 20) {
```

```
    player.volume(30);

    player.play(7);

    delay(1400);

    lcd.clear(); lcd.setCursor(3, 0); lcd.print("FROUNT SIDE "); lcd.setCursor(2, 1); lcd.print("Object detected");

  }

  else if (R < 20) {

    player.volume(300);

    player.play(6);

    delay(1400);

    lcd.clear(); lcd.setCursor(3, 0); lcd.print("RIGHT SIDE "); lcd.setCursor(2, 1); lcd.print("Object detected");

  }

  if (B < 20) {

    player.volume(300);

    player.play(7);

    delay(1400);

    lcd.clear(); lcd.setCursor(3, 0); lcd.print("BACK SIDE "); lcd.setCursor(2, 1); lcd.print("Object detected");

  }
```

```
  else if (L < 20) {
    player.volume(100);
    player.play(1);
    delay(1400);
    lcd.clear(); lcd.setCursor(3, 0); lcd.print("LEFT SIDE "); lcd.setCursor(2, 1);
lcd.print("Object detected");
  }
  if (MIC_SENSOR > 300 ) {
    lcd.clear(); lcd.setCursor(3, 0); lcd.print("NOISE so HIGH"); lcd.setCursor(2,
1);  digitalWrite(VIBM, HIGH); delay(2000); digitalWrite(VIBM, LOW);
/*lcd.print("Object detected");*/
  }
  delay(100);
  while (Serial.available() > 0) {
    data = Serial.read();
    Serial.println(data);
    switch (data) {
      case 'A':
        player.volume(30);
        player.play(5);
```

```
  delay(1400);
  lcd.clear(); lcd.setCursor(3, 0); lcd.print("MOTHER");
  break;
case 'B':
  player.volume(30);
  player.play(6);
  delay(1400);
  lcd.clear(); lcd.setCursor(3, 0); lcd.print("FATHER");
  break;
case 'C':
  player.volume(30);
  player.play(3);
  delay(1400);
  lcd.clear(); lcd.setCursor(3, 0); lcd.print("SISTER");
  break;
case 'D':
  player.volume(30);
  player.play(2);
  delay(1400);
```

```
        lcd.clear(); lcd.setCursor(3, 0); lcd.print("BROTHER");
        break;
    }
  }
}
```

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