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A Project Report on

"SMART ASSISTIVE ARMBAND THROUGH HAPTIC FEEDBACK FOR VISUALLY IMPAIRED"

Submitted in Partial Fulfillment of the Requirement for the Award of the Degree of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

Submitted by

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K.L.E. Society's

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CERTIFICATE

Certified that the Project Work entitled **"SMART ASSISTIVE ARMBAND THROUGH HAPTIC FEEDBACK FOR VISUALLY IMPAIRED"** carried out by **Mr. Vishal Musandi** (2KD15EC052),the bonafide students of KLE College of Engineering and Technology, Chikodi in partial fulfillment of the award of **Bachelor of Engineering in Electronics and Communication Engineering** of the Visvesvaraya Technological University**,** Belagavi during the year 2018-2019. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library. The Project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

Signature of the Guide	**Signature of the HOD**	**Signature of the Principal**
Prof. Vijay Hallappanavr	**Prof. V.K. Patil**	**Dr. Prasad Rampure**

External Viva

Name of the Examiners: Signature with Date:

1. ……

2. ……

DECLARATION

I, **Mr. Vishal Musandi (2KD15EC052),** student of 8th semester BE in Electronics and Communication Engineering, K.L.E college of Engineering and Technology Chikodi, hereby declare that the project work entitled, **"Smart Assistive Armband Through Haptic Feedback For Visually Impaired"** submitted to the Visvesvaraya Technological University during the Academic year 2018-19, is a record of an Original work done by me under the guidance of **Prof. Vijay Hallappanavar**, Assistant professor, Department of Electronics and Communication Engineering, KLE college of Engineering and Technology, Chikodi. This project work is submitted in partial fulfillment of the requirements for the award of the degree of Bachelor of Engineering in Electronics and Communication Engineering. The results embodied in this thesis have not been submitted to any other University or Institute for the award of any degree.

Date:

Place: Chikodi

Mr.Vishal Musandi

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The beautiful fragrance that accompanies successful completion of our task would be incomplete without expressing our appreciation to the people, who made it possible, though words are not enough to express the sense of gratitude towards everyone who helped directly or indirectly.

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Finally, I am obliged to thank my parents and my family members for their continuous encouragement and support.

Mr.Vishal Musandi

I would like to dedicate this

Project

To My

BELOVED

PARENTS

AND

TEACHER

ABSTRACT

People with visual disability need a constant assistance in their lives to carry out the daily routine. The assistance required may range from relying on other people for help to using various Electronic Travel Aid (ETA) assistive devices whenever needed. In order to make the blind independent and provide a smart assistance we aim to develop a smart wearable device which would guide the user in daily routine and also provide assistance to navigate the indoor as well as outdoor environment. Our project is a wearable device that greatly increases the independence of the blind. It is designed to help the visually impaired by integrating machine learning with haptic feedback. After waking the device from sleep, with a wake word or button press, users can summon the smart assistant to help them to identify products. It can detect the objects and then guide the users arm towards the object through haptic feedback. Through facial recognition, the device can even remember and identify faces to help the user recognize people he or she has met before. The device is a wearable solution that minimizes the daily problems faced by the blinds.

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CHAPTER 1

INTRODUCTION

People with visual disability need a constant assistance in their lives to carry out the daily routine. The assistance required may range from relying on other people for help to using various Electronic Travel Aid (ETA) assistive devices whenever needed. In order to make the blind independent and provide a smart assistance, this project aims to develop a smart wearable device which would guide the user in daily routine and also provide assistance to navigate the indoor as well as outdoor environment. Our project is a wearable device that greatly increases the independence of the blind. It is designed to help the visually impaired by integrating machine learning with haptic feedback. After waking the device from sleep, with a wake word or button press, users can summon the smart assistant to help them to identify products. It can detect the objects and then guide the users arm towards the object through haptic feedback. Through facial recognition, the device can even remember and identify faces to help the user recognize people he or she has met before. The device is a wearable solution that minimizes the daily problems faced by the blinds.

CHAPTER 2

PROBLEM DEFINITION

There are around 285 million people around the world who are visually impaired. For the people with visual disability there is a need of constant assistance in their lives to carry out their daily routine. The assistance required may range from relying on other people for help to using various Electronic Travel Aid (ETA) assistive devices whenever needed. Vision difficulties are often associated with aging, and with a growing population, the World Health Organization predicts that the number of visually impaired people will triple by the year 2050.Despite the rapid growth in medical field in recent years, a permanent cure for blindness is still a question, and even the most promising current treatments are highly experimental and extremely expensive. Blind people today rely on sighted guides, seeing-eye dogs and canes. In order to make the blind independent and provide a smart assistance, this project aims to develop a smart wearable device which would guide the user in daily routine and also provide assistance to navigate the indoor as well as outdoor environment.

In this project a smart wearable device that greatly increases the independence of the blinds is developed. It is designed to help the visually impaired by integrating machine learning with haptic feedback. The device can detect the objects and then guide the users arm towards the object through haptic feedback. Through facial recognition, the device can even remember and identify faces to help the user recognize people he or she has met before. The haptic feedback is integrated with the camera. If the object is detected on the left side, the left haptic motors will vibrate and if object is detected on right side, the right haptic motors will vibrate. The device is a wearable solution that minimizes the daily problems faced by the blinds.

CHAPTER 3

LITERATURE SURVEY

[1] The necessity for developing a cost efficient assistive system for the visually impaired and blind people has increased with gradual increase in their population worldwide. The white canes also known as stick system presented in the paper uses artificial intelligence along with various sensors in real time to assist the visually impaired people to help them to navigate their environment independently. The tasks performed by system are the Image recognition and obstacle detection. The image recognition system consists of a smartphone application utilizing the artificial intelligence. The obstacle detection system consists of ultrasonic sensors to alert the blind or visually impaired of the obstacles in his route.

[2] The another project with objective to provide the assistance to the virtually impaired people with the help of smart device using an Android application. This project is an innovative and cause efficient guiding system for the Visually Impaired People (VIP). The major problem for the blinds is to navigate the outdoor environment. Voice control being the one of the main asset for controlling the smart device the system is based on Android application which can be controlled by voice and it is designed for helping the visually impaired to navigate the outdoor environment. The android application helps the user to open any app a sand also to make a call to any contact through voice commands. The user commands the mobile device to do something via speech, now these commands are then analyzed immediately by the Speech Recognition Engine(SRE) that converts speech into text for performing out the direct actions.

[3] Another system which helps the visually impaired is called as Artificial Vision System for Blind (AVSB), this system consists of ultrasonic sensors and a microcontroller that calculates the distance of the obstacles around the user and to advise him go through an alternative route with the help of an audio feedback. The drawback of this system was that it blocked the daily hearing routine of the visually impaired individuals.

[4] According to some tests, the assistant system that uses consists of android application proves to be efficient, cost effective and does not require any special training for the usage of the method. The portable devices most commonly used by everyone have a lot of potential in assisting the visually impaired people on a daily basis. In this project the main objective is to develop an android application for smartphone, specially designed to assist the visually impaired. The application uses inbuilt sensors of a smartphone and also the information received from a few external sensor modules developed for the project. The sensor modules together form an assistive portable system. Communication between smartphone and the sensor modules is made via Bluetooth and Wi-Fi. The communication between smartphone application and its user is made through a text-to-speech conversion module. The assistive activities that are carried out by these modules range from making a phone call, to indoor and outdoor guidance and helping the user to navigate the surroundings independently.

[5] The smart assistive system for blinds based on the testing and implementation of the microcontroller (MCU), the device includes a selectable feedback i.e. haptic and audio feedback depending on the user. In this project the smart phone is used to control the device using inbuilt voice commands and Bluetooth. The device is a portable device and it aims at warning the user of the obstacle or object when obstacle is present on the walking path of the blind to avoid the collision. The distance between the user and the obstacle is also calculated with the help of the ultrasonic sensors and the action is performed using ultrasonic echolocation and the data provided by the ultrasonic sensor is now processed by a microcontroller. The microcontroller also controls the feedback system of the device i.e. the audio and haptic feedback mechanism.

[6] It is hard to identify people during group meetings and it is drawback for blind people in many situations like professional and educational situations. To overcome by this problem in this project they have used smart phone technology in existence with wireless network to provide audio feedback of the people in front of the blind user. The camera can recognize the face up to a 40 degree angle between the direction of the camera and where the person is looking then it scans and gives result with 96% accuracy.

[7] Haptic is the science of applying touch sensation and control to interact with computer applications. This gives the user a sense of touch with computer created natures, so that

when virtual things are touched, it looks real and tangible. This technology interfaces with virtual environment via sense of touch by applying force, motions or vibrations to the user. This mechanism is used to create virtual environment, for control of virtual objects, and to enhance remote control of machines and device.

[8] Vision is the one of the important part of a human sense and it plays important role in human life. Many papers are published on these topics that propose a variety of computer vision devices and serviced by developing new electronic aids for the blind. In this paper it introduces a system that restores a central function of the visual system which is the identification of surrounding objects. To identify the objects the method is based on the local feature extraction concept. The simulation result using SFIT algorithm and key points matching shows good accuracy of detecting objects.

[9] This paper describes machine learning approach for visual object identification which enables processing of images extremely rapidly and achieving high detection rates. This is differentiated by three key contributions. First one: new image introduction representation is known as “integral image”, which allows the features used our detector to be computed fast. Second one: learning algorithm based on AdaBoost , which selects a small number of critical visual features from a larger set and yield extremely efficient classifiers. Third : the method for combining increasingly more complex classifier in a “cascade “which allows background region of the image to be quickly vanished while spending more computation on promising object like regions.

CHAPTER 4

HARDWARE REQUIREMENTS

4.1 Raspberry Pi Model

Raspberry Pi is a small single board computer. By connecting peripherals like Keyboard, mouse, display to the Raspberry Pi, it will act as a mini personal computer. Raspberry Pi is popularly used for real time Image/Video Processing; IoT based applications and Robotics applications. Raspberry Pi is slower than laptop or desktop but is still a computer which can provide all the expected features or abilities, at low power consumption. Raspberry Pi Foundation officially provides Debian based Raspbian OS. Also, they provide NOOBS OS for Raspberry Pi. Third-Party versions of OS like Ubuntu, Arch linux, RISC OS, Windows 10 IOT Core, etc can also be installed.

The figure 4.1 shows the Raspberry pi model diagram.

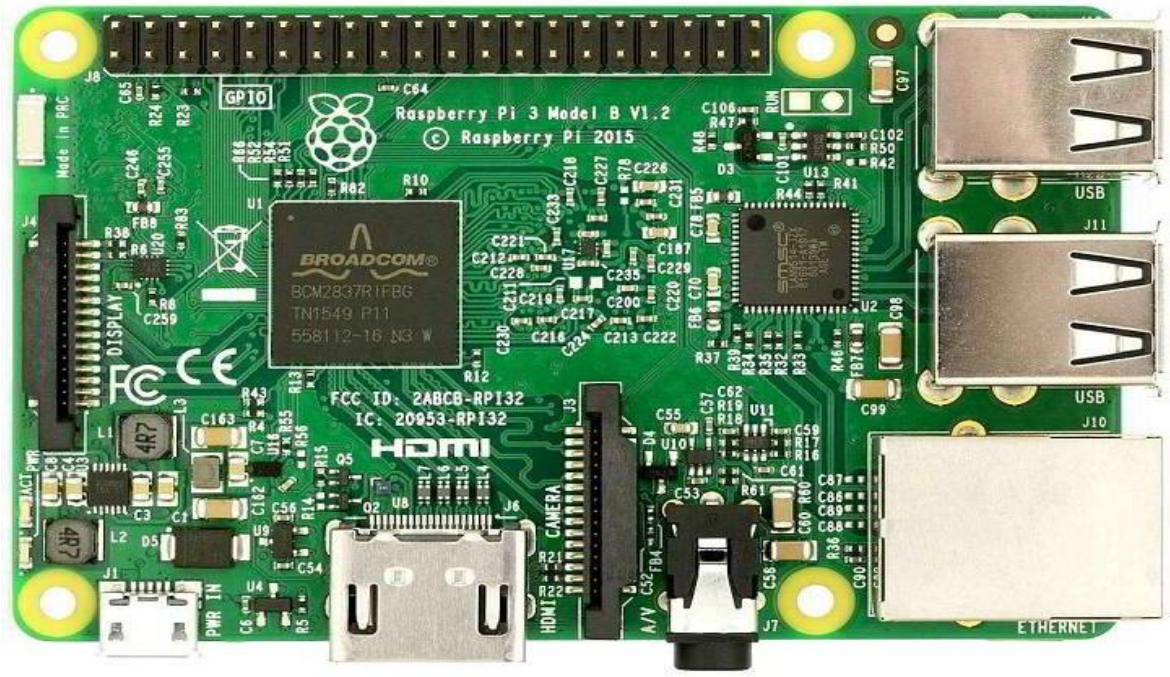

Figure 4.1 Raspberry Pi Model

Raspbian OS is official Operating System available for free to use. This OS is efficiently optimized to use with Raspberry Pi. Raspbian have GUI which includes tools for Browsing, Python programming, office, games, etc. It uses SD card (minimum 8 GB

recommended) to store the OS (operating System). Raspberry Pi is more than computer as it provides access to the on-chip hardware i.e. GPIOs for developing an application. By accessing GPIO, devices like LED, motors, sensors etc can be connected and can control them too. It has ARM based Broadcom Processor SoC along with on-chip GPU (Graphics Processing Unit).The CPU speed of Raspberry Pi varies from 700 MHz to 1.2 GHz. Also, it has on-board SDRAM that ranges from 256 MB to 1 GB. Raspberry Pi also provides on-chip SPI, I2C, I2S and UART modules. There are different versions of raspberry pi available as listed below:

1. Raspberry Pi 1 Model A
2. Raspberry Pi 1 Model A+
3. Raspberry Pi 1 Model B
4. Raspberry Pi 1 Model B+
5. Raspberry Pi 2 Model B
6. Raspberry Pi 3 Model B
7. Raspberry Pi Zero

Features	Raspberry Pi Model B+	Raspberry Pi 2 Model B	Raspberry Pi 3 Model B	Raspberry Pi zero
SoC	BCM2835	BCM2836	BCM2837	BCM2835
CPU	ARM11	Quad Cortex A7	Quad Cortex A53	ARM11
Operating Freq.	700 MHz	900 MHz	1.2 GHz	1 GHz
RAM	512 MB SDRAM	1 GB SDRAM	1 GB SDRAM	512 MB SDRAM
GPU	250 MHz Videocore IV	250MHz Videocore IV	400 MHz Videocore IV	250MHz Videocore IV
Storage	micro-SD	Micro-SD	micro-SD	micro-SD
Ethernet	Yes	Yes	Yes	No
Wireless	Wi-Fi and Bluetooth	No	No	No

Table 4.1 Raspberry Pi Features

4.1.1 Raspberry Pi 3 Model B Hardware

The On-chip hardware of Raspberry Pi 3 is as shown in below figure 4.2,

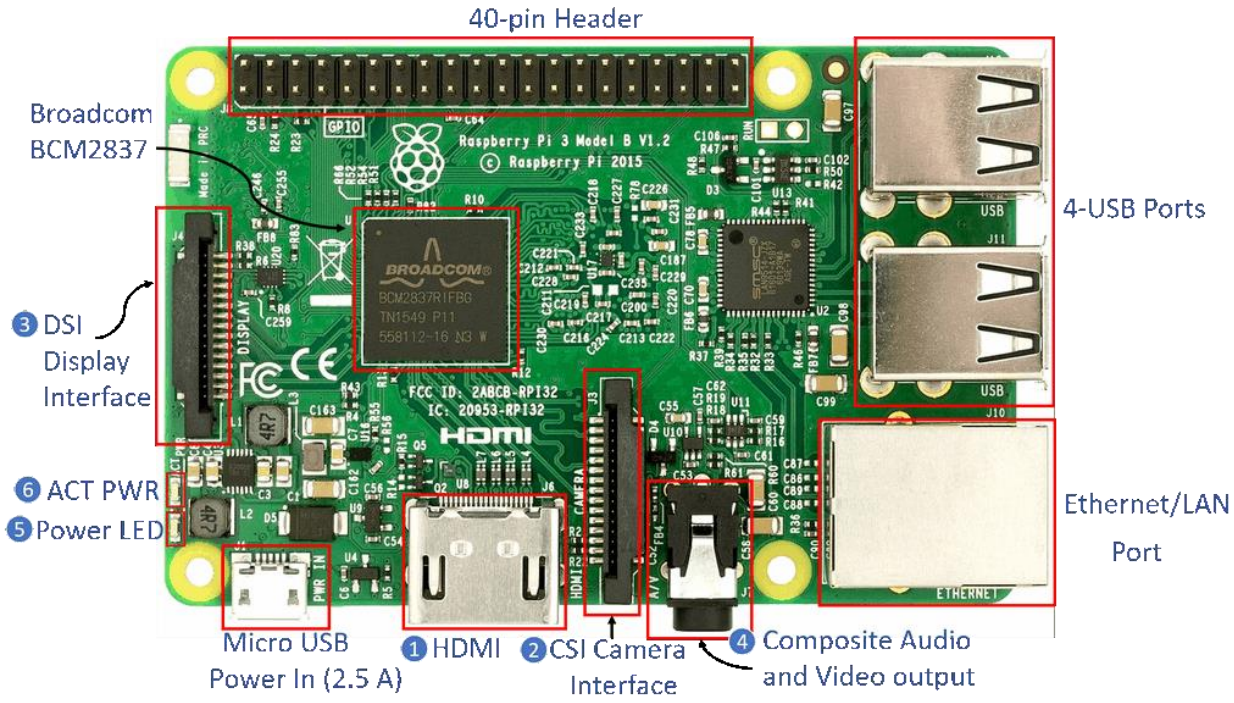

Figure 4.2 Raspberry Pi 3 Model B Hardware

Some Hardware Components shown above are mention below:

1. HDMI (High-Definition Multimedia Interface): It is used for transmitting uncompressed video or digital audio data to the Computer Monitor, Digital TV, etc. Generally, this HDMI port helps to connect Raspberry Pi to the Digital television.
2. CSI Camera Interface: CSI (Camera Serial Interface) interface provides a connection in between Broadcom Processor and Pi camera. This interface provides electrical connections between two devices.
3. DSI Display Interface**:** DSI (Display Serial Interface) Display Interface is used for connecting LCD to the Raspberry Pi using 15-pin ribbon cable. DSI provides fast High-resolution display interface specifically used for sending video data directly from GPU to the LCD display.

4. Composite Video and Audio Output: The composite Video and Audio output port carries video along with audio signal to the Audio/Video systems.
5. Power LED: It is a RED colored LED which is used for Power indication. This LED will turn ON when Power is connected to the Raspberry Pi. It is connected to 5V directly and will start blinking whenever the supply voltage drops below 4.63V.
6. ACT PWR: ACT PWR is Green LED which shows the SD card activity.

4.2 Ultrasonic Sensor

The ultrasonic sensor works on the principle of SONAR and RADAR system which is used to determine the distance to an object. An ultrasonic sensor generates the high-frequency sound (ultrasound) waves. When this ultrasound hits the object, it reflects as echo which is sensed by the receiver.

The below figure 4.3 shows the image of an Ultrasonic Sensor.

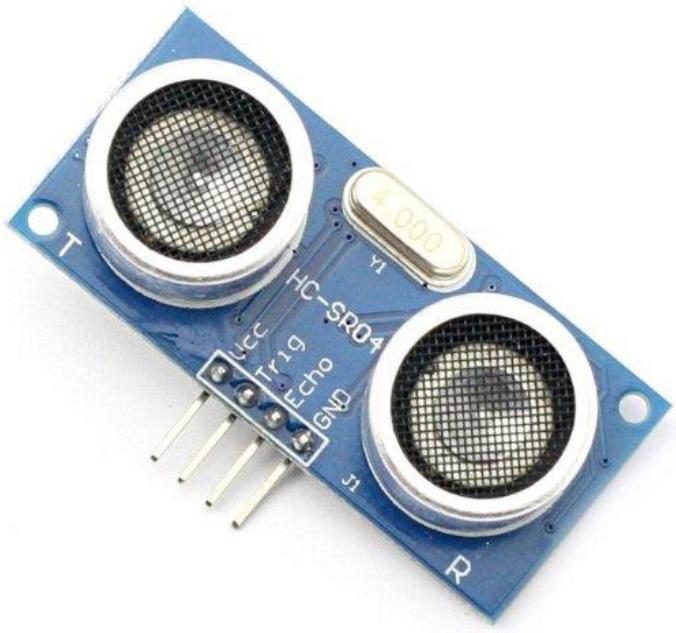

Figure 4.3 Ultrasonic Sensor

HC-SR-04 has an ultrasonic transmitter, receiver and control circuit. In ultrasonic module HCSR04, trigger pulse must be given, so that it will generate ultrasound of frequency 40 kHz. After generating ultrasound i.e. 8 pulses of 40 kHz, it makes echo pin high. Echo pin

remains high until it does not get the echo sound back. So the width of echo pin will be the time for sound to travel to the object and return back. Once the sensor gets the time it calculates the distance, as it knows the speed of sound. HC-SR04 can measure up to range from 2 cm - 400 cm. Description of each port of ultrasonic sensor:

- **VCC** - +5 V supply
- TRIG – Trigger input of sensor. Microcontroller applies 10 us trigger pulse to the HC-SR04 ultrasonic module.
- ECHO–Echo output of sensor. Microcontroller reads/monitors this pin to detect the obstacle or to find the distance.
- GND – Ground.

4.3 Camera Module for Raspberry Pi

The below figure 4.4 shows the Raspberry Pi camera module.

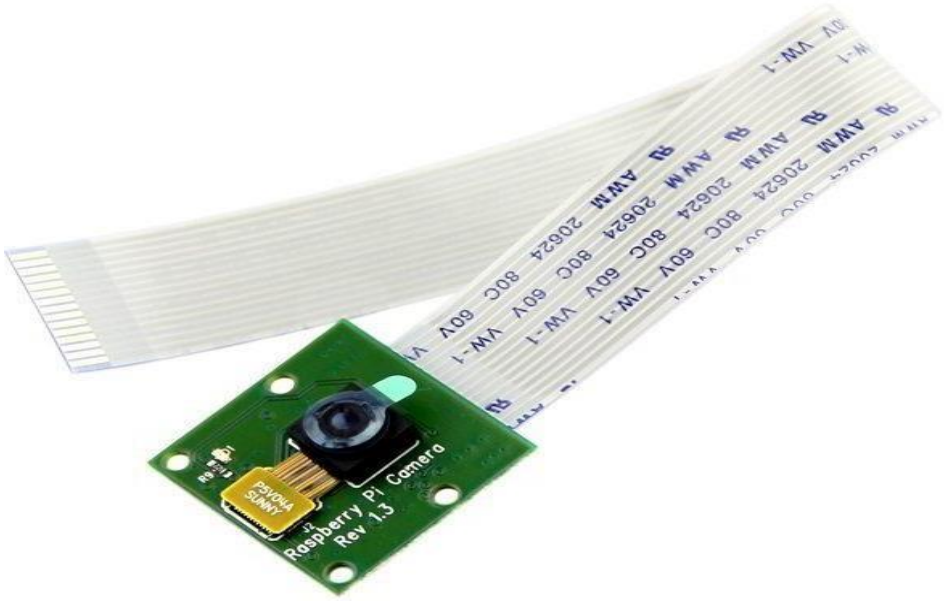

Figure 4.4 Camera Module for Raspberry Pi

This camera module features with 5MP (2592×1944 pixels) and 160 degrees viewing angle. It is compatible with both Raspberry Pi model A and model B. The OV5647

sensor, native resolution of 5 megapixel. The CSI bus is capable of extremely high data rates, and it exclusively carries pixel data to the BCM2835 processor. The camera module supports 1080p at 30 fps, 720 p at 60 fps and 640 x480 p 60/90 video recording. With IR filter, full Color in daylight.

4.3.1 Specifications of camera module

The below table 4.2 gives the specifications of the Raspberry Pi camera module

Lens	1/4 inch
Pixel	5 Mega
Sensor	OV5647
Resolution	2592 x 1944
Image Color	Full Color in daylight (with IR filter)
FOV	160 degrees
Cable length	2.36 inch / 60 mm
Video	Support 1080p@30 fps, 720p@60 fps and 640x480p 60/90 Recording
Compatible with	Raspberry Pi model A and model B
Size	225 x 24 x 9 mm /0.99 x 0.95 x 0.36 inch

Table 4.2 Specifications of Camera Module for Raspberry Pi

4.4 Coin Mobile Phone Vibration Motors

Coin vibration motors are designed to be easy to mount. They come with either spring PCB connectors or a high-strength long life self-adhesive backing sheet that is pre-attached to the underside of the chassis. The adhesive allows for a secure mounting of the vibration motor to a wide range of surfaces such as PCBs or flat internal surfaces of the enclosure and makes manufacturing installation fast and clean. Three brands of adhesive are typically used on our coin vibrator motors depending on availability (they all have very similar specifications). These are: 3M VHB 9448, Sony 4000T, Nitto 5000NS.

The below figure 4.5 gives the image of coin mobile phone vibration motors

Figure 4.5 Coin Mobile Phone Vibration Motors

These 0.16mm thick adhesive tapes typically offer a 180 degree peeling strength of 15N/20mm, and a tensile strength of around 20N/10mm. The acrylic adhesive is considered to be resistant to most solvents, UV light, moisture and temperature extremes. As with all adhesives, the final bond strength is dependent on the cleanliness of the mating surface. It is recommended that this mating surface is clean, dry, and offers a good unified fit to the motor backing-plate (on which the self-adhesive pad is stuck). Spring PCB vibrator motors have spring-loaded fingers on the motor which mat with pads on the PCB. This makes assembly easier for applications where it's desired to have the motor mounted to the enclosure. Also, higher frequency harmonics are absorbed and reduced by the rubber 'boots' that enclose these kinds of motors. If extra security is required, consider the mounding securing walls within the enclosure body. This technique is commonly used in mobile phones to ensure that the maximum amount of vibration is transmitted through the case.

CHAPTER 5

SOFTWARE REQUIREMENTS

5.1 Google cloud

Google Cloud offers two computer vision products that use machine learning to help us understand images with industry-leading prediction accuracy. Those are

1. AutoML Vision
2. Vision API

5.1.1 AutoML Vision

Automate the training of user's own custom machine learning models. Simply upload images and train custom image models with AutoML Vision's easy-to-use graphical interface optimize user models for accuracy, latency, and size; and export them to user application in the cloud, or to an array of devices at the edge.

5.1.2 Vision API

Google Cloud's Vision API offers powerful pre-trained machine learning models through REST and RPC APIs. Assign labels to images and quickly classify them into millions of predefined categories. Detect objects and faces, read printed and handwritten text, and build valuable metadata into user image catalog.

5.1.3 Benefits of Google Cloud

1. **Detect objects automatically** Vision API and AutoML Vision both can detect and extract multiple objects, and provide information about each object including its position within the image.
2. **Gain intelligence at the edge** Use AutoML Vision Edge to build and deploy fast, high-accuracy models to classify images at the edge, and trigger real-time actions

based on local data. AutoML Vision Edge supports a variety of edge devices where resources are constrained and latency is critical.

3. **Use our data labeling service** If user have images for AutoML Vision that aren't yet labeled, Google has a team of people that can help user annotate images, videos, and text to get high-quality training data.

4. **Reduce purchase friction** With Vision API's vision product search, retailers can create an engaging mobile experience that enables user's customers to upload a photo of an item and immediately see a list of similar items for purchase from user.

5. **Understand text and act on it** Vision API uses OCR to detect text within images in more than 50 languages and various file types. It's also part of Document Understanding AI, which lets user process millions of documents quickly and automate business workflows.

6. **Detect explicit content** Vision API can review user images and estimate the likelihood that any given image includes adult content, violence, and more.

5.1.4 Features of Google Cloud Vision API

1. Use REST and RPC APIs.
2. Classify images using predefined labels - Pre-trained models leverage vast libraries of predefined labels.
3. Use Google's data labeling service - Annotate images, videos, and text
4. Detect objects - Detect objects, where they are, and how many.
5. Enable vision product search - Compare photos to images in users product catalog, and return a ranked list of similar items.
6. Detect printed and handwritten text - Use OCR and automatically identify language.
7. Detect faces - Detect faces and facial attributes. (Face recognition not supported.)
8. Identify popular places and product logos - Automatically identify well known landmarks and product logos.

9. Assign general image attributes - Detect general attributes and appropriate crop hints.
10. Detect web entities and pages - Find news events, logos, and similar images on the web.
11. Moderate content - Detect explicit content (adult, violent, etc.) within images.

5.2 Google cloud text-to-speech

Google Cloud Text-to-Speech converts text into human-like speech in more than 100 voices across 20+ languages and variants. It applies groundbreaking research in speech synthesis (WaveNet) and Google's powerful neural networks to deliver high-fidelity audio. With this easy-to-use API, user can create lifelike interactions with the users that transform customer service, device interaction, and other applications.

5.2.1 Cloud Text-to-Speech features

1. **Multilingual:** Supports 100+ voices across 20+ languages and variants, with more to come so on.
2. **Wave Net Voices:** Exclusive multilingual access to Deep Mind Wave Net voices that provide the most natural-sounding speech.
3. **Text and SSML Support:** Customize user's speech with SSML tags that allow user to add pauses, numbers, date and time formatting, and other pronunciation instructions.
4. **Speaking Rate Tuning:** Customize user's speaking rate to be 4x faster or slower than the normal rate.
5. **Pitch Tuning:** Customize the pitch of user's selected voice, up to 20 semitones more or less than the default output.
6. **Volume Gain Control:** Increase the volume of the output by up to 16db or decrease the volume up to -96db.
7. **Audio Format Flexibility:** Choose from a number of audio formats including mp3, Linear16, and Ogg Opus.
8. **Audio Profiles:** Optimize for the type of speaker from which user's speech is intended to play, such as headphones or phone lines.

5.3 Open CV

OpenCV (Open source computer vision) is a library of programming functions mainly aimed at real-time computer vision. Originally developed by Intel, it was later supported by Willow Garage then Itseez (which was later acquired by Intel). The library is cross-platform and free for use under the open-source BSD license.

OpenCV supports the deep learning frameworks Tensor Flow, Torch/Pytorch and Caffe. OpenCV is written in C++ and its primary interface is in C++, but it still retains a less comprehensive though extensive older C interface. There are bindings in Python, Java and MATLAB/OCTAVE. The API for these interfaces can be found in the online documentation. Wrappers in other languages such as C#, Perl, Ch, Haskell, and Ruby have been developed to encourage adoption by a wider audience. All of the new developments and algorithms in Open CV are now developed in the C++ interface.

5.4 PHP (Hypertext Preprocessor)

The PHP software works with the web server, which is the software that delivers web pages to the world. When user types a URL into web browser's address bar. User is now sending a message to the web server at that URL, asking it to send user an HTML file. The web server responds by sending the requested file. The browser reads the HTML file and displays the web page. When the person clicks on link in a web page a request for the file from web server is made. In addition, the web server processes a file when user click a web page button that submits a form. This process is essentially the same when PHP is installed. User requests a file, the web server happens to be running PHP, and it sends HTML back to the browser, thanks to the programming in PHP. More specifically, when PHP is installed, the web server is configured to expect certain file extensions to contain PHP language statements. Often the extension is .php or .phtml, but any extension can be used. When the web server gets a request for a file with the designated extension, it sends the HTML statements as is, but PHP statements are processed by the PHP software before they're sent to the requester. When PHP language statements are processed, only the output, or anything printed to the screen is sent by the web server to the web browser. The

PHP language statements, those that don't produce any output to the screen, aren't included in the output sent to the browser, so the PHP code is not normally seen by the user.

5.5 MYSQL

MySQL is a freely available open source Relational Database Management System (RDBMS) that uses Structured Query Language (SQL).SQL is the most popular language for adding, accessing and managing content in a database. It is most noted for its quick processing, proven reliability, ease and flexibility of use. MySQL is an essential part of almost every open source PHP application. Good examples for PHP & MySQL-based scripts are WordPress, Joomla, Magento and Drupal. One of the most important things about using MySQL is to have a MySQL specialized host.

MySQL can be built and installed manually from source code, but it is more commonly installed from a binary package unless special customizations are required. On most Linux distributions, the package management system can download and install MySQL with minimal effort, though further configuration is often required to adjust security and optimization settings. Though MySQL began as a low-end alternative to more powerful proprietary databases, it has gradually evolved to support higher-scale needs as well. It is still most commonly used in small to medium scale single-server deployments, either as a component in a LAMP-based web application or as a standalone database server. Much of MySQL's appeal originates in its relative simplicity and ease of use, which is enabled by an ecosystem of open source tools such as phpMyAdmin. In the medium range, MySQL can be scaled by deploying it on more powerful hardware, such as a multi-processor server with gigabytes of memory.

There are, however, limits to how far performance can scale on a single server ('scaling up'), so on larger scales, multi-server MySQL ('scaling out') deployments are required to provide improved performance and reliability. A typical high-end configuration can include a powerful master database which handles data write operations and is replicated to multiple slaves that handle all read operations. The master server continually pushes binlog events to connected slaves so in the event of failure a slave can be promoted to become the new master, minimizing downtime. Further improvements in

performance can be achieved by caching the results from database queries in memory using memcached, or breaking down a database into smaller chunks called shards which can be spread across a number of distributed server clusters.

5.6 PHYTHON

Python is an interpreted, object-oriented programming language similar to PERL, that has gained popularity because of its clear syntax and readability. Python is said to be relatively easy to learn and portable, meaning its statements can be interpreted in a number of operating systems, including UNIX-based systems, Mac OS, MS-DOS, OS/2, and various versions of Microsoft Windows 98. Python was created by Guido van Rossum, a former resident of the Netherlands, whose favorite comedy group at the time was Monty Python's Flying Circus. The source code is freely available and open for modification and reuse. Python has a significant number of users. A notable feature of Python is its indenting of source statements to make the code easier to read. Python offers dynamic data type, ready-made class, and interfaces to many system calls and libraries. It can be extended, using the C or C++ language. Python can be used as the script in Microsoft's Active Server Page (ASP) technology. The scoreboard system for the Melbourne (Australia) Cricket Ground is written in Python. Z Object Publishing Environment, a popular Web application server, is also written in the Python language.

Its high-level built in data structures, combined with dynamic typing and dynamic binding, make it very attractive for Rapid Application Development, as well as for use as a scripting or glue language to connect existing components together. Python's simple, easy to learn syntax emphasizes readability and therefore reduces the cost of program maintenance. Python supports modules and packages, which encourages program modularity and code reuse. The Python interpreter and the extensive standard library are available in source or binary form without charge for all major platforms, and can be freely distributed. Often, programmers fall in love with Python because of the increased productivity it provides. Since there is no compilation step, the edit-test-debug cycle is incredibly fast. Debugging Python programs is easy: a bug or bad input will never cause a segmentation fault. Instead, when the interpreter discovers an error, it raises an exception. When the program doesn't catch the exception, the interpreter prints a stack trace. A source level debugger allows inspection of local and global variables, evaluation of

arbitrary expressions, setting breakpoints, stepping through the code a line at a time, and so on. The debugger is written in Python itself, testifying to Python's introspective power. On the other hand, often the quickest way to debug a program is to add a few print statements to the source: the fast edit-test-debug cycle makes this simple approach very effective.

5.7 MACHINE LEARNING

Machine learning (ML) is the study of algorithms and mathematical models that computer systems use to progressively improve their performance on a specific task. Machine learning algorithms build a mathematical model of sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to perform the task.

Machine learning algorithms are used in the applications of email filtering, detection of network intruders, and computer vision, where it is infeasible to develop an algorithm of specific instructions for performing the task. Machine learning is closely related to computational statistics, which focuses on making predictions using computers. The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning. Data mining is a field of study within machine learning, and focuses on exploratory data analysis through unsupervised learning.

Machine learning tasks are classified into several broad categories. In supervised learning, the algorithm builds a mathematical model of a set of data that contains both the inputs and the desired outputs. For example, if the task were determining whether an image contained a certain object, the training data for a supervised learning algorithm would include images with and without that object (the input), and each image would have a label (the output) designating whether it contained tehe object. In special cases, the input may be only partially available, or restricted to special feedback.[clarification needed] Semi-supervised learning algorithms develop mathematical models from incomplete training data, where a portion of the sample inputs are missing the desired output

Supervised machine learning algorithms can apply what has been learned in the past to new data using labeled examples to predict future events. Starting from the

analysis of a known training dataset, the learning algorithm produces an inferred function to make predictions about the output values. The system is able to provide targets for any new input after sufficient training. The learning algorithm can also compare its output with the correct, intended output and find errors in order to modify the model accordingly.

In contrast, unsupervised machine learning algorithms are used when the information used to train is neither classified nor labeled. Unsupervised learning studies how systems can infer a function to describe a hidden structure from unlabeled data. The system doesn't figure out the right output, but it explores the data and can draw inferences from datasets to describe hidden structures from unlabeled data.

Semi-supervised machine learning algorithms fall somewhere in between supervised and unsupervised learning, since they use both labeled and unlabeled data for training – typically a small amount of labeled data and a large amount of unlabeled data. The systems that use this method are able to considerably improve learning accuracy. Usually, semi-supervised learning is chosen when the acquired labeled data requires skilled and relevant resources in order to train it / learn from it. Otherwise, acquiring unlabeled data generally doesn't require additional resources.

Reinforcement machine learning algorithms is a learning method that interacts with its environment by producing actions and discovers errors or rewards. Trial and error search and delayed reward are the most relevant characteristics of reinforcement learning. This method allows machines and software agents to automatically determine the ideal behavior within a specific context in order to maximize its performance. Simple reward feedback is required for the agent to learn which action is best; this is known as the reinforcement signal.

Machine learning enables analysis of massive quantities of data. While it generally delivers faster, more accurate results in order to identify profitable opportunities or dangerous risks, it may also require additional time and resources to train it properly. Combining machine learning with AI and cognitive technologies can make it even more effective in processing large volumes of information.

CHAPTER 6

METHEDOLOGY

6.1 Main Block Diagram

The below figure 6.1 gives the overall view of the project

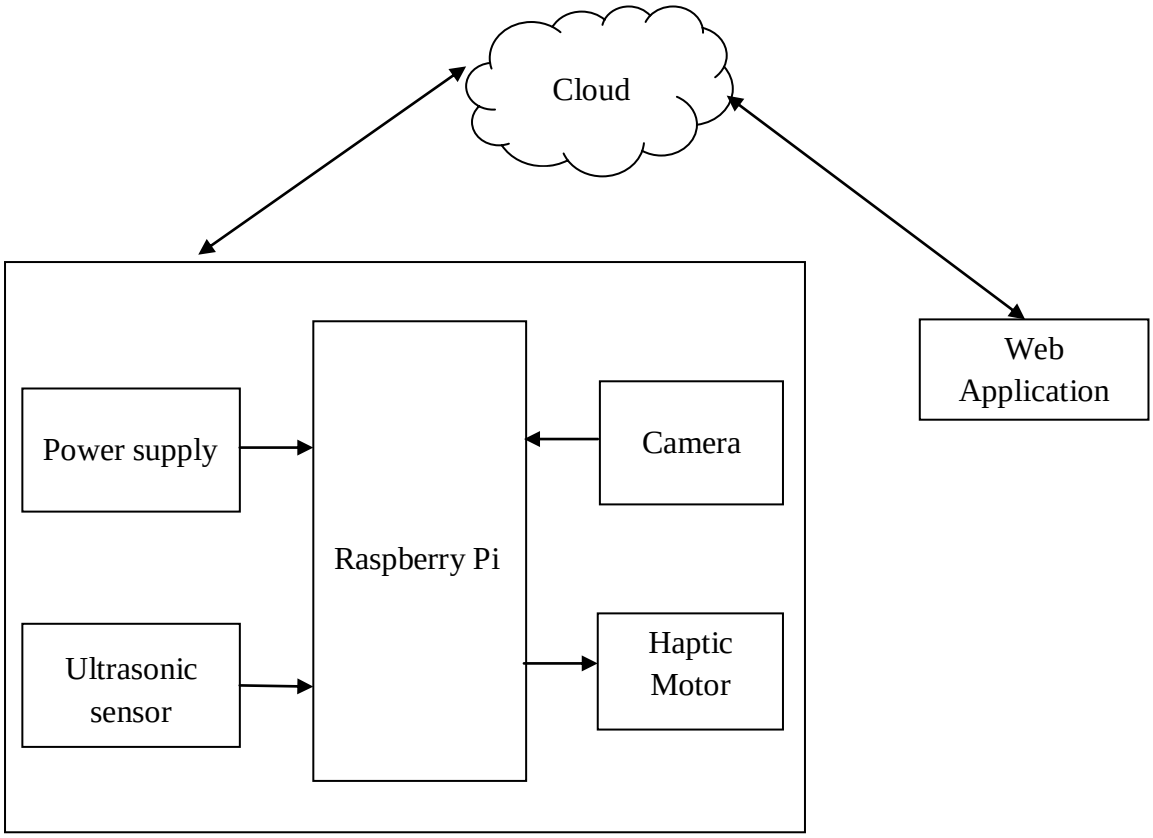

Figure 6.1 Main Functional Block Diagram

In this project Raspberry powered by batteries is used for the armband, and a mobile device for sending voice input to the Pi and for vocalizing the audio feedback. Using a custom armband with embedded cellphone vibration motors (Haptic motors) and an integrated camera, our device could locate objects upon a user's request, and then guide them to the actual object through directional haptic feedback (if the object is to the left of the user, the motors on the left side of the arm vibrate, etc.) as shown in figure 6.1.

6.2 Object detection

The below figure 6.2 explains about the work flow of object detection using raspberry pi through YOLO Object Detection algorithm.

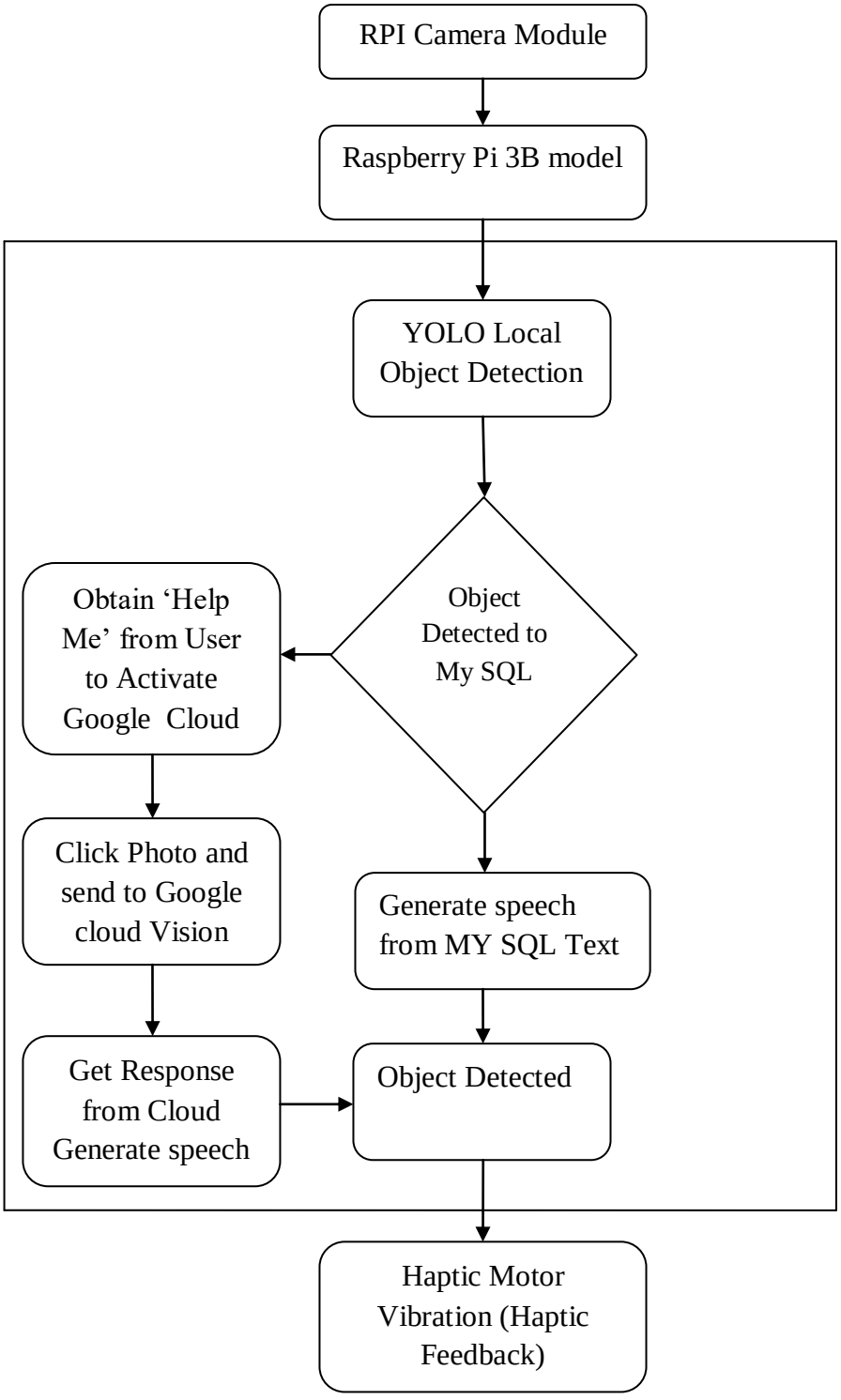

Figure 6.2 Object Detection Work Flow Diagram

Pi camera takes the image and then that image is processed by YOLO object detection algorithm. Now a single neural network is applied to the full image. This network divides the image into regions and predicts bounding boxes and probabilities for each region. These bounding boxes are weighted by the predicted probabilities. The labels and the location of the divided image are sent to the database through MySQL queries. If the labels and location of the sent image matches with the pre trained database then MySQL text is converted into speech and the location of the object is given whether it is on right side or on left side of the visually impaired.

If the image sent does not match with the pre trained images in the database then the Google cloud vision is activated by the wake word "Help Me". Once the Google cloud vision is activated the image is sent to the cloud server where Vision API can detect and extract multiple objects and provide information about each object including its position in the image. The position of the image is given by google vision speech synthesizer where the text to speech conversion is done and audio output is given.

Once the object is detected the user waits for haptic feedback. For haptic feedback mechanism the video frame is divided into two equal halves that are left and right side. If the object detected is on left side of the video frame then left haptic motor will vibrate and if the object detected is on right side of the video frame then right haptic motor will vibrate.

6.2.1 YOLO (You only look once)

You only look once (YOLO) is a system for detecting objects on the Pascal VOC 2012 dataset. It can detect the 20 Pascal object classes:

- person
- bird, cat, cow, dog, horse, sheep
- Aero plane, bicycle, boat, bus, car, motorbike, train
- bottle, chair, dining table, potted plant, sofa, tv/monitor.

6.2.1.1 Working of YOLO

All prior detection systems repurpose classifiers or localizers to perform detection. They apply the model to an image at multiple locations and scales. High scoring regions of the image are considered detections. YOLO uses a totally different approach. It applies a single neural network to the full image. This network divides the image into regions and predicts bounding boxes and probabilities for each region. These bounding boxes are weighted by the predicted probabilities. Finally, it can threshold the detections by some value to only see high scoring detections. The below figure 6.3 shows the bounding boxes for YOLO object detection.

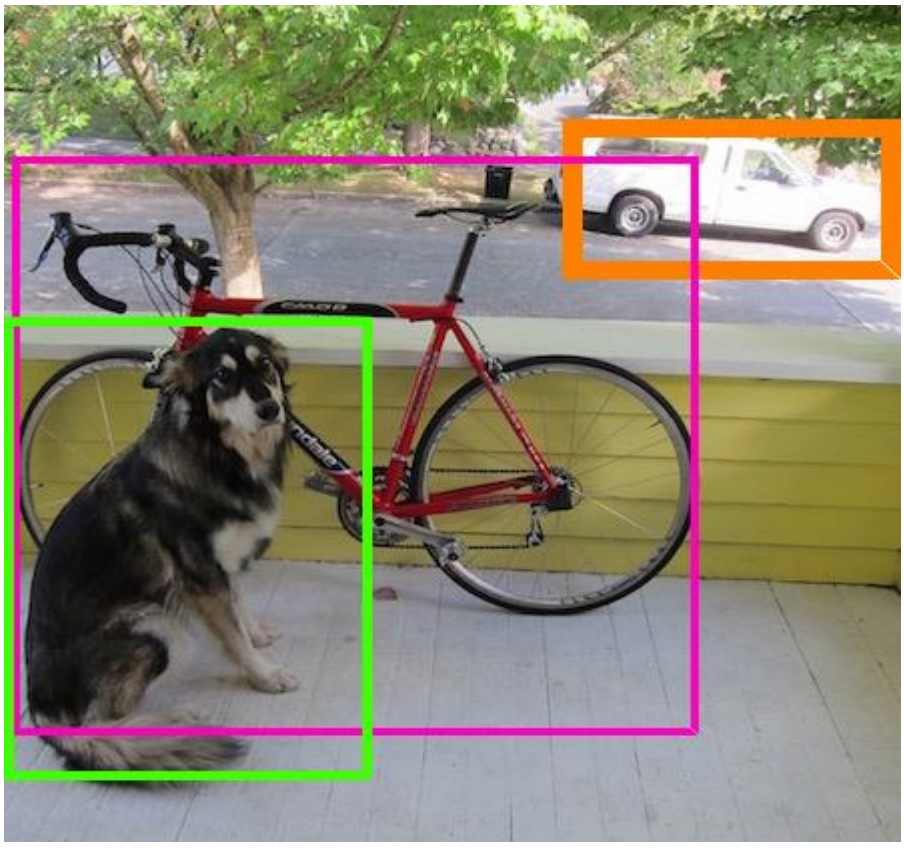

Figure 6.3 Object detection using YOLO

This model has several advantages over classifier-based systems. It looks at the whole image at test time so its predictions are informed by global context in the image. It also makes predictions with a single network evaluation unlike systems like R-CNN which require thousands for a single image.

6.2.1.2 Advantages of YOLO Algorithm

1. YOLO is its superb speed – it's incredibly fast and can process 45 frames per second.
2. YOLO also understands generalized object representation. This is one of the best algorithms for object detection.

6.2.1.3 Disadvantages of YOLO Algorithm

1. Struggles for detection of small objects that appear in image.
2. Incorrect localization of object.

6.3 Facial Recognition

A face recognition dataset is necessary for building a face encodings file to use with our Python + OpenCV + Raspberry Pi face recognition method.

Before applying face recognition first need to gather the dataset of example images that has to be recognized.

There are a number of ways to gather such images, including:

1. Performing face enrollment by using a camera + face detection to gather example faces

2. Using various APIs (ex., Google, Facebook, Twitter, etc.) to automatically download example faces.

3. Manually collecting the images

Beginning with capturing input frames from our Raspberry Pi, the workflow consists of detecting faces, computing embeddings, and comparing the vector to the database via a voting method. Open CV, dlib, and face recognition are required for this face recognition method. A deep neural network is used to compute a 128-d vector (i.e., a list of 128 floating point values) that will quantify each face in the dataset.

The below figure 6.4 explains about the work flow of facial recognition using raspberry pi through Haar cascade algorithm.

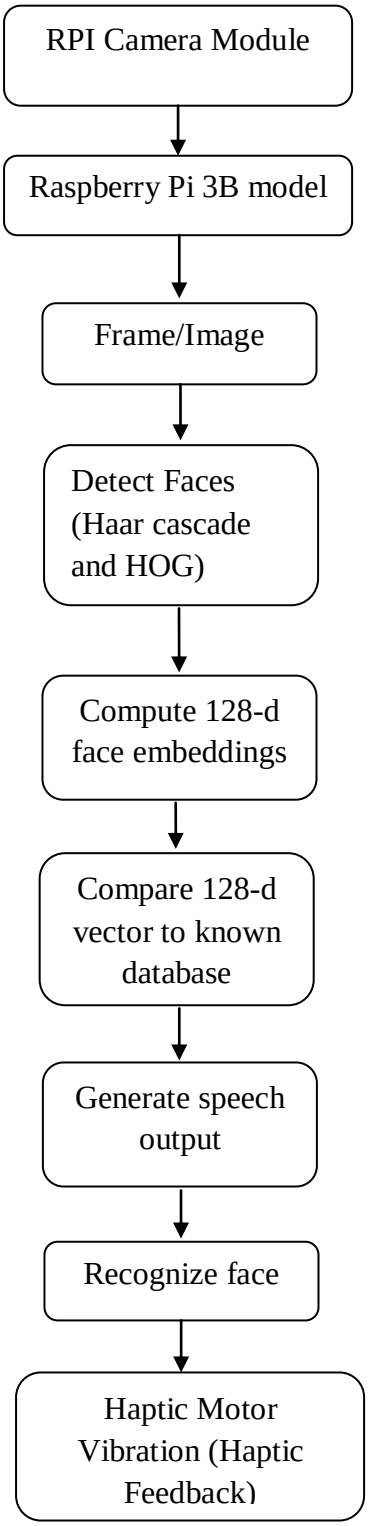

Figure 6.4 Face Detection Workflow Diagram

Once the person is recognized the user waits for haptic feedback. For haptic feedback mechanism the video frame is divided into two equal halves that are left and

right side. If the person recognized is on left side of the video frame then left haptic motor will vibrate and if the person recognized is on right side of the video frame then right haptic motor will vibrate.

6.3.1 Haar Cascade Algorithm

A Haar-like feature considers adjacent rectangular regions at a specific location in a detection window, sums up the pixel intensities in each region and calculates the difference between these sums.

This difference is then used to categorize subsections of an image. For example, an image database with human faces is present. It is a common observation that among all faces the region of the eyes is darker than the region of the cheeks. Therefore a common Haar feature for face detection is a set of two adjacent rectangles that lie above the eye and the cheek region. The position of these rectangles is defined relative to a detection window that acts like a bounding box to the target object (the face in this case).

6.3.1.1 DEFIN1TION: Haar Cascade is a machine learning object detection algorithm used to identify objects in an image or video where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images.

6.3.1.2 STAGES IN ALGORITHM:

The algorithm has four stages:

1. Haar Feature Selection
2. Creating Integral Images
3. Ad boost Training
4. Cascading Classifiers

Able to detect faces and body parts in an image, but can be trained to identify almost any object.

Let’s take face detection as an example. Initially, the algorithm needs a lot of positive images of faces and negative images without faces to train the classifier. Then features are extracted from it.

Stage 1: Haar Feature Selection

To collect the Haar Features. A Haar feature considers adjacent rectangular regions at a specific location in a detection window, sums up the pixel intensities in each region and calculates the difference between these sums. The below figure 6.5 show the Haar feature selection types.

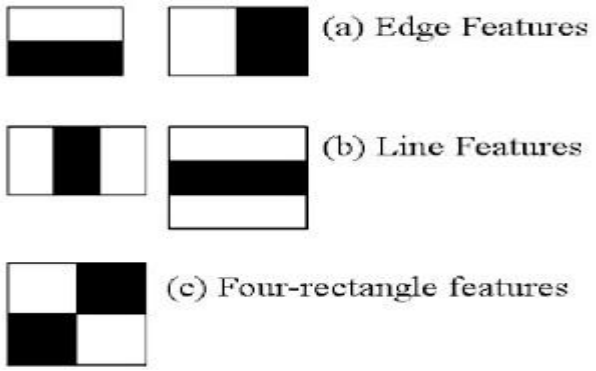

Figure 6.5 Four Haar feature types

Stage2: Creating Integral Images

An integral image is summed-area table is a data structure and algorithm for quickly and efficiently generating the sum of values in a rectangular subset of a grid.

For example, consider the image below. Top row shows two good features. The first feature selected seems to focus on the property that the region of the eyes is often darker than the region of the nose and cheeks. The second feature selected relies on the property that the eyes are darker than the bridge of the nose. But the same windows applying on cheeks or any other place is irrelevant. The below figure 6.6 shows the Creating integral of image

Figure 6.6 Creating integral images

Stage 3: Ad boost Training

Problems in machine learning often suffer from the curse of dimensionality each sample may consist of a huge number of potential features (for instance, there can be 162,336 Haar features, as used by the Viola–Jones object detection framework, in a 24×24 pixel image window), and evaluating every feature can reduce not only the speed of classifier training and execution, but in fact reduce predictive power, per the Hughes. Effect Unlike neural networks and SVMs, the AdaBoost training process selects only those features known to improve the predictive power of the model, reducing dimensionality and potentially improving execution time as irrelevant features need not be computed.

During the detection phase, a window of the target size is moved over the input image, and for each subsection of the image and Haar features are calculated. It can be seen in action in the video below. This difference is then compared to a learned threshold that separates non-objects from objects. Because each Haar feature is only a "weak classifier" (its detection quality is slightly better than random guessing) a large number of Haar features are necessary to describe an object with sufficient accuracy and are therefore organized into cascade classifiers to form a strong classifier.

Stage 4: Cascading Classifiers

The below figure 6.7 explains the stages of cascade classifier.

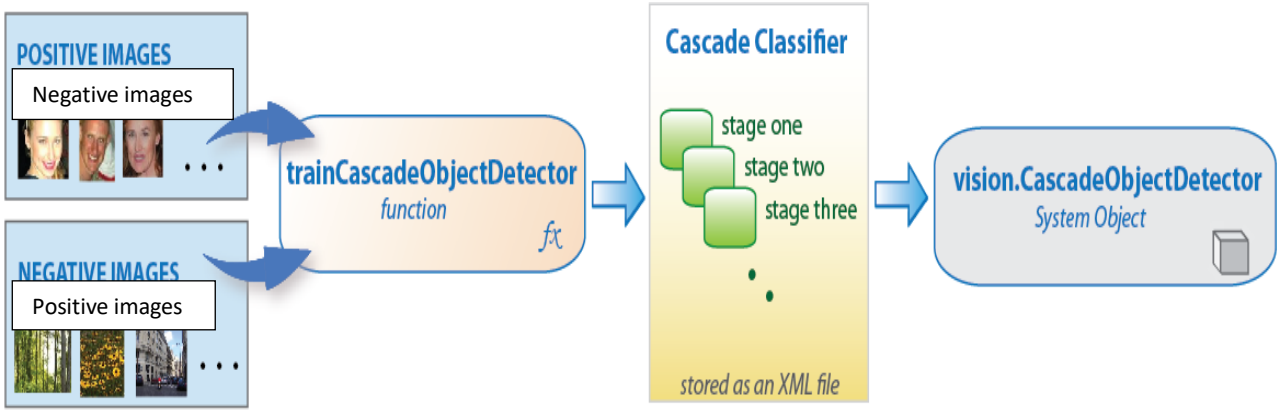

Figure 6.7 The stages of cascade classifier

The cascade classifier consists of a collection of stages, where each stage is an ensemble of weak learners. The weak learners are simple classifiers called decision stumps. Each stage is trained using a technique called boosting. Boosting provides the ability to train a

highly accurate classifier by taking a weighted average of the decisions made by the weak learners.

Each stage of the classifier labels the region defined by the current location of the sliding window as either positive or negative. Positive indicates that an object was found and negative indicates no objects were found. If the label is negative, the classification of this region is complete, and the detector slides the window to the next location. If the label is positive, the classifier passes the region to the next stage. The detector reports an object found at the current window location when the final stage classifies the region as positive.

The stages are designed to reject negative samples as fast as possible. The assumption is that the vast majority of windows do not contain the object of interest. Conversely, true positives are rare and worth taking the time to verify.

- A true positive occurs when a positive sample is correctly classified.
- A false positive occurs when a negative sample is mistakenly classified as positive.
- A false negative occurs when a positive sample is mistakenly classified as negative.

To work well, each stage in the cascade must have a low false negative rate. If a stage incorrectly labels an object as negative, the classification stops, and user cannot correct the mistake. However, each stage can have a high false positive rate. Even if the detector incorrectly labels a non-object as positive, user can correct the mistake in subsequent stages. Adding more stages reduces the overall false positive rate, but it also reduces the overall true positive rate.

Cascade classifier training requires a set of positive samples and a set of negative images. User must provide a set of positive images with regions of interest specified to be used as positive samples. User can use the Image Labeler to label objects of interest with bounding boxes. The Image Labeler outputs a table to use for positive samples. User also must provide a set of negative images from which the function generates negative samples automatically. To achieve acceptable detector accuracy, set the number of stages, feature type, and other function parameters.

The below figure 6.8 shows the facial recognition using Haar cascade algorithm.

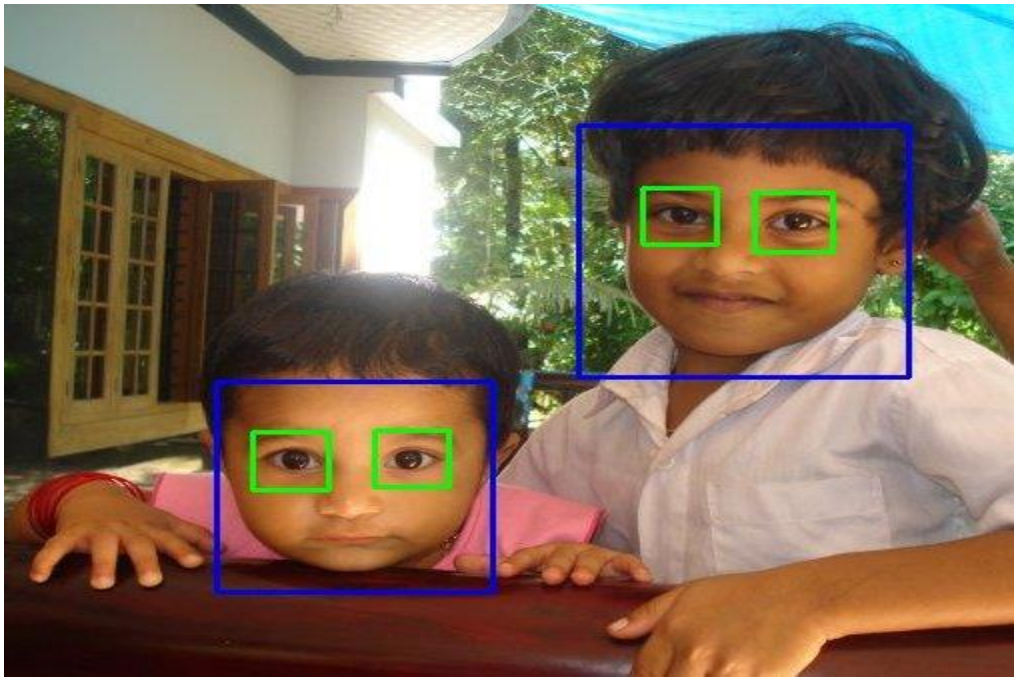

Figure 6.8 Haar Cascade Algorithm for Face Recognition

Each and every feature on all the training images. For each feature, it finds the best threshold which will classify the faces to positive and negative. But obviously, there will be errors or misclassifications. Haar cascade selects the features with minimum error rate, which means they are the features that best classifies the face and non-face images.

CHAPTER 7

RESULTS

1. The blind user would be able to navigate the surrounding independently with the help of this smart armband. The user would be able to identify the objects around him and the user will also get the guidance to grab the object through haptic feedback.
2. The user would be able to identify the person he/she has met earlier through facial recognition.
3. Our device aims to be the ultimate solution and a smart device that would help the blinds and visually impaired to carry on with the daily routine.

7.1 Snapshots of Project

The below figure 7.1 shows the project setup model.

Figure 7.1 Project Setup Model

The below figure 7.2 shows the notification panel of the project.

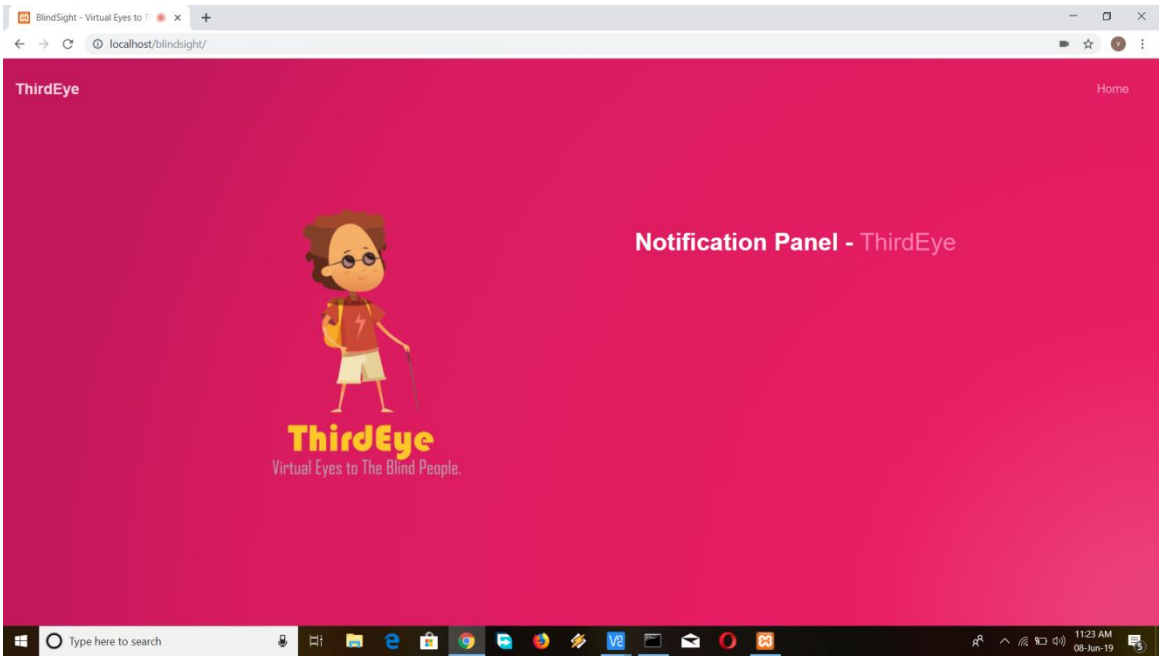

Figure 7.2 Snapshot of Notification Panel

The below figures 7.3(a) and 7.3(b) shows the results of Object Detection.

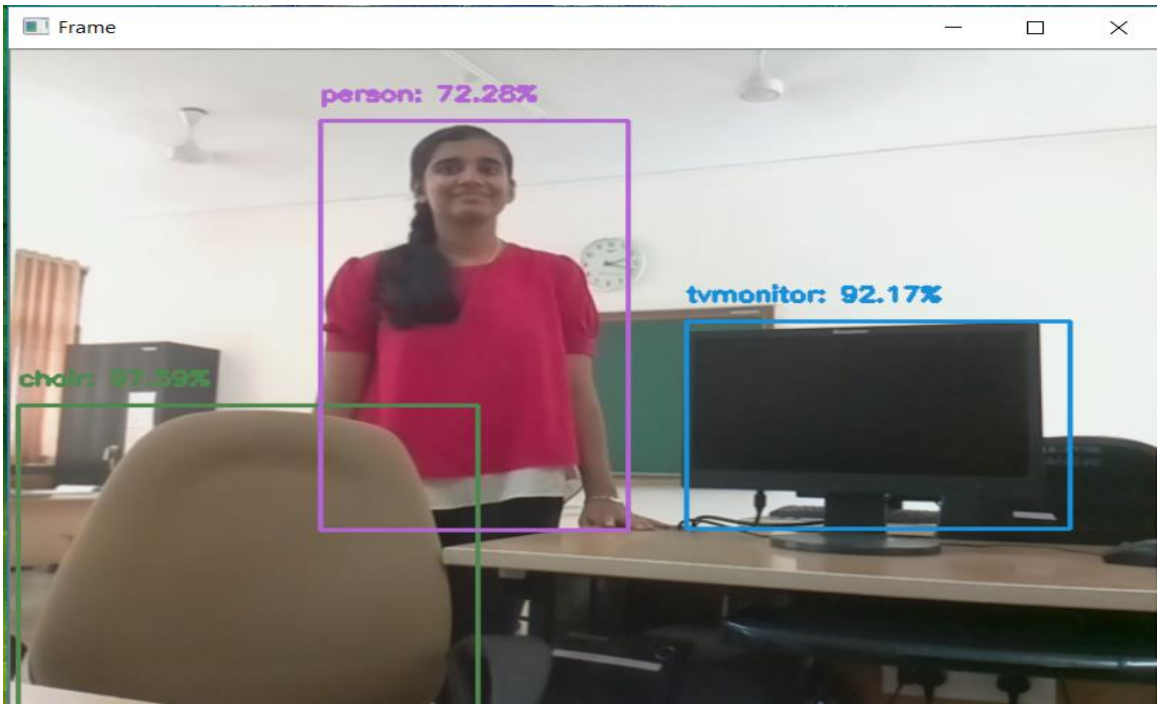

Figure 7.3(a) Results of Object Detection

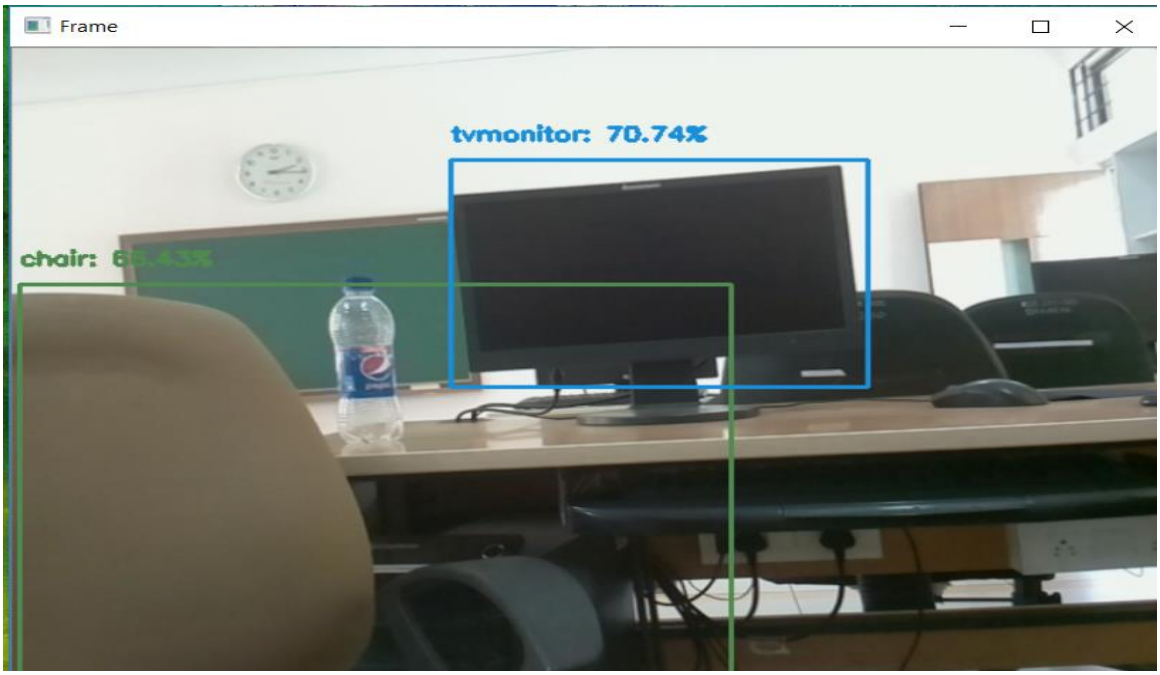

Figure 7.3(b) Results of Object Detection

The below figures 7.4(a) and 7.4(b) shows the results of Facial Recognition.

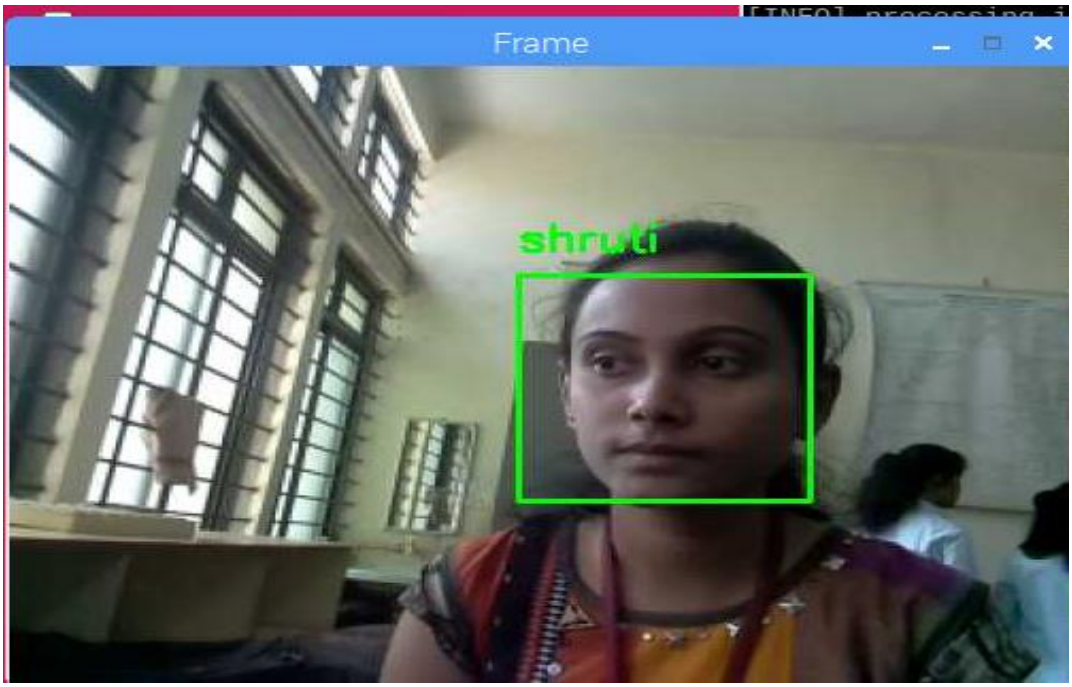

Figure 7.4(a) Results of Facial Recognition

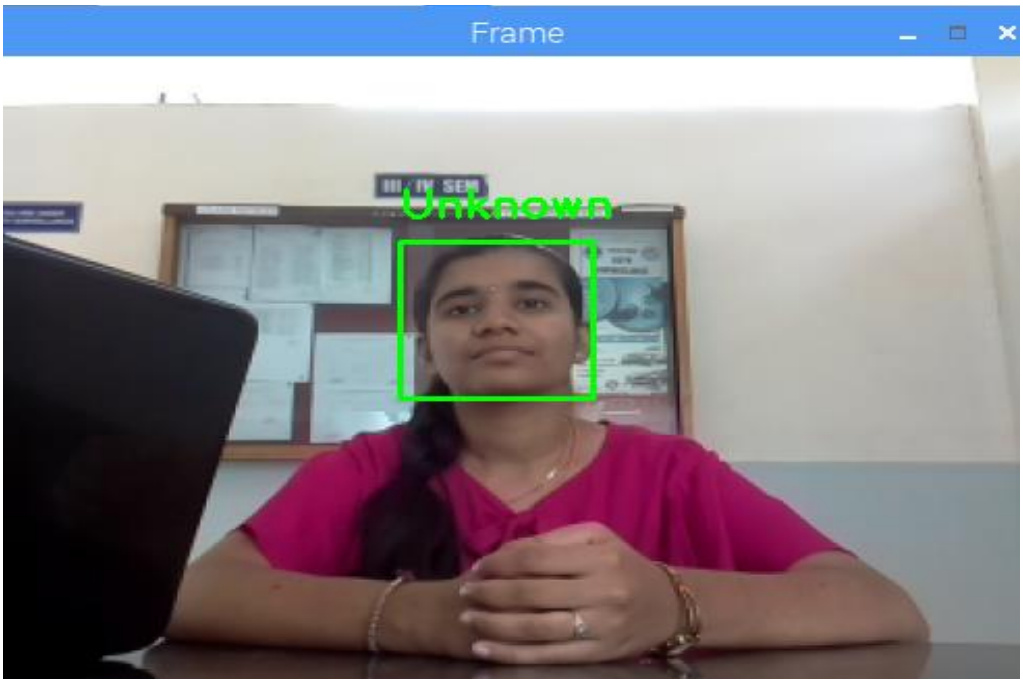

Figure 7.4(b) Results of Facial Recognition

CHAPTER 8

ADVANTAGES AND DISADVANTAGES

8.1 ADVANTAGES

1. This project helps the user to identify the misplaced objects by object detection through “Haptic feedback” and also assist through Armband to reach the objects.
2. By this user can able to recognize the person he/she has met earlier from facial recognition.
3. It will facilitate ease way to recognize the objects and persons.

8.2 DISADVANTAGES

1. The smart assistance is provided in web page form, a blind user must continuously hold their device out in front of them, an awkward pose to maintain for long periods of time.
2. Strong Wi-Fi connection is required to operate between the mobile application and processor.
3. Short range i.e. the assistance is restricted only to the area which the camera module is able to cover.

CONCLUSION

Design and development of a Smart assistive armband through haptic feedback for visually impaired and blind people using Machine learning has been discussed. The system performed three main tasks of Face recognition, object detection and assisting the user through haptic feedback and allowing the user to perform his daily routine independently. Using devices like a smartphone and compact but high quality hardware, our system managed to overcome the hurdle of developing an assistive system which was both efficient and affordable enough for the visually impaired people especially belonging to the middle class families. Future research work involves refining our system so that a more hands free assistive system experience can be provided for the visually disabled people.

FUTURE SCOPE

1. Future work involves refining our system so that a more hands free assistive system experience can be provided for the visually disabled people.
2. Easy switching of the modes between the objection detection mode to the facial recognition mode through a button or through audio input that is by using a particular word as a wake word for the switching purpose.
3. Powering the raspberry pi with the rechargeable batteries so that the batteries can be recharged and one more update is providing the wireless charging for the batteries by using Qi wireless charging.
4. Another future update is text reading that is reading the texts just by observing the posters and the sign boards for the blinds.

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