ALLY: EMULATING VISION TO DETECT, IDENTIFY AND ANNEX THE UNKNOWN NEARBY THE BLIND PERSON

BY

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Under the Guidance of

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

JSS ACADEMY OF TECHNICAL EDUCATION

C-20/1 SECTOR-62, NOIDA

May, 2022-2023

PROJECT REPORT

ON

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Submitted to the Department of Electronics & Communication Engineering

in partial fulfillment of the requirements

For the degree of

Bachelor of Technology

In

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JSS Academy of Technical Education, Noida

Dr. A.P.J Abdul Kalam Technical University, Lucknow

May, 2022-2023

DECLARATION

We hereby declare that this submission is our own work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher, except where due acknowledgment has been made in the text.

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Deependra Sharma
Assistant Professor

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ABSTRACT

In today's society, where independent living is becoming increasingly important, it can be extremely constricting for those who are blind. Blind and visually impaired (BVI) people face challenges because they need manual support to prompt information about their environment. In this work, we took our first step towards developing an affordable and high-performing eye wearable assistive device, ALLY, to provide visual navigation assistance for BVI people. This system comprises a camera module, ESP32 processor, Bluetooth module, smartphone and speakers. Using artificial intelligence, this system is proposed to detect and understand the nature of the users' path and obstacles ahead of the user in that path and then inform BVI users about it via audio output to enable them to acquire directions by themselves on their journey. This first step discussed in this paper involves establishing a proof-of-concept of achieving the right balance of affordability and performance by testing an initial software integration of a currency detection algorithm on a low-cost embedded arrangement. This work will lay the foundation for our upcoming works toward achieving the goal of assisting the maximum of BVI people around the globe in moving independently.

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LIST OF ABBREVIATIONS

TCP .....Transmission Control Protocol
IoT.....Internet of Things
UDP.....User Datagram Protocol
LBPH.....Local Binary Patterns Histograms
GSM.....Global System for Mobile communication
GPRS.....General Packet Radio Services
ASL.....American Sign Language
YOLO..... You Only Look Once
LBP..... Local Binary Patterns
K-NN.....k-Nearest Neighbors
NNC.....Neural Network Co-Processor
HOG.....Histogram of Oriented Gradients
CNN.....Convolutional Neural Network
VGG.....Visual Geometry Group
TPR.....True Positive Rate
FPR.....False Positive Rate
ROC.....Receiver Operating Characteristics
QVGA.....Quarter Video Graphic Array
UART.....Universal Asynchronous Receiver Transmitter
SPP.....Serial Port Profile
TTS.....Text to Speech
MAC Address.....Media Access Control Address

CHAPTER 1

LITERATURE SURVEY

Earlier so many projects similar this problem has been done such as

The author [1] conducted an experiment to evaluate the security of ESP32 Internet of devices. They created a physical model of an IoT system that included an ESP32- based temperature measurement device, a Wi-Fi home network, and a web interface. The experiment aimed to assess the vulnerability of the system to unauthorized access and data manipulation.

The attack scenario consisted of four stages: gaining unauthorized access to the network, intercepting and analyzing network traffic, creating a fraudulent ESP32 client, and disconnecting the genuine ESP32 from the server. The results of the experiment demonstrated that an attacker with basic knowledge and skills in wireless network hacking, as well as a basic understanding of ESP32 and programming, could successfully breach the system's security and send falsified information to the web interface.

To mitigate the likelihood of such an attack, the author suggests using TCP instead of UDP. TCP provides enhanced security and reliability compared to UDP, which can help reduce the susceptibility of the system to the attack scenario presented in the study.

The Author [2] in this research presents the design and development of smart glasses using Raspberry Pi for visually impaired individuals. The glasses incorporate facial recognition and voice assistant technologies to help users recognize people around them, even when they are not speaking. In addition to facial recognition, the glasses offer features like playing songs and browsing the internet, acting as a digital assistant. The glasses are activated using specific hot words, and user instructions are processed through voice input and provided as output through speech. The proposed system is user-friendly, lightweight, efficient, and cost-effective.

The Author [3] in this paper focuses on the design and development of smart glasses for the visually impaired, utilizing Raspberry Pi as the main processor. The glasses incorporate facial recognition and voice assistance capabilities, enabling users to recognize faces of people or objects stored in the system. Raspberry Pi's capabilities allow for the execution of Python and C++ programming,

as well as graphical calculations. The system includes Raspberry Pi 4 face recognition, a speaker as a buzzer, Google Text to Speech, an ultrasonic sensor for object detection, and an ESP 32 camera web server. The proposed system is described as superior, highly effective, affordable, user-friendly, and lightweight.

The Author [4] in this research presents a system aimed at assisting blind individuals through hand gesture and face recognition. The system employs Haar cascade classifiers and LBPH recognizers for real-time face detection and identification. Convex hull and convex defects algorithms are used for real-time hand gesture detection. Skin color recognition is performed in the YCbCr color space, with different threshold ranges used to detect skin color under different lighting conditions. The system achieves high accuracy in both hand gesture recognition and face recognition. The authors suggest exploring methods to recognize a wider range of gestures and improving face recognition techniques.

The Author [5] in this paper introduces smart glasses designed to assist visually impaired individuals in overcoming travel difficulties. The glasses incorporate an ultrasonic sensor and a microcontroller to detect obstacles and measure distances. Information from the environment is transmitted to the user through headphones. The system includes a GSM/GPRS SIM900A module for collecting internet-based information. An emergency switch is integrated into the glasses for sending SMS messages to a guardian, providing information on time, temperature, and location when the visually impaired individual is in danger. These smart glasses enable visually impaired individuals to navigate indoor and outdoor environments.

The Author [6] in this paper proposes a device called Eyeris designed to aid visually impaired individuals in their daily activities. Eyeris aims to detect and recognize objects, people, and signs within the user's field of vision and convey the information through audio output. The system employs object detection, facial recognition, and ASL detection. Text messages can be sent to a guardian for assistance or when the user is in danger. The goal of Eyeris is to provide an affordable and self-sufficient solution for the visually impaired, benefiting millions of individuals worldwide.

The Author [7] in this research work describes the development of a Raspberry Pi-based smart glass system for visually impaired individuals to recognize their family members using image processing. The system utilizes face recognition, face encoding, and face database creation to

recognize family members. The proposed smart glass system is lightweight, cost-effective, highly efficient, and capable of integrating machine learning algorithms. By providing audio information with the names of family members, this system acts as a valuable assistive device for visually impaired individuals.

The Author [8] in this paper presents smart glasses that utilize deep learning algorithms and a stereo camera to assist visually impaired individuals. The stereo camera calculates the distance between the user and obstacles and provides feedback on the level of danger through vibration and sound. LED lights are used to indicate the user's location, enhancing safety during nighttime. The YOLO v3 deep learning algorithm is employed to identify the type of an obstacle. Experimental results demonstrate that the proposed smart glasses overcome the limitations of existing blind guidance systems and help users recognize and avoid obstacles effectively.

1.1 THESIS OUTLINE

To make this read much easier, this thesis is organized in five chapters. The thesis is structured as follows.

Chapter 1: - Offers a broad summary of the literature review.

Chapter 2: - It presents basic introduction of project, aim & objective & problem statement of project.

Chapter 3: - It consists of Proposed System, Flow Chart & Hardware.

Chapter 4: - It consist of Outcome of the Model (Result) and Work Done

Chapter 5: - It shows conclusions and future work.

CHAPTER 2

INTRODUCTION & OBJECTIVE

2.1 INTRODUCTION OF PROJECT

To develop a visual assistance system using an ESP32 microcontroller for real-time face detection and recognition, here are some methods and techniques that can be employed:

Image Processing: Image pre-processing techniques can be applied to enhance the quality of images for subsequent analysis. These techniques may include resizing, noise reduction, and contrast adjustment to optimize the images for face detection and recognition algorithms. Given the limited computational resources of the ESP32, it's essential to balance the level of preprocessing with the available processing power.

Face Detection: Face detection is the initial step in identifying faces within the image or video stream. Consider using lightweight face-detection algorithms suitable for resource-constrained devices like the ESP32. Popular algorithms like Haar cascades or HOG-based methods can be considered, as they have relatively lower computational requirements compared to deep learning-based approaches.

Face Recognition: Once faces are detected, the system can proceed with face recognition to identify individuals. For the ESP32, it's recommended to employ lightweight feature extraction techniques such as LBP or other low-dimensional representations. These techniques can extract discriminative features from the detected faces and compare them against a predefined set of known faces using efficient classification methods like k-NN.

Real-time Processing: To achieve real-time performance on the ESP32, optimizations are necessary. Consider implementing the face detection and recognition algorithms in an optimized manner, utilizing the available hardware resources efficiently. Exploring hardware acceleration options specific to the ESP32, such as utilizing its onboard NNC, can potentially improve processing speed. Additionally, algorithmic optimizations like reducing the complexity of feature extraction and using efficient data structures can further enhance real-time performance.

User Interface: Design a user-friendly interface suitable for visually impaired individuals. Since the ESP32 typically lacks a display, consider utilizing audio-based interfaces, such as text-to-speech or speech recognition capabilities, to provide audible feedback and instructions to the user. Ensure the interface is intuitive, accessible, and capable of conveying information effectively.

Performance Evaluation: Assess the system's performance by evaluating metrics like accuracy, processing time, and false positive/negative rates. Conduct thorough testing with a diverse dataset that includes various lighting conditions, different facial expressions, and occlusions. This evaluation will help understand the system's reliability and efficacy in real-world scenarios.

Keep in mind that the limited computational resources and memory constraints of the ESP32 might impose limitations on the complexity and scale of the system. It's crucial to strike a balance between accuracy and efficiency to meet the goals of accuracy, real-time processing, and resource utilization.

By developing a visual assistance system with these components and techniques, utilizing the ESP32 microcontroller, visually impaired individuals can benefit from real-time face detection and recognition capabilities. This can help them identify people, navigate their surroundings more easily, and enhance their overall independence and confidence.

2.2 PROBLEM STATEMENT

- Blind individuals can often identify someone familiar to them by their voice. However, when the person stops talking, it can be challenging for them to identify someone nearby solely based on their voice.

- Blind individuals often encounter difficulties in social situations, particularly in unfamiliar or crowded spaces when it comes to recognizing and interpreting non-verbal cues.

2.3 OBJECTIVE

The proposed system aims to develop a wearable visual aid for visually impaired individuals. It focuses on incorporating speech recognition technology to enable users to control the device through voice commands. The Device identifies and saves the information of the person in the Database, with whom the blind person is interacting.

CHAPTER 3

PROPOSED ALGORITHM

3.1 IMAGE PROCESSING

Image processing [10] refers to the process of converting an image into a digital format and performing various operations to extract useful information from it. In image processing systems, images are typically treated as 2D signals when applying specific signal processing techniques. Different types of images can be categorized as follows:

- Visualization: The process of uncovering hidden objects within an image.
- Recognition: Identifying and detecting specific items or objects present in the image.
- Sharpening and recovery: Enhancing and improving the quality of the original image.
- Pattern recognition: Analyzing the patterns surrounding the objects in the image to identify and classify patterns.
- Retrieval - Search and read thru pix in a massive library of Digital pics which can be akin to the supply image.

3.2.1 Fundamental Image Processing Steps

Image Acquisition

The initial level of photograph processing is photo acquisition. In image processing , this level is often referred to as pre-remedy. It includes getting the photo from a supply, typically one that is hardware-primarily based.[9]

Image Enhancement

Image Enhancement is the technique of bringing out and emphasising unique exciting characteristics in a hidden picture. Changing the brightness, assessment, and so forth., can do that.

Image restoration

Image recovery is the manner of enhancing an images appearance. Image restoration, rather than photo augmentation, is achieved making use of mathematical models.

Colour image processing

Image recovery is the system of improving an image's look. Image recovery, as opposed to photograph augmentation, is done using unique mathematical or probabilistic fashions.

Wavelets and multiresolution processing

Wavelets are used to symbolize photographs at exclusive resolution ranges. For the purposes of pyramidal representation and information compression, the photographs are divided into wavelets or smaller areas.

Compression

Compression is a method for lowering the amount of storage or bandwidth needed to save or ship an photograph. This is finished mainly when the picture can be used on-line.

Morphological Processing

A collection of processing strategies referred to as “morphological processing” are used to trade the form of photos.

Segmentation

Segmentation is one of the most tough steps of picture processing. It entails partitioning an photo into its constituent parts or items.

Representation and Description

A process called segmentation separates a picture into areas, and every area is then represented and

defined in a manner that is suitable for similarly laptop processing. Representation deals with the photo's characteristics and local properties. Description entails accumulating quantitative facts that helps differentiate one class of items from some other.

Recognition

A label is given to an object by means of recognition based totally on its description.

3.2 FACE DETECTION AND RECOGNITION ALGORITHM

Face detection and face recognition are important components of image processing

3.2.1 Face Detection

Face detection is a fundamental task in image processing that involves locating and identifying human faces within an image or video frame. It is the initial step in many applications that involve analyzing or manipulating facial information. Face detection algorithms analyze the image to identify regions that likely contain faces, based on specific patterns, features, or characteristics associated with faces. This process involves image preprocessing, feature extraction, and classification techniques. Face detection plays a crucial role in applications like facial recognition, emotion analysis, face tracking, and more.

Face detection is a crucial part of Image processing. Image processing involves the manipulation and analysis of digital images to extract useful information or perform specific tasks. Face detection specifically focuses on identifying and localizing human faces within an image or video- stream. Steps involved in this process: -

- Preprocessing
- Feature Extraction
- Region Proposal
- Face Classification
- Post-processing and Validation
- Output

3.2.2 Face Recognition

Face recognition is a type of biometric technology that is involve in identifying or verifying the identity of individuals by analyzing and comparing their facial features. It has gained significant attention in recent years due to its wide range of applications , including security systems, access control, surveillance, and personalized experiences.

Face recognition algorithms utilize sophisticated techniques to extract unique and distinguishing features from facial images and match them against a pre-existing data-base of known individuals. The process involves several key steps:

1. **Face Detection:**

- Prior to face recognition, the system must first detect and locate Face within an image or video frame.
- Face detection algorithms analyze the image to identify regions that likely contain faces based on patterns, features, or characteristics associated with faces.

2. **Feature Extraction:**

- Once faces are detected, facial features are extracted to create a unique representation of each individual's face.
- Traditional methods such as Eigenfaces or Fisherfaces use statistical techniques to extract relevant facial features and reduce dimensionality.

3. **Feature Matching:**

- The extracted facial features are then compared against a database of known individual`s to find potential matches.
- Various algorithms and similarity metrics , such as Euclidean-distance or cosine similarity , can be employed to measure the similarity between facial feature vectors.
- Thresholds or decision rules are applied to determine whether a match is found or to rank potential matches.

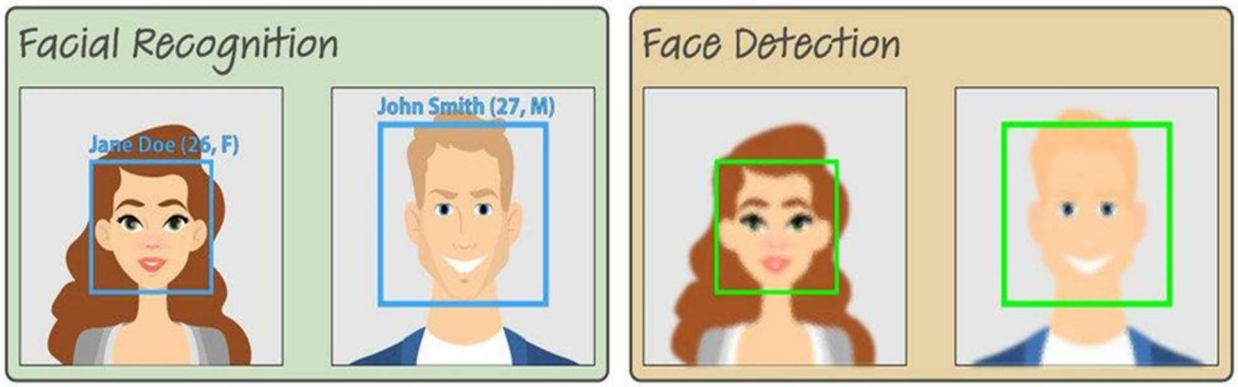

Figure 3.1: Face Recognition and Detection

4. **Verification vs. Identification:**

- Face recognition systems can perform either verification or identification tasks.
- Verification involves authenticating an individuals claimed the identity by comparing their face against a specific reference sample.
- Identification aims to determine the identity of an individual by comparing their face against a larger database of known individuals.

5. **Accuracy and Performance:**

- The performance of a face recognition system is evaluated based on accuracy, speed, and robustness.
- Accuracy is measured by metrics such as TPR , FPR , or ROC curves.
- Factors like lighting conditions , pose variations , occlusions , and the quality of the captured images can impact the performance of Face Recognition Algorithms.

6. **Privacy and Ethical Considerations:**

- Face recognition technology raises privacy and ethical concerns related to data security, consent, and potential misuse.
- It is crucial to handle and protect facial data in a secure manner, adhere to privacy regulations, and ensure transparency and informed consent.

7. **Advancements and Challenges:**

- Recent advancements in deep learning, such as the development of more powerful CNN architectures and the availability of large-scale face datasets, have significantly improved face

recognition accuracy.

- However, challenges remain, including handling large databases efficiently, dealing with variations in lighting and pose, addressing bias and fairness issues, and ensuring robustness against spoofing attacks.

3.3 PROPOSED SYSTEM

This project entails the development of a virtual visual assistance device for individuals with visual impairments, utilizing a microcontroller. The primary goal is to transform the visual environment into an auditory realm , enabling visually challenged individuals to navigate and perform their daily activities with the greater ease and independence. To accomplish this, the ESP32 camera module will capture images of the surroundings, including individuals nearby. These captured images will undergo real-time processing using various algorithms and be compared against a database. Extracted information will then be converted into audio signals, serving as feedback for the user.

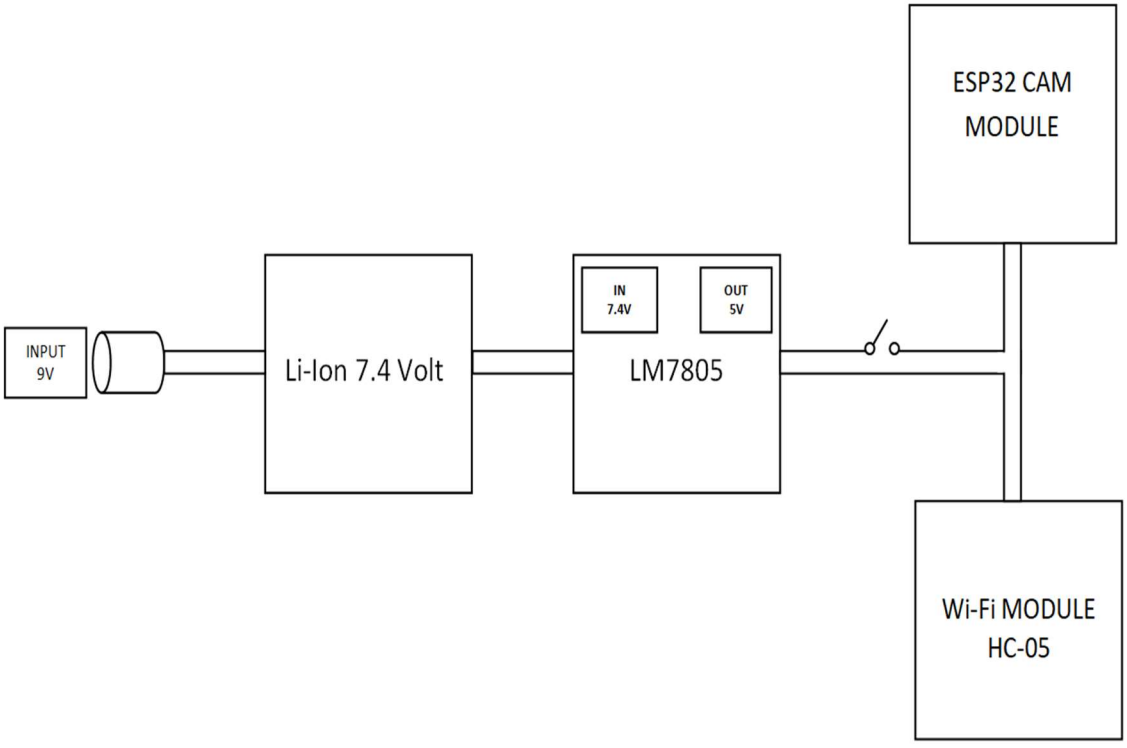

Figure 3.2: Block Diagram of our System

3.4 IoT

The Internet of Things (IoT) [11] is a network of physical objects embedded with sensors, software, and other technologies that enables them to connect and exchange data with other devices and structures over the internet. These devices can range from everyday household items to advanced industrial equipment. Experts predict that the number of connected IoT devices, currently exceeding 7 billion, will reach 10 billion by 2020 and 22 billion by 2025. Oracle has partnered with various hardware companies to build its IoT network.

IoT devices serve various purposes in different industries, helping businesses operate more efficiently, enhance customer service, make better decisions, and increase revenue. The first layer of the IoT technology stack consists of devices, sensors, transducers, and similar components. IoT devices can take many forms and shapes.

These devices are composed of transducers, sensors, actuators, and a wide range of smart objects such as smart lightbulbs, valves, pumps, meters, cars with built-in sensors, home appliances, wearables, street lighting, trackers, thermostats, irrigation controllers, collaborative robots, manufacturing assets, health monitoring devices, and even location-aware tags on personal items like fridges. The application of IoT extends to agriculture, farming, heavy industry, retail, virtual signage, and many other sectors.

3.5 FLOW CHART

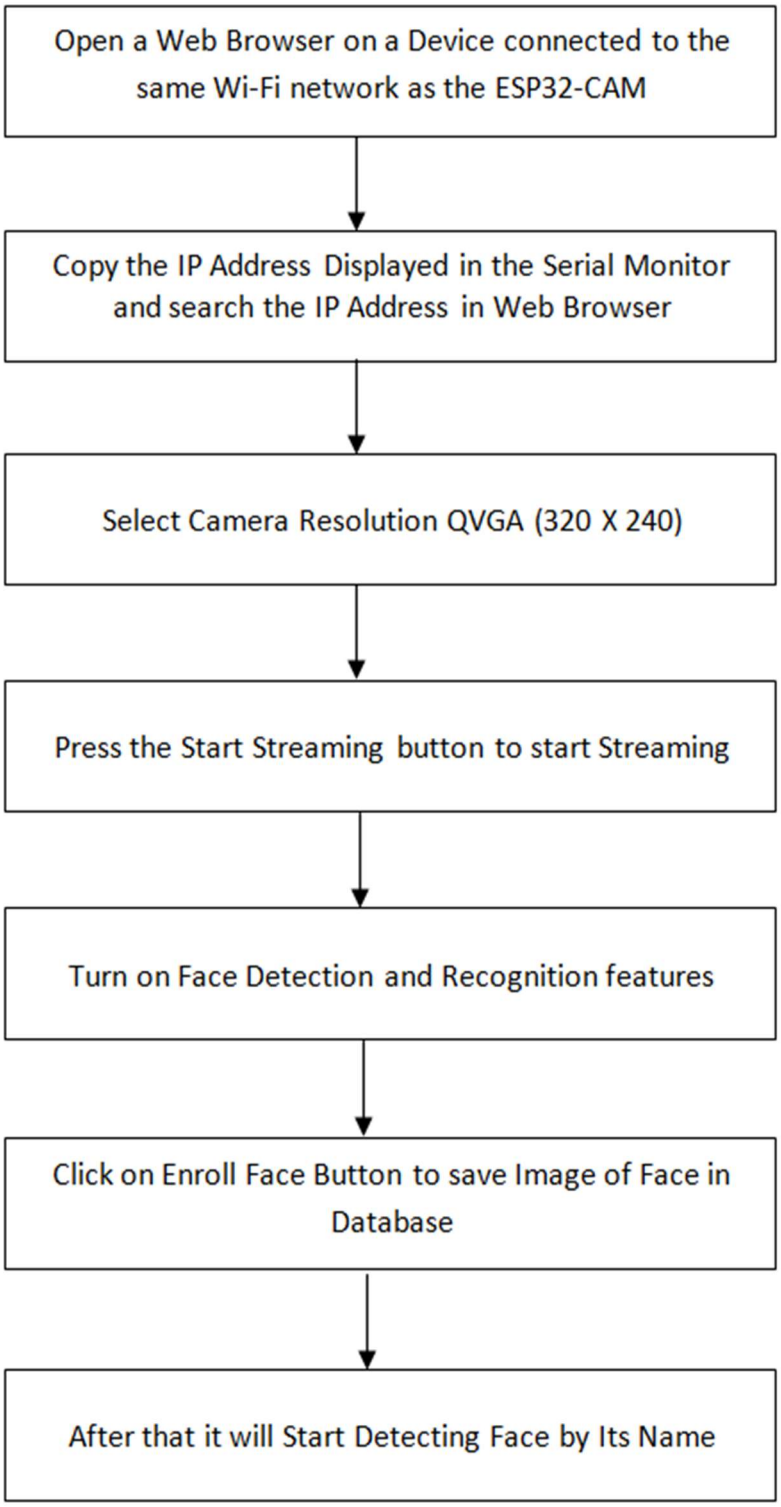

Figure 3.3: System Flow-Chart

3.6 HARDWARE IMPLEMENTATION

3.6.1 ESP-32 CAM

- ESP-32 cam is a low-cost, low-power System on a chip microcontroller with integrated Wi-Fi and dual-mode Bluetooth capabilities. It is designed and developed by Espressif [18] Systems, and it is a successor to the ESP-8266 micro- controller.
- The ESP32 microcontroller [12] is based on the Xtensa LX6 processor core and has a clock speed of up to 240 MHz It has a 32-bit RISC-V CPU, 520KB of SRAM, and 448 KB of ROM, which can be used to store firmware and other data. The microcontroller also includes a variety of Peripheral interfaces, including UART, SPI, I2C, I2S, and PWM.
- One of the most attractive features of the ESP32 microcontroller is its built-in Wi-Fi and Bluetooth capabilities. It has a dual-core processor that can handle the processing load of both wireless protocols simultaneously. This makes it ideal for use in Internet of Things (IoT) projects that require wireless connectivity.
- The ESP32 microcontroller is also easy to program and can be programmed using various programming languages, including C++, MicroPy- thon, and Lua. It has a variety of development boards and tools available, which makes it easy to get started with development.
- Overall, the ESP32 microcontroller is a powerful and versatile microcontroller i.e., is ideal for use in a wide range of applications, including IoT, robotics, and home automation.

Figure 3.4: ESP-32 Cam Module

3.6.2 UART TTL Programmer

A USB to UART TTL programmer [13] is a device that allows you to pro- gram microcontrollers and other embedded systems through a USB interface. The programmer serves as a bridge between a computer and the microcontroller, converting USB signals to UART signals that the microcontroller can understand.

The programmer typically comes in the form of a small circuit board that plugs into a USB port on our computer. It also features a connector for attaching the microcontroller or other embedded system to be programmed. The programmer is compatible with a wide range of microcontroller and other embedded systems, making it a versatile tool for anyone working in the field of embedded systems development.

Using a USB to UART TTL programmer can greatly simplify the process of programming microcontrollers and other embedded systems. It eliminates the need for complex wiring and setup, as well as the need for specialized hardware. The programmer can be easily connected to our computer and used with a variety of programming software. Overall, the USB to UART TTL programmer is an essential tool for anyone working with microcontrollers and other embedded systems, offering a reliable and convenient means of programming, and testing these devices.

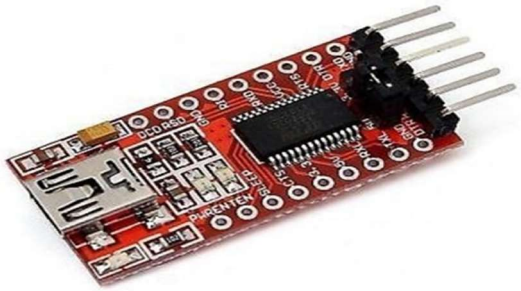

Figure 3.5: UART TTL Programmer

3.6.3 Bluetooth Module HC-05

- The HC-05 module is a Bluetooth module that provides wireless communication capabilities to electronic devices. The module is designed to be integrated into a wide range of electronic

systems, including microcontrollers, robotics systems, and other embedded systems.

- The HC-05 module operates on the Bluetooth 2.0 protocol, which sup- ports a range of profiles, including the Serial Port Profile (SPP). This allows the module to function as a wireless serial communication channel, enabling data transfer between two Bluetooth-enabled devices. The module can be configured to operate in either master or slave mode, depending on the ap- plication requirements.
- The HC-05 module is highly versatile and offers a range of features, including low power consumption, fast data transfer rates, and a simple inter- face. It can be easily integrated into existing electronic systems and offers a reliable means of wireless communication between devices. Overall, the HC-05 module is a powerful tool for anyone working in the field of embedded systems development, offering a simple and efficient means of adding wireless communication capabilities to electronic devices.

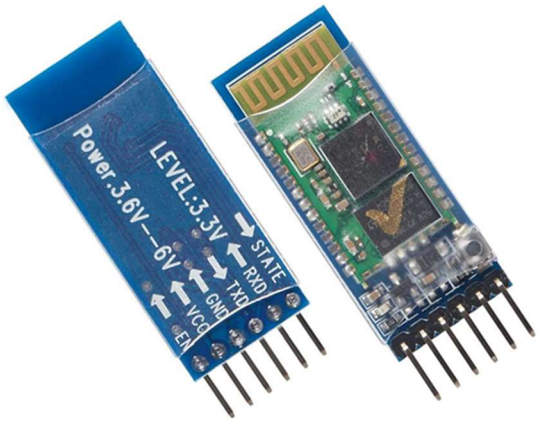

Figure 3.6: HC05 Bluetooth Module

3.6.4 Voltage Regulator LM7805

The L7805 voltage regulator is a widely used integrated circuit (IC) that provides a fixed output voltage of 5 volts. It is part of the 78xx series [19] of voltage regulators, which are designed to regulate and stabilize the input voltage to a constant and reliable output voltage.

The L7805 is a linear voltage regulator that operates by continuously adjusting its internal circuitry to maintain a steady output voltage, even when the input voltage or load conditions vary. It is

commonly used in electronic instruments and power supply applications where a stable 5V power source is required.

Key features and characteristics of the L7805 voltage regulator include:

- Output Voltage: The L7805 provides a fixed output voltage of 5 volts, making it suitable for powering various electronic components and devices that operate at this voltage level.
- Input Voltage Range: The input voltage range for the L7805 is typically between 7V and 35V, allowing it to be powered by a wide range of input sources, such as batteries or AC adapters.

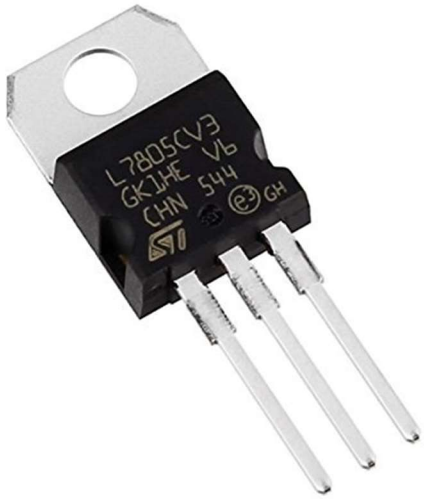

Figure 3.7: 5V Voltage Regulator

3.6.5 Li-ion Polymer Battery

A lithium-ion battery is a type of rechargeable battery that uses Lithium-ions as the primary source of energy. These Batteries [17] are widely used in a variety of applications, including portable electronic devices, electric vehicles, and renewable energy systems.

- Li-ion batteries offer several advantages over other types of Rechargeable Batteries, including high energy density, low self-discharge rates, and longer lifespan. They are also more environmentally friendly than other types of batteries, as they do not contain heavy metals such as lead or cadmium.
- However, Li-ion batteries also have some limitations, such as the risk of thermal runaway and

the need for careful handling and management. The batteries can become unstable and dangerous if overcharged, overheated, or damaged, and therefore require proper handling and management to ensure safe operation. Overall, Li-ion batteries are a powerful and versatile source of energy, offering a reliable and efficient means of powering a wide range of electronic and mechanical systems.

Figure 3.8: Li-ion Polymer battery

3.7 SOFTWARE IMPLEMENTATION

3.7.1 Arduino Bluetooth Text to Speech

Arduino Bluetooth Text to Speech is a project that involves using an Arduino microcontroller in combination with a Bluetooth module and a Text-to-Speech (TTS) module to convert text input into audible speech output wirelessly via a Bluetooth connection.

Here's how the Arduino Bluetooth Text to Speech project generally works:

1. Arduino Microcontroller: The project starts with an Arduino board , such as Arduino Uno or Arduino Nano, which serves as the central control unit. The Arduino is programmed to receive text input from a Bluetooth-enabled device and send it to the TTS module for speech synthesis.

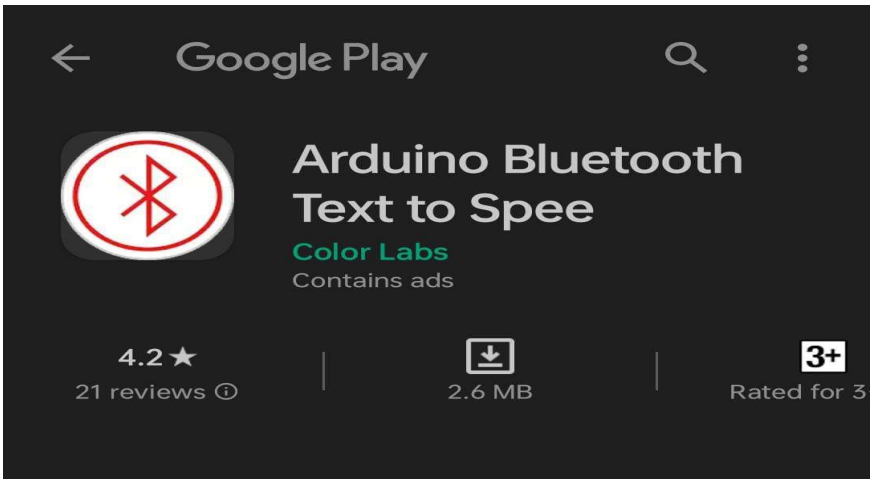

Figure 3.9: Google play-store Application

2. Bluetooth Module: A Bluetooth module, such as HC-05, is connected to the Arduino. It enables wireless communication between the Arduino and a Bluetooth - enabled device, such as a smartphone, tablet, or computer. The Bluetooth module receives the text input from the device and sends it to the Arduino for processing.

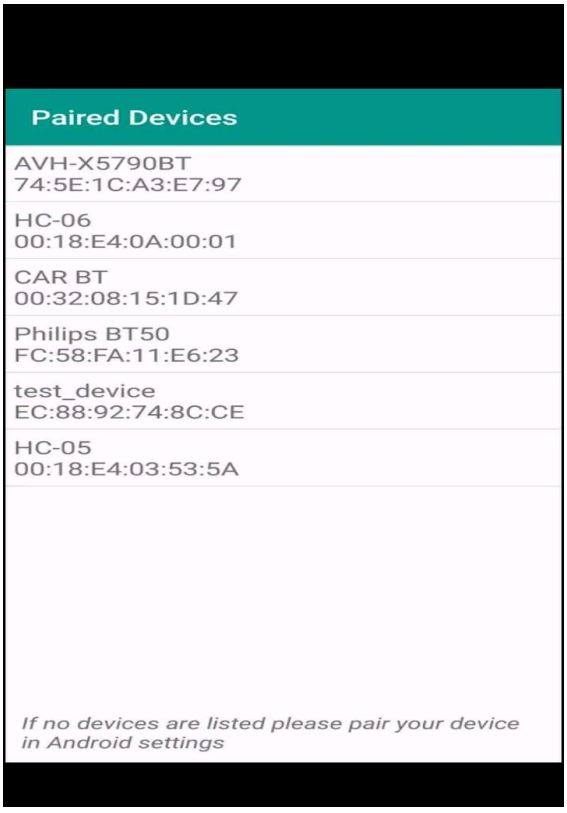

Figure 3.10: Paired devices on application

3. Text-to-Speech Module: A TTS module, such as the DF Player Mini or the ISD1820 Voice Recorder Module, is connected to the arduino. The TTS [16] module is responsible for converting the received text into audible speech output. It may include built-in sound libraries or use pre-recorded audio files for generating speech.
4. Arduino Programming: The Arduino is programmed to receive the text input through the Bluetooth module and send it to the TTS module for speech synthesis. The Arduino code interprets the received text and sends the appropriate commands to the TTS module to generate the corresponding speech output.
5. Wireless Communication: The bluetooth module establishes wireless connection with the Bluetooth-enabled device. The device sends the desired text input to the Arduino via the Bluetooth connection. The Arduino processes the received text and triggers the TTS module to generate the speech output.
6. Speech Output: The TTS module converts the processed text into audible speech using its built-in capabilities or by playing pre-recorded audio files. The synthesized speech output is typically amplified using a speaker connected to the TTS module or an additional audio amplifier.

Figure 3.11: Display output on App

3.7.2 Chrome Browser to Open MAC Address

The ESP32-CAM module is a popular development board that combines an ESP-32 Cam microcontroller and a camera module. While the ESP32-CAM does not have a built-in Chrome browser, it can connect to a Wi-Fi network and interact with web-based applications.

The MAC address , also known as the media access control address, is a unique identifier assigned to the network interface of a device. Each ESP32-CAM module has its own MAC address, which can be accessed programmatically.

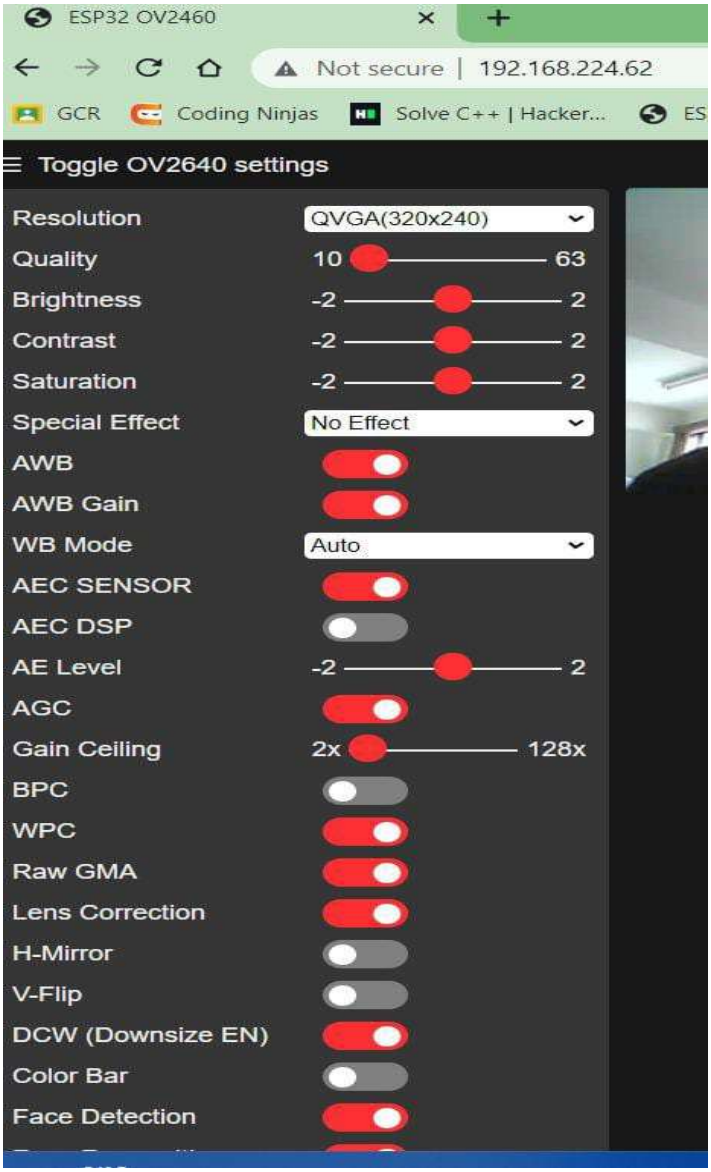

Figure 3.12: ESP32 CAM control in Chrome

Make sure to replace "our_wifi_ssid" and "our_wifi_password" with the appropriate credentials for our Wi-Fi network. The MAC address will be printed in the Serial Monitor at a baud-rate of 115200.

Note that this code assumes you have the necessary libraries installed for ESP32 and Wi-Fi support. You may need to install the ESP32 and WiFi libraries through the Arduino Library Manager if you haven't done so already.

By running this code on the ESP32-CAM, you can obtain its MAC address and use it for various network-related tasks or identification purposes.

3.7.3 Arduino IDE Software

Arduino IDE (i.e., Integrated Development Environment) is an open-source software platform that provides a user friendly interface for programming Arduino boards. It is widely used by hobbyists, students, and professionals for developing and uploading code to arduino microcontrollers. The Arduino IDE [14] simplifies the process of writing , compiling , and uploading code , making it accessible to users with varying levels of programming experience.[15]

Features of the Arduino IDE:

I. **Code Editor :** The Arduino IDE offers a simple and intuitive code editor where users can write their Arduino sketches (programs). It supports syntax highlighting , auto-completion, and indentation , making it easier to write code and navigate as well.

II. **Library Manager:** Arduino IDE comes with a built-in Library Manager, which allows users to easily browse and install various libraries . Libraries provide pre - written code and functions that can be used to extend the functionality of Arduino boards.

III. **Board Manager :** The board manager feature in arduino IDE allows users to install and manage different board configurations. It provides a convenient way to select the specific Arduino board model and processor variant to ensure compatibility with the target

hardware.

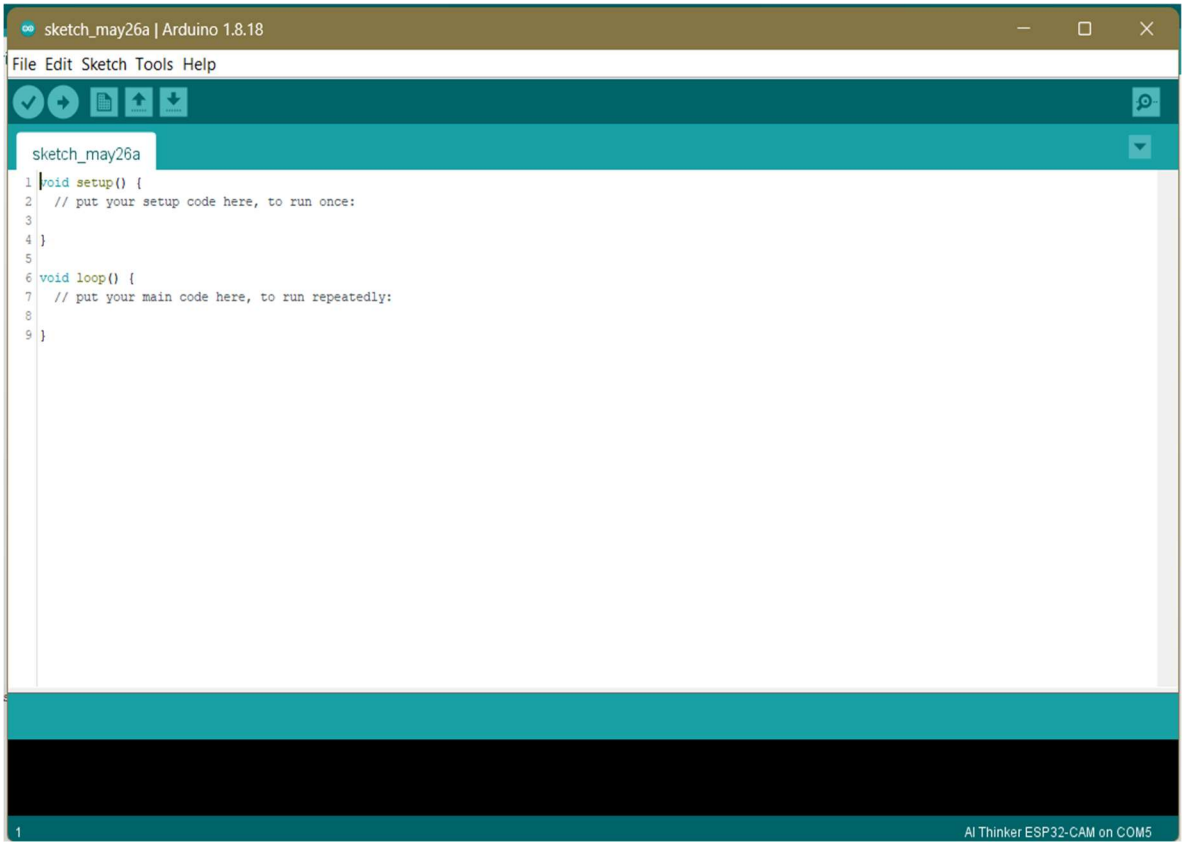

Figure3.13: Arduino IDE Software Page

IV. **Serial Monitor :** Arduino IDE includes a serial monitor tool that enables users to communicate with the arduino board via the serial port. It allows for real-time data transmission, debugging, and monitoring of the Arduino program's output.

V. **Sketch Upload :** One of the essential features of Arduino IDE is its ability to compile and upload sketches to Arduino boards. With a simple click of a button, users can compile their code and upload it directly to the connected Arduino board, enabling rapid prototyping and testing.

VI. **Examples and Tutorials :** Arduino Integrated Development Environment offers a wide range of example sketches and tutorials to help users understand and learn the basics of Arduino programming. These examples cover various functionalities, including digital and

analog input/output, sensor interfacing, communication protocols, and more.

VII. **Cross-Platform Compatibility :** Arduino IDE is available for multiple Operating Systems, including macOS, Windows and Linux, ensuring that users can access and use the software on their preferred platform.

VIII. **Open-Source Community :** Arduino IDE benefits from a vibrant and active open-source community. Users can find a vast array of resources, including forums, online communities, and documentation, where they can seek assistance, share projects, and collaborate with other Arduino enthusiasts.

CHAPTER 4

SIMULATION AND RESULT

4.1 RESULTS

Several important outcomes from blind assistance with glasses were attained:

1) Model of Smart Glasses:

- A successful working model of smart glasses with integrated cameras, microprocessors, and audio systems.
- Instantaneous human recognition is made possible by the real-time collection and processing of visual data.

2) Auditory Feedback:

- The incorporation of a user-friendly audio feedback system to provide users with visual information.
- Positive user feedback on the audio feedback system's efficiency and understandability.

3) Accuracy of Recognition:

- The human detection model was highly accurate in identifying and recognizing the person in front of blind man. This accuracy was evaluated through extensive testing and validation against ground truth annotations.

4.1.1 STEPS AND OUTCOMES

In order to help people with visual impairments navigate their surroundings, the Blind Assistance project set out to create a wearable technology solution. The project's results support ongoing initiatives in assistive technology, fostering autonomy and mobility for people with visual impairments.

For people with visual impairments, the system has the potential to significantly improve social interactions, safety, and independence thanks to its high accuracy, real-time performance, and audio feedback capabilities.

The human recognition algorithm should be continually improved because it can become less accurate in complex situations, under different lighting conditions, and with people who have different facial features.

These are the steps involved in the proposed working model.

Step 1. First Open chrome browser and enter the generated IP address

Step 2. Click the Start Stream Button and select the Camera Resolution On QVGA

Step 3. Click on Face Detection and Face Recognition option.

Step 4. Click to Enrol Face to save the person's images.

Step 5. Connect the Android application and get the output.

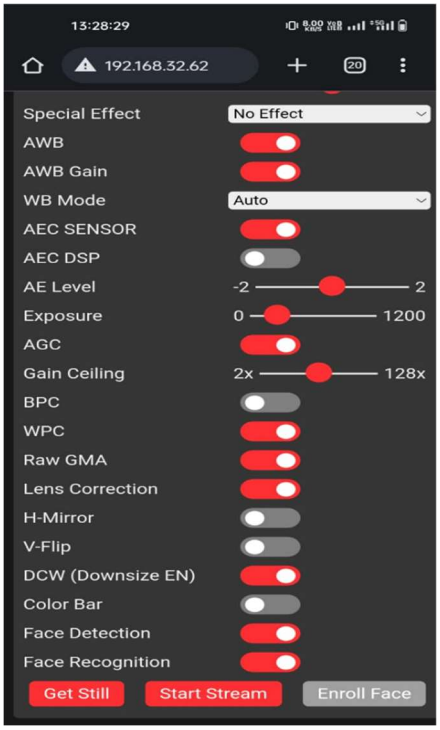

Figure 4.1: Start streaming by entering the IP address

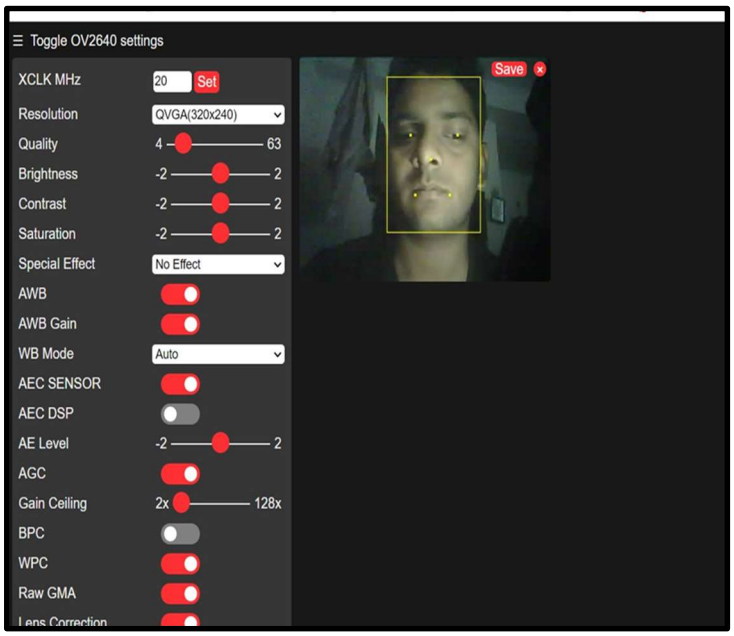

Figure 4.2: Camera detects the person face

The camera captures the image instantly and saves it with the name as mentioned by the user with the highest resolution available in the camera.

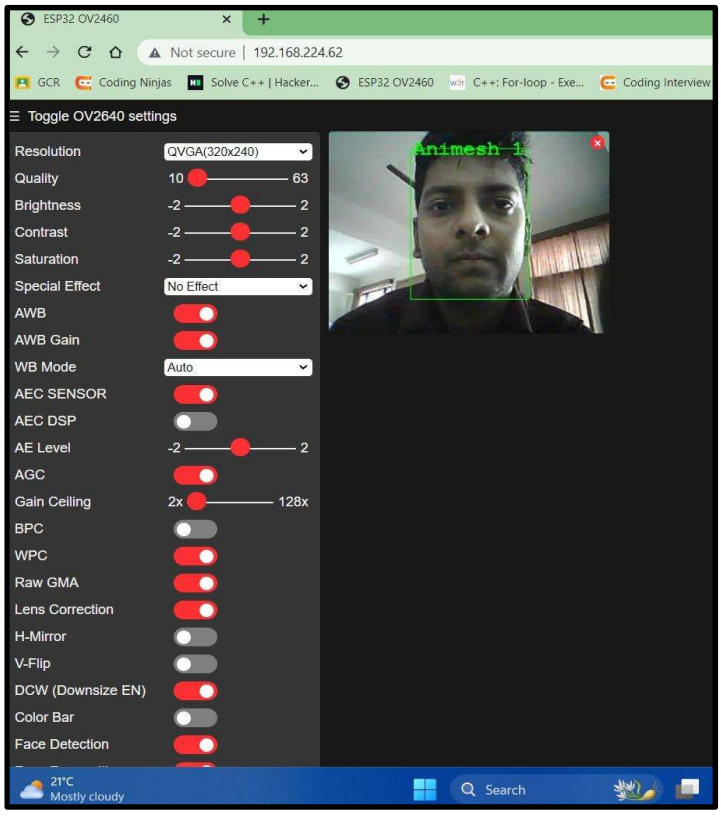

Figure 4.3: Camera recognizes the person accurately

The camera recognizes the person very instantly with the name that was saved by the user and gives the name in audio form in the ear of blind person via headphones or any audio aid.

Here is another test case of our project, where the camera recognizes the person standing in front of it, as shown below in the snapshot:

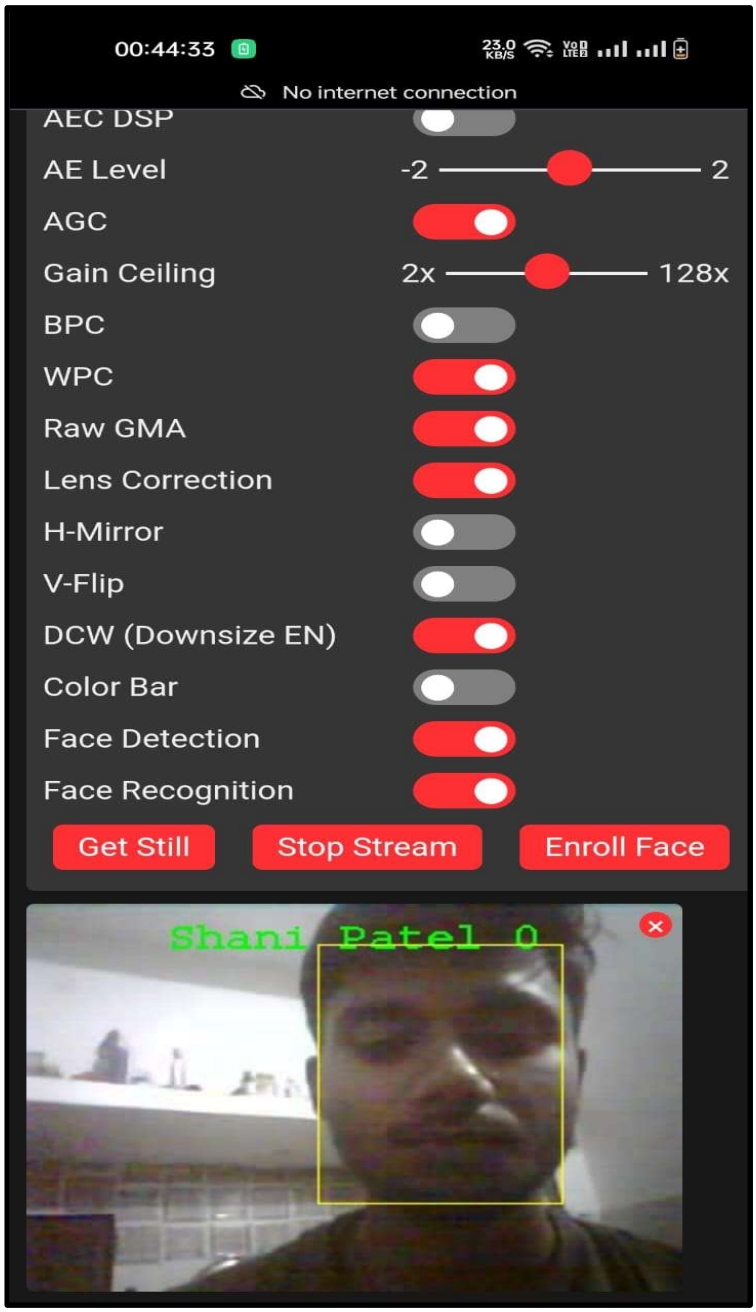

Figure 4.4: Camera recognizes the face and display the name

The results demonstrated how wearable technology, when used in conjunction with sophisticated human recognition algorithms, could provide visually impaired people with important information about their surroundings.

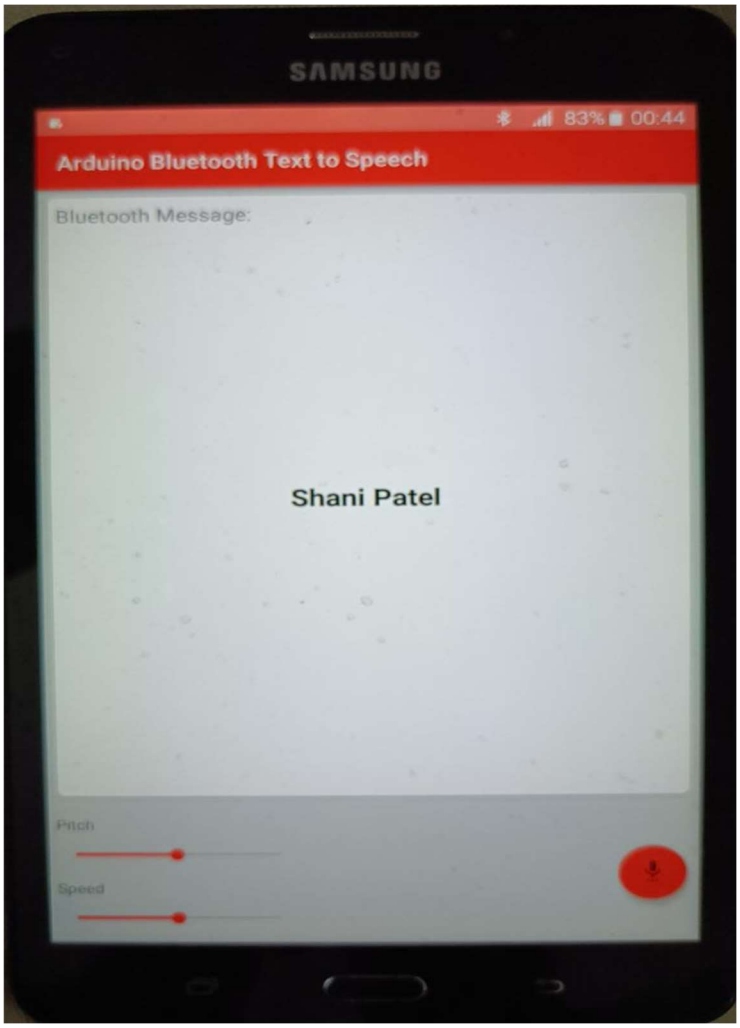

Figure 4.5: Output Displayed on android application

4.2 WORKING MODEL FOR PROPOSED SYSTEM

The project's final model incorporates the ESP32 microcontroller, a versatile and powerful microcontroller that is widely used in numerous Internet of Things applications. The camera, Bluetooth module, microprocessor, and assistive technology software work together to enable real-time visual data capture and processing by the smart glasses. Below are the different snapshots of the final model:

Figure 4.6: Front View of working Model

Figure 4.7: Side View of working Model

Figure 4.8: Top View of working Model

The development of a wearable visual aid for visually impaired people has yielded promising results. The device successfully identifies and saves information about individuals encountered by the user, enhancing their overall social interactions. Additionally, the integration of speech commands as an input method provides a convenient and hands-free user experience. The work done in researching, designing, and developing this system showcases the potential of advanced technologies to improve the lives of visually impaired individuals and promote inclusivity in society.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 CONCLUSION

In this project we successfully developed a Blind Assistance Glass system that used to detect and recognize face and give voice feedback via earphone to the blind people who is wearing that glass. We come to Conclusion part of the project that we are working on is very easily handled and completed. Here we developed a Face Recognition-based system through which we can inform BVI user about neighboring person via audio output. It can be done by its ESP32 CAM which is used for capturing the images of an individual and give audio output through earphone.

This innovative system not only reduces the overall cost of the glasses but also enhances their portability and ease of use. By informing the user about the presence of neighboring individuals, the Blind Assistance Glass greatly improves the user's ability to recognize and interact with people in front of them. This breakthrough has the potential to significantly enhance the independence and social interaction capabilities of blind individuals, empowering them to navigate their surroundings with greater confidence. Continued user feedback and testing will be crucial to further refine and optimize the system for real-world application, while ensuring the privacy and security of the captured images.

5.2 FUTURE SCOPE

1. **Facial Recognition and Personalization:** Implement facial recognition algorithms to recognize familiar faces and provide personalized assistance to visually impaired individuals. The system can detect and identify people the user knows and provide audio prompts or information about their presence. This feature can greatly enhance social interactions and help visually impaired users recognize and engage with friends, family, or caregivers.

2. **Real-Time Object Detection and Scene Understanding:** Enhance the object detection capabilities of the system to identify a broader range of objects, including everyday items, landmarks, and obstacles. Utilize deep learning algorithms and pre-trained models to achieve real-time object detection and scene understanding. This can enable the blind assistance glass to provide detailed descriptions of the user's environment, helping them navigate and interact with objects more effectively.

3. **Environmental Feedback and Safety Alerts:** Integrate environmental sensors such as proximity sensors, temperature sensors, or humidity sensors into the blind assistance glass. This would allow the system to provide real-time feedback on the surrounding environment, such as detecting nearby obstacles, alerting the user to changes in temperature, or warning about potentially hazardous conditions. These alerts can help visually impaired users make informed decisions and navigate their environment safely.

4. **Gesture Recognition and Voice Control:** Incorporate gesture recognition technology to enable hands-free operation of the blind assistance glass. Users can perform predefined gestures to control various functions, such as adjusting volume, activating specific features, or navigating menus. Additionally, integrate voice control capabilities to allow users to interact with the system using voice commands, making the device even more user-friendly and accessible.

5. **Integration with Mobile Applications and Cloud Services:** Develop companion mobile applications that can work in conjunction with the blind assistance glass. These applications can provide additional functionalities, such as remote control, customization of settings, or access to cloud services for data storage, synchronization, and analysis. Cloud integration can also enable the system to leverage machine learning models and constantly improve its object

recognition and navigation capabilities.

6. **Wearability and Design Optimization:** Focus on optimizing the design of the blind assistance glass to ensure maximum comfort, usability, and aesthetics. Consider factors such as weight distribution, ergonomic fit, and adjustability for different head sizes. Explore options for integrating the electronics seamlessly into the frame of the glasses, making them more discreet and socially acceptable.

APPENDIX

Image Processing

Image processing involves the manipulation and analysis of digital images to extract useful information or enhance their visual quality. It encompasses various operations, such as filtering, segmentation, feature extraction, and image enhancement. Image processing techniques are widely used in computer vision applications, including face detection and recognition.

Face Detection

Face detection is the process of locating and identifying human faces in images or videos. It is an essential step in many applications, such as biometric systems, surveillance, and facial analysis. Face detection algorithms analyze the visual features of an image to determine the presence and location of faces. These algorithms typically utilize machine learning and computer vision techniques, such as Haar cascades, Viola-Jones algorithm, or deep learning-based methods using convolutional neural networks (CNNs).

Face Recognition

Face recognition refers to the identification or verification of an individual's identity based on their facial features. It involves comparing the detected face with a database of known faces to find a match or determine similarity. Face recognition systems employ various algorithms and methodologies, including geometric-based methods, eigenface approaches, and deep learning techniques such as deep neural networks and Siamese networks. These algorithms extract distinctive facial features, such as landmarks, textures, or embeddings, to perform accurate identification or verification.

Applications of Face Detection and Recognition

Face detection and recognition have numerous practical applications in today's digital world. Some notable applications include:

a. Biometric Identification: Face recognition is commonly used in biometric systems for identity verification or access control. It enables secure authentication by comparing the captured face with stored templates.

b. Surveillance and Security: Face detection and recognition are integral to surveillance systems, enabling the automated identification of individuals for security purposes.

c. Human-Computer Interaction: Facial recognition can be employed for natural and intuitive interaction with computers, enabling applications such as emotion detection or gesture recognition.

d. Law Enforcement: Face recognition aids law enforcement agencies in identifying suspects from surveillance footage or forensic images.

e. Personalized Marketing: Facial analysis and recognition techniques can be used for targeted advertising or personalized user experiences.

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CODE USED

```
#include "esp_camera.h"
#include <WiFi.h>
#define CAMERA_MODEL_AI_THINKER
#include "camera_pins.h"
const char* ssid = "real5G";
const char* password = "shani777";
void startCameraServer();
void setup() {
  Serial.begin(9600);
  Serial.setDebugOutput(true);
  Serial.println();
  camera_config_t config;
  config.ledc_channel = LEDC_CHANNEL_0;
  config.ledc_timer = LEDC_TIMER_0;
  config.pin_d0 = Y2_GPIO_NUM;
  config.pin_d1 = Y3_GPIO_NUM;
  config.pin_d2 = Y4_GPIO_NUM;
  config.pin_d3 = Y5_GPIO_NUM;
  config.pin_d4 = Y6_GPIO_NUM;
  config.pin_d5 = Y7_GPIO_NUM;
  config.pin_d6 = Y8_GPIO_NUM;
  config.pin_d7 = Y9_GPIO_NUM;
  config.pin_xclk = XCLK_GPIO_NUM;
  config.pin_pclk = PCLK_GPIO_NUM;
```

```
  config.pin_vsync = VSYNC_GPIO_NUM;
  config.pin_href = HREF_GPIO_NUM;
  config.pin_sscb_sda = SIOD_GPIO_NUM;
  config.pin_sscb_scl = SIOC_GPIO_NUM;
  config.pin_pwdn = PWDN_GPIO_NUM;
  config.pin_reset = RESET_GPIO_NUM;
  config.xclk_freq_hz = 20000000;
  config.pixel_format = PIXFORMAT_JPEG;
  //init with high specs to pre-allocate larger buffers
  if(psramFound()){
    config.frame_size = FRAMESIZE_UXGA;
    config.jpeg_quality = 10;
    config.fb_count = 2;
  } else {
    config.frame_size = FRAMESIZE_SVGA;
    config.jpeg_quality = 12;
    config.fb_count = 1;
  }

#if defined(CAMERA_MODEL_ESP_EYE)
  pinMode(13, INPUT_PULLUP);
  pinMode(14, INPUT_PULLUP);
#endif

  // camera init
```

```
  esp_err_t err = esp_camera_init(&config);
  if (err != ESP_OK) {
    Serial.printf("Camera init failed with error 0x%x", err);
    return;
  }

  sensor_t * s = esp_camera_sensor_get();
  //initial sensors are flipped vertically and colors are a bit saturated
  if (s->id.PID == OV3660_PID) {
    s->set_vflip(s, 1);//flip it back
    s->set_brightness(s, 1);//up the blightness just a bit
    s->set_saturation(s, -2);//lower the saturation
  }
  //drop down frame size for higher initial frame rate
  s->set_framesize(s, FRAMESIZE_QVGA);

#if defined(CAMERA_MODEL_M5STACK_WIDE)
  s->set_vflip(s, 1);
  s->set_hmirror(s, 1);
#endif

  WiFi.begin(ssid, password);

  while (WiFi.status() != WL_CONNECTED) {
    delay(500);
```

```
    Serial.print(".");
  }
  Serial.println("");
  Serial.println("WiFi connected");

  startCameraServer();

  Serial.print("Camera Ready! Use 'http://");
  Serial.print(WiFi.localIP());
  Serial.println("' to connect");
}

void loop() {
  // put your main code here, to run repeatedly:

  delay(10000);
}
```