KLE Technological University

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Electronics and Communication Engineering

Mini Project Report

on

Navigation Assistance for the Visually Impaired

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Semester: V, 2021-2022

Under the Guidance of

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K.L.E SOCIETY'S
KLE Technological University,
HUBBALLI-580031
2021-2022

SCHOOL OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that project entitled " **Navigation Assistance for the Visually Impaired** " is a bonafide work carried out by the student team of "**Govind Madhva (01FE19BEC247)**, **Yash Mahale (01FE19BEC265)**,**Sandeep P (01FE19BEC269)**, **Bharat Gunhalkar (01FE19BEC274)**". The project report has been approved as it satisfies the requirements with respect to the mini project work prescribed by the university curriculum for BE (V Semester) in School of Electronics and Communication Engineering of KLE Technological University for the academic year 2021-2022.

N C Iyer

Dr.Sujata.S.Kotabagi	**Dr.Nalini C. Iyer**	**N. H. Ayachit**
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External Viva:

Name of Examiners **Signature with date**

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ACKNOWLEDGMENT

We would like to express our gratitude to our institute, KLE Technological University, Hubballi, for providing us with the necessary materials to accomplish our project, ”Navigation using Object Detection and Avoidance for Visually Impaired.” We deeply thank our guide, Dr. Sujata. S. Kotabagi, for entrusting us with this project, as well as the dean of the School of Electronics and Communication, Dr. Nalini. Iyer, for steering us in the proper way with this industrial-scale project. We would want to thank our guide for assisting us in achieving complete success in our project and continuous encouragement. We’d like to express our heartfelt gratitude to the Prakalp team for their recommendations and assistance. We’d also like to express our gratitude to our guardians for their unwavering support in ensuring the success of our project. Finally, we’d want to express our gratitude to those who have indirectly assisted us in obtaining the delight of project completion.

-Bharat G, Yash M, Sandeep P, Govind M

ABSTRACT

Visually impaired people confront numerous challenges in their daily lives. Due to traffic, constantly changing terrain, and increasing population density, mobility, or moving from one area to another, is a difficult endeavor. The team has offered a solution to help visually impaired persons move about more easily in this project. The solution comprises of a product that assists visually impaired people in getting from point A to point B. Object recognition by camera and obstacle avoidance via ultrasonic sensors are used to accomplish this navigation. After testing it in real-life circumstances, the product has shown positive results.

Contents

List of Tables

List of Figures

Chapter 1

Introduction

Humans who are not blind can go out and accomplish their daily tasks with ease, while the visually impaired, who have a lower quality of life, cannot. Some of the most basic activities become the most difficult. As a result, there have long been technologies in use that were assumed to be the most cost-effective yet were not reliable. When we think about assistive technology for the visually impaired, the first thing that springs to mind is the blind stick. Because of its low cost and portability, the white cane has long been the most common and basic tool for identifying impediments. It allows the user to scan the area in front of them and detect obstacles on the ground such as holes, steps, walls, uneven surfaces, and so on. However, it can only detect obstacles up to knee-level. It can only detect objects within a range of 1-2 feet. Certain hazards (for example, jutting windowpanes, high platforms, a moving vehicle, and horizontal bars) are not detectable until they are dangerously close to the individual. Even professional dog guides are capable of guiding these individuals, but they are unable to notice potentially dangerous impediments at head level. The average lifespan of a guide dog is 6 years, which necessitates ongoing dog care expenses and lifestyle changes.

According to [1], there is a real-time obstacle identification and avoidance system for autonomous navigation of mobile robots in an unstructured environment using a stereo camera. Autonomous navigation of mobile robots necessitates the following: a) precise determination of the robot's position and orientation; and b) precise determination of the size, shape, depth, and range of potential impediments in the environment. For long-range operation, a simple kinematic model is employed, and a stereo camera with pan and tilt capability is examined. The stereo matching algorithm and the triangulation method are used to obtain a complete 3D reconstruction of the object/obstacle. This method employs cutting-edge technologies and equipment to assist visually impaired individuals.

1.1 Motivation

Nothing should be impossible in today's technology environment. However, the fact that millions of people are blind should serve as motivation for us to work more to improve their lives. The medical business is moving at a breakneck pace, with new discoveries being made every second. However, some of them are simply beyond of reach for the average person. There is a need for a technology that can provide a better quality of life for the million blind people while also being affordable. We chose this topic for the reasons stated above, and designed a gadget that can impact the lives of those around us and make a difference.

1.2 Literature survey

1) K. Rajan , E. Kalaiselvan, 2015, Intelligent Navigation System for Blind People with Real Time Tracking, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) NCEASE – 2015 (Volume 3 – Issue 22) [2],
The user's location in the building is determined using a system called "Roshni," which uses audio messages and keys on the mobile unit to navigate. It employs ultrasonic modules mounted at regular intervals on the ceiling to determine the user's position using sonar technology. This system is lightweight, simple to use, and unaffected by changes in the surroundings. However, because it requires a thorough inside map of the structure, this technology is confined to indoor navigation.

2) "BLIND ASSISTANCE SYSTEM: REAL-TIME OBJECT DETECTION USING TENSORFLOW WITH DISTANCE AND VOICE(PART-1)" YouTube, uploaded by beingryaan, 31 May 2020, https://www.youtube.com/watch?v=3BXIuU2AcGg&t=732s
In this YouTube video the author demonstrates object detection with voice feedback. It is a step-by-step guide on how to prepare the environment for object detection on laptop. On the software part he implements the code using python3 and latest versions of the packages needed. The algorithm calculates the average distance between the object detected and the camera. He uses SSD Architecture i.e., Single Shot detection along with depth estimation. SSD is a most suitable as it provides a better trade-off between the speed and accuracy.

3) C. K. Lakde and P. S. Prasad, "Navigation system for visually impaired people," 2015 International Conference on Computation of Power, Energy, Information and Communication (ICCPEIC), 2015, pp. 0093-0098, doi: 10.1109/ICCPEIC.2015.7259447.[3]
The author explains in this publication a produced product called NavBelt that is centered on navigation and obstacle-prevention technologies that were initially built for mobile robots. This system comprises of eight ultrasonic sensors worn on a user's waist, a portable computer carried in his backpack, and a headset. Ultrasonic sensors were used to create a vibration and voice-activated navigation system. It's the most cost-effective method of object detection and avoidance.

4) Vayeda Anshav Bhavesh, 2015, Comparison of Various Obstacle Avoidance Algorithms, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) Volume 04, Issue 12 (December 2015), http://dx.doi.org/10.17577/IJERTV4IS120636 [4]
This journal demonstrates the difference between different shortest path algorithm available and which one is suitable for what kind of project. The author discusses some of widely accepted algorithms such as bug algorithms, APF, VFH, bubble band technique and fixed sonar technique

5) L. Dunai, G. P. Fajarnes, V. S. Praderas, B. D. Garcia and I. L. Lengua, "Real-time assistance prototype — A new navigation aid for blind people," IECON 2010 - 36th Annual Conference on IEEE Industrial Electronics Society, 2010, pp. 1173-1178, doi: 10.1109/IECON.2010.5675535. [5]

The paper speaks about the system which is developed to complement the navigation systems such as white cane. The system consists of two stereo cameras and a portable computer for computing the real time information. The system is able to detect the static and dynamic object around and send signals to the person. With the help of stereophonic headphones the user can hear the real time environment.

6) Balakrishnan, G., et al. ”Wearable real-time stereo vision for the visually impaired.” Engineering Letters 14.2 (2007). [6]

The system developed here, is called Stereo Vision based Electronic Travel Aid (SVETA). It has computing device, stereo cameras and stereo earphones, all integrated in a helmet. A sonification technique is used to map the image to stereo musical sound.

7) T. H. Riehle et al., ”Indoor magnetic navigation for the blind,” 2012 Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2012, pp. 1972-1975, doi: 10.1109/EMBC.2012.6346342. [7]

This paper describes about a navigation system that identifies the users' location using magnetic sensing. The system consists of a wireless magnetometer placed at the user's hip streaming magnetic readings to a mobile phone calculating location. The property of objects to respond to the magnetic field around it, is used to assist the blind.

8) R. Lagisetty, N. K. Philip, R. Padhi and M. S. Bhat, ”Object detection and obstacle avoidance for mobile robot using stereo camera,” 2013 IEEE International Conference on Control Applications (CCA), 2013, pp. 605-610, doi: 10.1109/CCA.2013.6662816. [1]

This is a real-time obstacle identification and avoidance system for autonomous operation of mobile robots in an unknown environment utilising a stereo camera. Independent navigation of mobile robots necessitates the following: a) precise determination of the robot's location and orientation; and b) precise identification of the size, shape, depth, and range of possible impediments in the environment. For long-range operation, a simple kinematic model is employed, and a stereoscopic camera with pan and tilt capability is examined. The stereo matching algorithm and the triangulation method are used to produce a complete 3D reconstruction of the object/obstacle. This technique employs cutting-edge technology and equipment to aid visually impaired individuals.

9) ”Tsight Blind obstacle avoidance” YouTube, uploaded by Robcib Upm, 14 March 2012, https://youtu.be/-NuqMIDKBS4

This a product built for blind which consists of sensors and camera to detect the object and provide the collision warning if any to the blind person. This is a demonstration video where a person is blind folded, and he wears the product which goes around his neck and walks along the hallway and is successful in avoiding all the objects in front of him, which proves a good product for blind people. From the same ground we are planning on creating a device which cane be easily be worn by a person. And is portable while serving all the objectives.

1.3 Background

According to research conducted by [8] it was found that Blindness affects about 3.2 percent of the world's population. And India has the highest percentage in the world for people with Moderate to Severe Blindness. So therefore, this is actually a real challenge to be tackled. There are a few different types of visual impairment that fall into the overall category of blindness. 1. Low Vision 2. Total Blindness 3. Congenital blindness 4. Legally blind Person with total and congenital blindness can perceive no light and they can be either caused during a trauma or at the time of birth.

Blind stick helps them with their disability to a certain extent, but they fail in aspects that require detection of fast-moving objects and instant decision-making. Often, these devices or technologies are designed only for specific tasks. Nevertheless, these greatly contribute to the mobility of the visually impaired.

Therefore, there is a need for a better product that can overcome these shortcomings. Development of the state-of-the-art device to guide visually impaired people is closely related to the technologies like computer vision which largely deals with the image processing and dealing with the images. Object detection utilising real-time video stream is one such component. Regardless of the technology used, the application must work in real time, taking rapid actions and making quick choices, since speed may be crucial for tacking actions. Choosing the optimum solution is essentially a trade-off between the software component's performance and the hardware capabilities. Along with the optimum setups, optimal parameter tweaking is essential.

Chapter 2

Conception of Idea

2.1 Problem statement

Develop a solution that can securely guide people with Moderate to Severe Visual Impairment(MSVI) to their destination using technologies such as real-time object detection and avoidance.

2.2 Functional block diagram

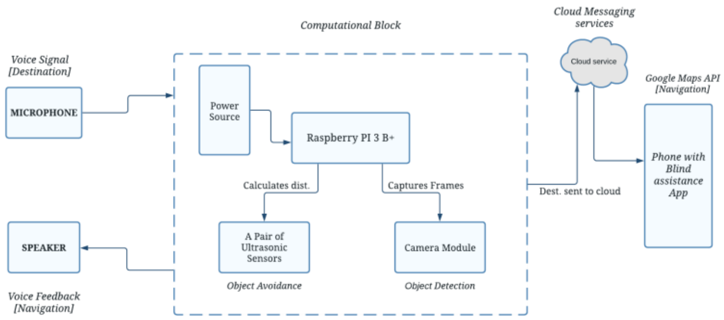

Figure 2.1: Functional block diagram

The framework's recommended block chart, which aids in comprehending the framework and its theoretical level comprehension of how it performs in the present.

The Raspberry Pi draws the appropriate voltage from the power source in the functional block diagram, and the system starts after boot-up.

2.3 Methodology

We have designed a system where every component in it is interacting with the rest of the components for synchronisation. The system consists of 2 ultrasonic sensors, a camera module, a headset, Raspberry PI 3B, and a mobile application.

Our 3 key objectives are Object recognition, avoidance, and Navigation. Object detection can be further separated into 2 primary tasks Take a picture of something and then figure out what it is. An object identification algorithm can be used to identify the item of a frame, and the frame can then be captured using a camera. Object avoidance is dependent on item detection, as the system must first be aware of the object in order to avoid it, which can be accomplished via sensors. Simple rules can be established based on the sensors to avoid the object and navigate the vision-impaired individual.

The Raspberry PI 3B, which has an ARM Advanced RISC Machine and uses RISC - Reduced instruction set computer technology, is powered by a constant 5v supply, which starts the process. The range of the ultrasonic sensor is 2cm to 250cm, which is ideal for our purpose. The camera utilised has a resolution of 1920x1080 at its highest setting and 640x480 at its lowest setting. The object detection model we're employing uses a 640x480 picture, which is more compatible with the Pi camera. SSD MobileNet was utilised as the object detection model, which operates on the idea of single-shot detection, which is efficient for embedded devices. Using a headset, the visually impaired person is prompted to provide a destination. The location is picked up via the headset's microphone and communicated to a mobile application, which then makes a request for instructions to an underlying API. The software maintains providing the person with directions once the request is successful, which is the initial component of the project.

Simultaneously, the camera module and sensors assist the user in anticipating a possible collision with obstruction and the measures that must be taken to prevent it. These commands are communicated to the headset via the Raspberry PI 3B. This is the second and most crucial section.

The collision with an obstruction has been divided into two types. There is no possibility of a collision if the object is more than 1.5 metres away from the person. If the object is within 1.5 metres, the system uses an ultrasonic sensor to determine the maximum distance between the two while also employing the camera. It recognises the object in its immediate proximity and advises the person in front of the impediment to stay away and the direction to take.

This process continues till the individual arrives at his or her goal. There are two options for directions. The first is to avoid the impediment, and the second is to notify with directions to the location specified by the API user. This is the most dependable and efficient system because it not only considers the system's cost-effectiveness but also its accuracy and range. We can improve the system even further by utilising some of the sophisticated equipment to achieve better outcomes.

Chapter 3

System Design

3.1 Hardware Perspective

The system is comprised of hardware components, and it is controlled by software. Hardware is critical in synchronising the rest of the system.

The Raspberry Pi 3 is the main processing unit, and it manages the peripherals that are connected to it. It contains a 1GB onboard memory, 4 USB 2.0 connections, a camera port, a display port, and 40 GPIO pins for connecting ultrasonic sensors, among other features.

The controller receives the distance of the nearest item from the ultrasonic sensors. The sensors have a range of 2cm to 250cm. There are two of these sensors, each at a 45-degree angle to the vertical axis.

Simultaneously, the PI camera captures each frame and transmits it to the object detection model, which only detects objects in the vicinity of the person if the identified object's accuracy exceeds 50

The system gives the person feedback on the possible directions to go based on the distance between the sensors and the outcome of the object detection using the Pi camera.

Finally, the following hardware is required: a. Raspberry Pi 3B b. A pair of Ultrasonic sensors c. A headset with a microphone and speaker The entire system is contained in a vest.

Table 3.1: Device Specification

Device or Component name	**Specification**
Raspberry PI 3 B+	Power source: +5V, +3.3V GND, Vin, I/O pins: 26, PMW: 4 channels, Microprocessor: Broadcom BCM2837 64bit Quad Core Processor, Max Current: 16mA, Flash memory: 16Gbytes, Internal RAM: 1Gbytes DDR2, Clock freq.: 1.2Ghz, Board connectors: 40 GPIO, LAN, HDMI, 4x USB 2.0, Audio Jack, Camera Serial Interface
Ultrasonic Sensors	Power Supply: 5V, Current: 15mA, Frequency: 40Hz, Range: 2cm – 250cm/2.5m, Resolution: 0.3 cm, Measuring Angle: 15 degrees, Dimension: 4.5cm x 2.0cm x 1.5cm
PI camera module	Size: 25x24x9mm, Resolution: 5Mp, Video modes: 1080p30, 720p60 and 640x480p60/90, Sensor: OmniVision OV5647, Depth of field: 1m to infinity, Focal length: 3.60mm +/- 0.01, S/N ratio: 36dB
SD Card	Size: 8GB memory, Speed: 6Mb/s
Headset	With built-in Mic and speaker

3.2 Software Perspective

Object detection and avoidance are the two primary steps. The goal of object detection is separated into two parts:

- The first is to capture a frame
- The second is to identify the object in that frame

An object identification algorithm can be used to identify the item of a frame, and the frame can then be captured using a camera. Object avoidance is dependent on item detection, as the system must first be aware of the object in order to avoid it, which can be accomplished via sensors. Simple rules can be established based on the sensors to avoid the object and navigate the vision-impaired individual.

The majority of the work takes place in the system's software, which includes object detection and avoidance. SSD MobileNet is the object detection model employed, and it is based on the concept of single-shot detection, which is more power-efficient and has a better speed-accuracy trade-off.

3.2.1 TensorFlow Models

Object detection finds the object's location in terms of bounding boxes as well as anticipates it. This is precisely what we require in our project to detect the presence of an object and identify the discovered object's class. An SSD is made up of two parts:

- A backbone model
- A SSD head.

As a feature extractor, the backbone model is commonly a pre-trained image classification network. This is often a ResNet network trained on ImageNet that has had the final fully linked classification layer removed. As a result, we have a deep neural network that can extract semantic meaning from an input image while maintaining its spatial structure, although at a lesser resolution. For embedded systems, the SSD MobileNet is the most efficient model. It is programmed to use the least amount of energy feasible while maintaining the highest level of precision.

The TensorFlow library includes a pre-trained object identification model that may be used on a variety of platforms. The model we used in our project was pre-trained using coco-dataset, which has 90 classes ranging from Person, Car, Bus, Chair, Table, and so on, all of which can be accurately identified by the model using bounding boxes. This model achieves a 22 per cent accuracy and a response time of 21 milliseconds, which implies it takes 21 milliseconds to compute a single frame, however owing to hardware constraints, the frame rate is reduced.

3.2.2 SSD Architecture

According to [9], the SSD method uses a feed-forward convolutional network to generate a set array of bounding boxes and scores for the occurrence of object class instances in those boxes, accompanied by a semi suppression step to provide final detections. The early network layers are based on the base network1, which is a common architecture for high-quality picture categorization (truncated before any classification layers).

The network is then enhanced with auxiliary structure to create detection methods with the following important characteristics:

3.2.3 Flutter Development

A mobile application has been integrated to provide the essential directions for a specific destination. We built the app from the ground up using Google's Flutter framework under tight deadlines. We used packages to read all of the messages on a phone and get the message containing the PI controller's destination. We chose flutter because it makes development simple and is adaptable to future developments.

The Raspbian operating system is utilised for the controller. The complete code has been written in the Python3 environment. The Raspberry Pi team recommends Raspbian as the official operating system for developing real-time apps on the Raspberry Pi.

The controller connects with the mobile app which is built using the Flutter framework for fetching the directions from the Google Maps Directions API. It also consists of the Maps SDK Integrated to show the current location of the user using a visual Map.

3.3 Algorithm

- *Step 1:* Boot the Raspberry Pi 3 B+ using 5v power supply and connect it with the camera module and sensors.
- *Step 2:* Check the proper working of sensors, camera, Mic, and speaker.
- *Step 3:* Ultrasonic sensors should be at mounted properly with strategic positioning of the camera.
- *Step 3:* Run the code from the python3 environment.
- *Step 4:* Once the code starts running, say the destination as an input which gets converted to text via Google Speech-To-Text. If the destination is not properly picked the system asks for the destination again.
- *Step 5:* When the message is received on the connected phone, Open the Blind Assistance App.
- *Step 6:* Wait for a few seconds until the Directions for the destination is fetched from Google Directions API. Once it is complete the voice-based directions start on the phone.
- *Step 7:* At the same time the Object detection based on SSD Architecture begins with voice feedback on the directions to take in a radius of 1.5meters.
- *Step 8:* The object avoidance is categorised into 2 types:
  1. Object is beyond 1.5 meters then say “Go straight”
  2. Object is within 1.5 meters then check for the distance from the ultrasonic sensors, if the distance of an object is more from the right sensor, then say “Take 2 steps towards Left”. If the distance is more from left sensor say, “Take 2 steps towards Right”.
  3. If the distance is very less from both sensors say, “STOP”. This is the critical situation.
  4. In the 2nd and 3rd case, start the object detection to say the object near him. Example: “Chair is in your Vicinity”
- *Step 9:* Step 8 along with step 6 keeps repeating until:
  1. Internet disturbance
  2. Person reaches destination
  3. Manual termination
- *Step 10:* This voice feedback continues until the person reaches the destination.
- *Step 11:* Once confirmed that the person has reached, turn off the device and other components.

3.4 Flowchart

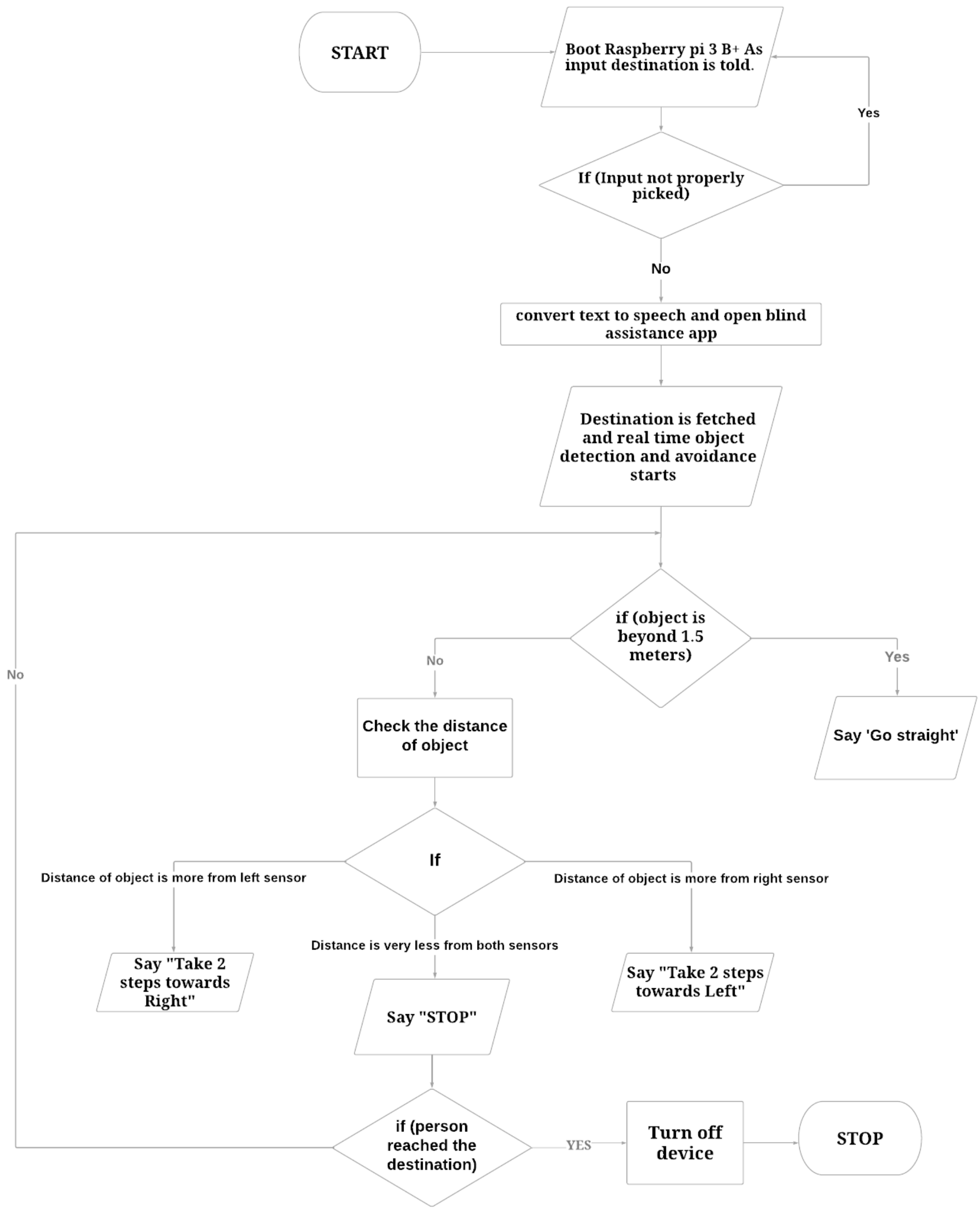

Figure 3.1: Flowchart

3.5 Bill of Materials

Table 3.2: Materials

SL No.	Part Name	Specification	Quantity
1	Raspberry PI 3 B+	Broadcom BCM2837 64bit Quad Core Processor, 1GB Memory, 40 GPIO, LAN, HDMI, 4x USB 2.0, Audio Jack, Camera Serial Interface	1
2	Ultrasonic Sensors	45mmx20mmx15mm, 2cm-250cm Range, 15mA working current, 15° angle	2
3	PI camera module	480x640 min-resolution	1
4	SD Card	480x640 min-resolution	1
5	Headset	With built-in Mic and speaker	1
6	Resistors	680 ohm and 1.5K ohm	2 each
7	Jumper wires	Male-female and Male-Male	5 each
8	Power Adapter	5v 3Amp output	1
9	LAN cable	-	1

Chapter 4

Testing and Results

4.1 Testing Environment

The item was tested numerous times in a well-lit environment with enough lighting. Some of the exact things provided in the object detection class list were present in the room to test the model's accuracy. It was ensured that the chamber was soundproofed from the outside world. The hardware is connected as a whole system in the setup of the connectors indicated below.

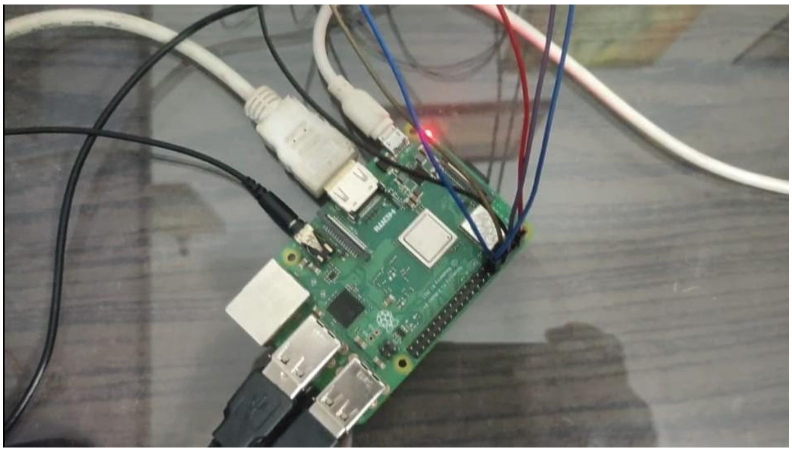

Figure 4.1: Raspberry Pi on Boot-Up

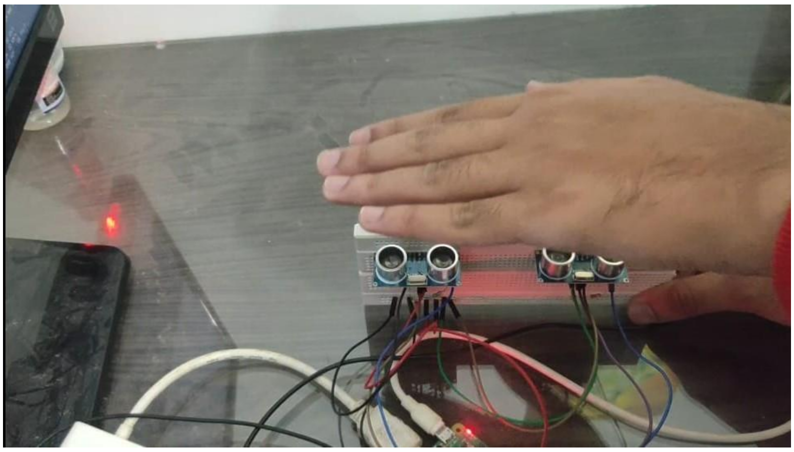

Figure 4.2: Testing of the ultra-sonic sensors

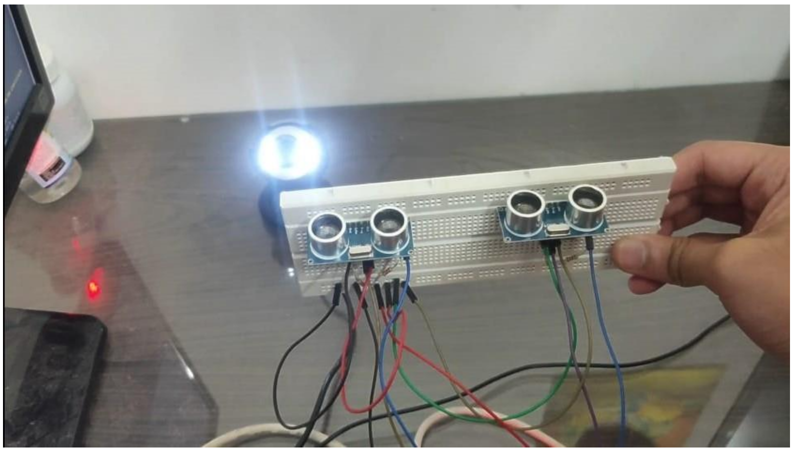

Figure 4.3: Camera for object detection and ultra-sonic sensors for avoidance

4.2 Results

We used the destination ”Railway station Hubli” as an example, and when the gadget was examined for accuracy, it accurately identified the actual statement. It also questioned us about the destination again when we replied nothing. This is immediately communicated to the smartphone application, which responds with the instructions stated.

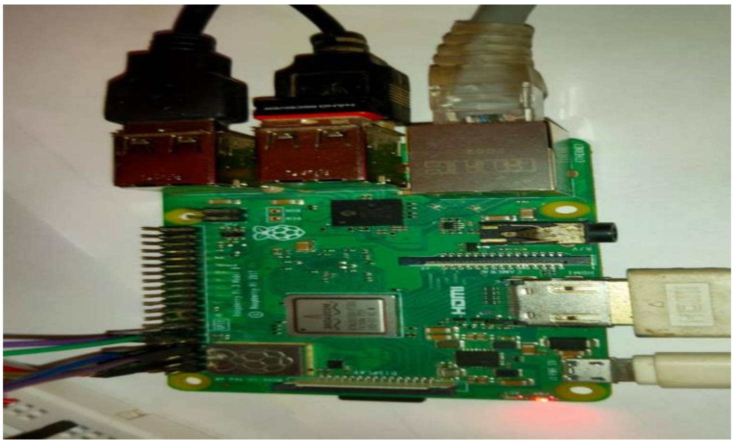

Figure 4.4: Raspberry Pi connected and boot-up

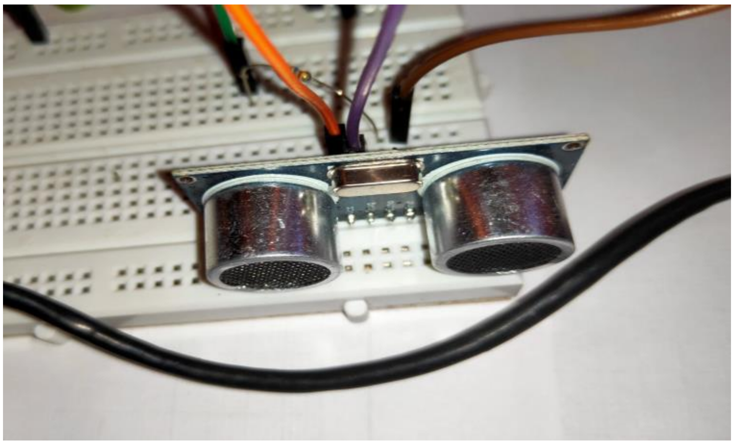

Figure 4.5: Ultra-sonic sensors starting with the avoidance algorithm

The above-mentioned two categories, within 1.5 metres and beyond 1.5 metres, were evaluated, and the findings were found to be in line with our expectations/predictions, with an average accuracy of 80

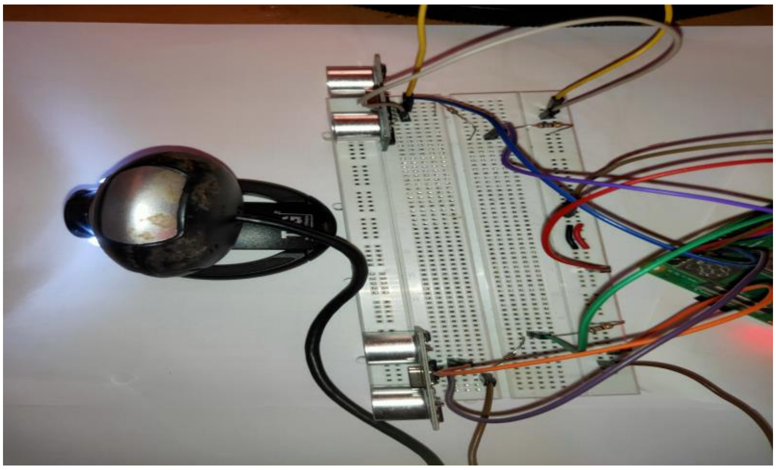

Figure 4.6: Camera positioned in between the ultrasonic sensors so as to detect the objects that are in the vicinity

The system was likewise put through its paces and responded appropriately. The technology provided accurate audio input for when the person should halt and when the person should take two steps to the right or left depending on the situation. We also ran testing in natural settings with enough noise and found that the system had no trouble picking up the voice message.

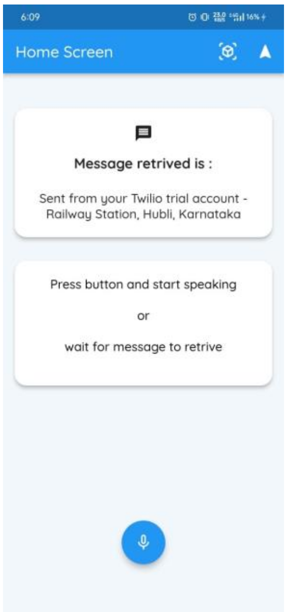

Figure 4.7: Flutter App: Screen 1, where the message is received

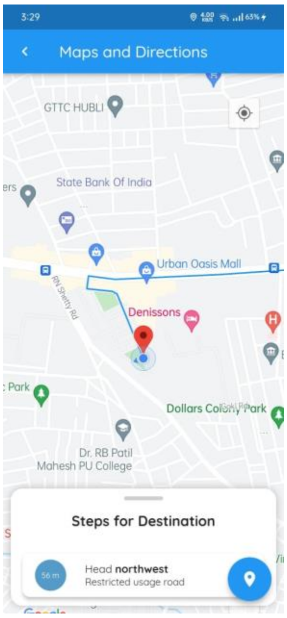

Figure 4.8: Flutter App: Screen 2, Destination given by the user is sent to Google Maps API and the destination "pin" is dropped marking the start of the journey

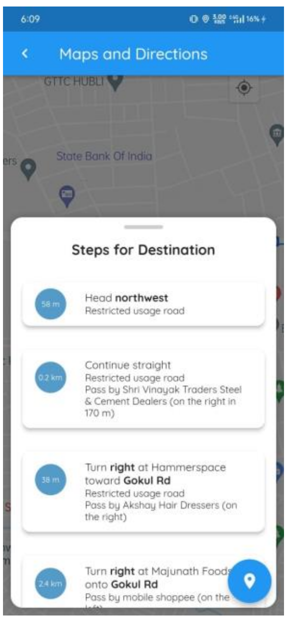

Figure 4.9: Flutter App: Screen 3, Navigation begins and turn-by-turn real-time feed is fed via the headset

Chapter 5

Conclusions and Future Scope

5.1 Conclusion

The overall system is user-friendly since the user only needs to say the destination and the model will take care of the rest. The voice command can also be used to launch the mobile app. The proposed system is created with all ages in mind, is user-friendly, and does not require any prior training or understanding of advanced technologies.

The suggested vision-based guidance and navigation system for the visually impaired is planned, built, and validated through a series of tests before being iteratively improved. The device adheres to the notion of creating a high-performance device that is also cost-effective in practice. The device employs disruptive technology to enable updates and the addition of new features.

If the device isn't capable of handling proper outdoor conditions, it's not fully functional. For real-time use, the suggested device has been put through several outdoor circumstances. This is a pressing need for the visually challenged community, and we've made a little contribution with this device, which can be extensively used with adequate production.

This does not mean that the person can become reliant on the device, as there are times when humans fail to respond quickly as well. Keeping all of these factors in mind, this is simply a device that will assist the visually impaired in doing some of the same things that other people do, such as going to the store without fear of danger.

We did our best to complete the project within the time frame provided, and we believe that this is the first step in the development of the project and that it may be improved significantly.

5.2 Future scope

A device or system that supports a blind person has a huge future potential. Because such a system is not widely used today, its future demand will undoubtedly increase whenever a reliable "blind aid system" enters the market.

Designing an energy-efficient, user-friendly, and compact 'blind assistance system' is critical in a country like India. With the increase in population and transportation, a system like this will be in more demand in the future.

Infrastructure construction in many regions is moving at a breakneck pace, resulting in frequent changes in the path a blind person must travel. As a result, such a system will be extremely beneficial to anyone who is blind. As a result, such a system would be extremely beneficial to a blind person travelling to a new location and walking comfortably.

As a result, we can upgrade the present equipment in a variety of ways. One solution is to utilise a better object detection model or better technology to calculate the distance between a person and an object, and so on.

Bibliography

[1] R. Lagisetty, N. K. Philip, R. Padhi, and M. S. Bhat, "Object detection and obstacle avoidance for mobile robot using stereo camera," in *2013 IEEE International Conference on Control Applications (CCA)*, pp. 605–610, 2013.

[2] K. Rajan and E. Kalaiselvan, "Intelligent navigation system for blind people with real time tracking," in *INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH TECHNOLOGY (IJERT) NCEASE – 2015*, vol. 3, 2015.

[3] C. K. Lakde and P. S. Prasad, "Navigation system for visually impaired people," in *2015 International Conference on Computation of Power, Energy, Information and Communication (ICCPEIC)*, pp. 0093–0098, 2015.

[4] V. A. Bhavesh, "Comparison of various obstacle avoidance algorithms," in *INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH TECHNOLOGY (IJERT)*, vol. 4, 2015.

[5] V. S. P. B. D. G. L. Dunai, G. P. Fajarnes and I. L. Lengua, "Real-time assistance prototype — a new navigation aid for blind people," in *IECON 2010 - 36th Annual Conference on IEEE Industrial Electronics Society, 2010*, pp. 1173–1178, 2010.

[6] G. Balakrishnan, G. Sainarayanan, R. Nagarajan, and S. Yaacob, "Wearable real-time stereo vision for the visually impaired.," vol. 14, Citeseer, 2007.

[7] T. H. Riehle, S. M. Anderson, P. A. Lichter, N. A. Giudice, S. I. Sheikh, R. J. Knuesel, D. T. Kollmann, and D. S. Hedin, "Indoor magnetic navigation for the blind," in *2012 Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, pp. 1972–1975, 2012.

[8] B. R. Ackland P, Resnikoff S, "World blindness and visual impairment: despite many successes, the problem is growing. community eye health," 2017.

[9] W. Liu, D. Anguelov, D. Erhan, C. Szegedy, S. Reed, C.-Y. Fu, and A. C. Berg, "Ssd: Single shot multibox detector," in *Computer Vision – ECCV 2016* (B. Leibe, J. Matas, N. Sebe, and M. Welling, eds.), (Cham), pp. 21–37, Springer International Publishing, 2016.

Navigation Assistance for the Visually Impaired

by Team 1

School

of

Electronics and Communication Engineering

Mini Project Report

on

Navigation Assistance for the Visually Impaired

By:

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Semester: V, 2021-2022

Under the Guidance of

Dr. Sujata.S.Kotabagi

K.L.E SOCIETY'S
KLE Technological University,
HUBBALLI-580031

2021-2022

SCHOOL OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that project entitled **" Navigation Assistance for the Visually Impaired "** is a bonafide work carried out by the student team of **"Govind Madhva (01FE19BEC247)**, **Yash Mahale (01FE19BEC265)**,**Sandeep P (01FE19BEC269)**, **Bharat Gunhalkar (01FE19BEC274)"**. The project report has been approved as it satisfies the requirements with respect to the mini project work prescribed by the university curriculum for BE (V Semester) in School of Electronics and Communication Engineering of KLE Technological University for the academic year 2021-2022.

Dr.Sujata.S.Kotabagi	**Dr.Nalini C. Iyer**	**N. H. Ayachit**
Guide	**Head of School**	**Registrar**

External Viva:

Name of Examiners **Signature with date**

1.

2.

ACKNOWLEDGMENT

We would like to express our gratitude to our institute, KLE Technological University, Hubballi, for providing us with the necessary materials to accomplish our project, "Navigation using Object Detection and Avoidance for Visually Impaired." We deeply thank our guide, Dr. Sujata. S. Kotabagi, for entrusting us with this project, as well as the dean of the School of Electronics and Communication, Dr. Nalini. Iyer, for steering us in the proper way with this industrial-scale project. We would want to thank our guide for assisting us in achieving complete success in our project and continuous encouragement. We'd like to express our heartfelt gratitude to the Prakalp team for their recommendations and assistance. We'd also like to express our gratitude to our guardians for their unwavering support in ensuring the success of our project. Finally, we'd want to express our gratitude to those who have indirectly assisted us in obtaining the delight of project completion.

-Bharat G, Yash M, Sandeep P, Govind M

ABSTRACT

Visually impaired people confront numerous challenges in their daily lives. Due to traffic, constantly changing terrain, and increasing population density, mobility, or moving from one area to another, is a difficult endeavor. The team has offered a solution to help visually impaired persons move about more easily in this publication. The solution comprises of a product that assists visually impaired people in getting from point A to point B. Object recognition by camera and obstacle avoidance via ultrasonic sensors are used to accomplish this navigation. After testing it in real-life circumstances, the product has shown positive results.

Contents

List of Tables

List of Figures

Chapter 1

Introduction

Humans who are not blind can go out and accomplish their daily tasks with ease, while the visually impaired, who have a lower quality of life, cannot. Some of the most basic activities become the most difficult. As a result, there have long been technologies in use that were assumed to be the most cost-effective yet were not reliable. When we think about assistive technology for the visually impaired, the first thing that springs to mind is the blind stick. Because of its low cost and portability, the white cane has long been the most common and basic tool for identifying impediments. It allows the user to scan the area in front of them and detect obstacles on the ground such as holes, steps, walls, uneven surfaces, and so on. However, it can only detect obstacles up to knee-level. It can only detect objects within a range of 1-2 feet. Certain hazards (for example, jutting windowpanes, high platforms, a moving vehicle, and horizontal bars) are not detectable until they are dangerously close to the individual. Even professional dog guides are capable of guiding these individuals, but they are unable to notice potentially dangerous impediments at head level. The average lifespan of a guide dog is 6 years, which necessitates ongoing dog care expenses and lifestyle changes.

According to [1], there is a real-time obstacle identification and avoidance system for autonomous navigation of mobile robots in an unstructured environment using a stereo camera. Autonomous navigation of mobile robots necessitates the following: a) precise determination of the robot's position and orientation; and b) precise determination of the size, shape, depth, and range of potential impediments in the environment. For long-range operation, a simple kinematic model is employed, and a stereo camera with pan and tilt capability is examined. The stereo matching algorithm and the triangulation method are used to obtain a complete 3D reconstruction of the object/obstacle. This method employs cutting-edge technologies and equipment to assist visually impaired individuals.

1.1 Motivation

Nothing should be impossible in today's technology environment. However, the fact that millions of people are blind should serve as motivation for us to work more to improve their lives. The medical business is moving at a breakneck pace, with new discoveries being made every second. However, some of them are simply beyond of reach for the average person. There is a need for a technology that can provide a better quality of life for the million blind people while also being affordable. We chose this topic for the reasons stated above, and designed a gadget that can impact the lives of those around us and make a difference.

1.2 Literature survey

1) K. Rajan , E. Kalaiselvan, 2015, Intelligent Navigation System for Blind People with Real Time Tracking, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) NCEASE – 2015 (Volume 3 – Issue 22) [2],
The user's location in the building is determined using a system called "Roshni," which uses audio messages and keys on the mobile unit to navigate. It employs ultrasonic modules mounted at regular intervals on the ceiling to determine the user's position using sonar technology. This system is lightweight, simple to use, and unaffected by changes in the surroundings. However, because it requires a thorough inside map of the structure, this technology is confined to indoor navigation.

2) "BLIND ASSISTANCE SYSTEM: REAL-TIME OBJECT DETECTION USING TENSORFLOW WITH DISTANCE AND VOICE(PART-1)" YouTube, uploaded by beingryaan, 31 May 2020, https://www.youtube.com/watch?v=3BXIuU2AcGg&t=732s
In this YouTube video the author demonstrates object detection with voice feedback. It is a step-by-step guide on how to prepare the environment for object detection on laptop. On the software part he implements the code using python3 and latest versions of the packages needed. The algorithm calculates the average distance between the object detected and the camera. He uses SSD Architecture i.e., Single Shot detection along with depth estimation. SSD is a most suitable as it provides a better trade-off between the speed and accuracy.

3) C. K. Lakde and P. S. Prasad, "Navigation system for visually impaired people," 2015 International Conference on Computation of Power, Energy, Information and Communication (ICCPEIC), 2015, pp. 0093-0098, doi: 10.1109/ICCPEIC.2015.7259447.[3]

The author explains in this publication a produced product called NavBelt that is centered on navigation and obstacle-prevention technologies that were initially built for mobile robots. This system comprises of eight ultrasonic sensors worn on a user's waist, a portable computer carried in his backpack, and a headset. Ultrasonic sensors were used to create a vibration and voice-activated navigation system. It's the most cost-effective method of object detection and avoidance.

4) Vayeda Anshav Bhavesh, 2015, Comparison of Various Obstacle Avoidance Algorithms, INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH & TECHNOLOGY (IJERT) Volume 04, Issue 12 (December 2015), http://dx.doi.org/10.17577/IJERTV4IS120636 [4]

This journal demonstrates the difference between different shortest path algorithm available and which one is suitable for what kind of project. The author discusses some of widely accepted algorithms such as bug algorithms, APF, VFH, bubble band technique and fixed sonar technique

5) L. Dunai, G. P. Fajarnes, V. S. Praderas, B. D. Garcia and I. L. Lengua, "Real-time assistance prototype — A new navigation aid for blind people," IECON 2010 - 36th Annual Conference on IEEE Industrial Electronics Society, 2010, pp. 1173-1178, doi: 10.1109/IECON.2010.5675535. [5]

The paper speaks about the system which is developed to complement the navigation systems such as white cane. The system consists of two stereo cameras and a portable computer for computing the real time information. The system is able to detect the static and dynamic object around and send signals to the person. With the help of stereophonic headphones the user can hear the real time environment.

6) Balakrishnan, G., et al. "Wearable real-time stereo vision for the visually impaired." Engineering Letters 14.2 (2007). [6]

The system developed here, is called Stereo Vision based Electronic Travel Aid (SVETA). It has computing device, stereo cameras and stereo earphones, all integrated in a helmet. A sonification technique is used to map the image to stereo musical sound.

7) T. H. Riehle et al., "Indoor magnetic navigation for the blind," 2012 Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2012, pp. 1972-1975, doi: 10.1109/EMBC.2012.6346342. [7]

This paper describes about a navigation system that identifies the users' location using magnetic sensing. The system consists of a wireless magnetometer placed at the user's hip streaming magnetic readings to a mobile phone calculating location. The property of objects to respond to the magnetic field around it, is used to assist the blind.

8) R. Lagisetty, N. K. Philip, R. Padhi and M. S. Bhat, "Object detection and obstacle avoidance for mobile robot using stereo camera," 2013 IEEE International Conference on Control Applications (CCA), 2013, pp. 605-610, doi: 10.1109/CCA.2013.6662816. [1]

This is a real-time obstacle identification and avoidance system for autonomous operation of mobile robots in an unknown environment utilising a stereo camera. Independent navigation of mobile robots necessitates the following: a) precise determination of the robot's location and orientation; and b) precise identification of the size, shape, depth, and range of possible impediments in the environment. For long-range operation, a simple kinematic model is employed, and a stereoscopic camera with pan and tilt capability is examined. The stereo matching algorithm and the triangulation method are used to produce a complete 3D reconstruction of the object/obstacle. This technique employs cutting-edge technology and equipment to aid visually impaired individuals.

9) "Tsight Blind obstacle avoidance" YouTube, uploaded by Robcib Upm, 14 March 2012, https://youtu.be/-NuqMIDKBS4

This a product built for blind which consists of sensors and camera to detect the object and provide the collision warning if any to the blind person. This is a demonstration video where a person is blind folded, and he wears the product which goes around his neck and walks along the hallway and is successful in avoiding all the objects in front of him, which proves a good product for blind people. From the same ground we are planning on creating a device which cane be easily be worn by a person. And is portable while serving all the objectives.

1.3 Background

According to research conducted by [8] it was found that Blindness affects about 3.2 percent of the world's population. And India has the highest percentage in the world for people with Moderate to Severe Blindness. So therefore, this is actually a real challenge to be tackled. There are a few different types of visual impairment that fall into the overall category of blindness. 1. Low Vision 2. Total Blindness 3. Congenital blindness 4. Legally blind Person with total and congenital blindness can perceive no light and they can be either caused during a trauma or at the time of birth.

Blind stick helps them with their disability to a certain extent, but they fail in aspects that require detection of fast-moving objects and instant decision-making. Often, these devices or technologies are designed only for specific tasks. Nevertheless, these greatly contribute to the mobility of the visually impaired.

Therefore, there is a need for a better product that can overcome these shortcomings. Development of the state-of-the-art device to guide visually impaired people is closely related to the technologies like computer vision which largely deals with the image processing and dealing with the images. Object detection utilising real-time video stream is one such component. Regardless of the technology used, the application must work in real time, taking rapid actions and making quick choices, since speed may be crucial for tacking actions. Choosing the optimum solution is essentially a trade-off between the software component's performance and the hardware capabilities. Along with the optimum setups, optimal parameter tweaking is essential.

Chapter 2

Conception of Idea

2.1 Problem statement

Develop a solution that can securely guide people with Moderate to Severe Visual Impairment(MSVI) to their destination using technologies such as real-time object detection and avoidance.

2.2 Functional block diagram

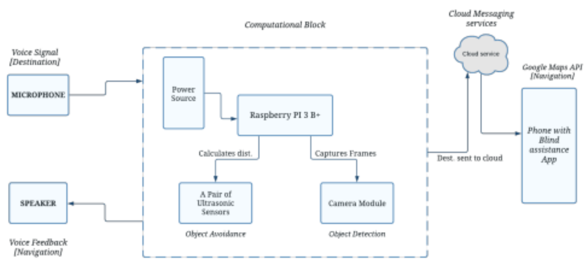

Figure 2.1: Functional block diagram

The framework's recommended block chart, which aids in comprehending the framework and its theoretical level comprehension of how it performs in the present.

The Raspberry Pi draws the appropriate voltage from the power source in the functional block diagram, and the system starts after boot-up.

2.3 Methodology

We have designed a system where every component in it is interacting with the rest of the components for synchronisation. The system consists of 2 ultrasonic sensors, a camera module, a headset, Raspberry PI 3B, and a mobile application.

Our 3 key objectives are Object recognition, avoidance, and Navigation. Object detection can be further separated into 2 primary tasks Take a picture of something and then figure out what it is. An object identification algorithm can be used to identify the item of a frame, and the frame can then be captured using a camera. Object avoidance is dependent on item detection, as the system must first be aware of the object in order to avoid it, which can be accomplished via sensors. Simple rules can be established based on the sensors to avoid the object and navigate the vision-impaired individual.

The Raspberry PI 3B, which has an ARM Advanced RISC Machine and uses RISC - Reduced instruction set computer technology, is powered by a constant 5v supply, which starts the process. The range of the ultrasonic sensor is 2cm to 250cm, which is ideal for our purpose. The camera utilised has a resolution of 1920x1080 at its highest setting and 640x480 at its lowest setting. The object detection model we're employing uses a 640x480 picture, which is more compatible with the Pi camera. SSD MobileNet was utilised as the object detection model, which operates on the idea of single-shot detection, which is efficient for embedded devices. Using a headset, the visually impaired person is prompted to provide a destination. The location is picked up via the headset's microphone and communicated to a mobile application, which then makes a request for instructions to an underlying API. The software maintains providing the person with directions once the request is successful, which is the initial component of the project.

Simultaneously, the camera module and sensors assist the user in anticipating a possible collision with obstruction and the measures that must be taken to prevent it. These commands are communicated to the headset via the Raspberry PI 3B. This is the second and most crucial section.

The collision with an obstruction has been divided into two types. There is no possibility of a collision if the object is more than 1.5 metres away from the person. If the object is within 1.5 metres, the system uses an ultrasonic sensor to determine the maximum distance between the two while also employing the camera. It recognises the object in its immediate proximity and advises the person in front of the impediment to stay away and the direction to take.

This process continues till the individual arrives at his or her goal. There are two options for directions. The first is to avoid the impediment, and the second is to notify with directions to the location specified by the API user. This is the most dependable and efficient system because it not only considers the system's cost-effectiveness but also its accuracy and range. We can improve the system even further by utilising some of the sophisticated equipment to achieve better outcomes.

Chapter 3

System Design

3.1 Hardware Perspective

The system is comprised of hardware components, and it is controlled by software. Hardware is critical in synchronising the rest of the system.

The Raspberry Pi 3 is the main processing unit, and it manages the peripherals that are connected to it. It contains a 1GB onboard memory, 4 USB 2.0 connections, a camera port, a display port, and 40 GPIO pins for connecting ultrasonic sensors, among other features.

The controller receives the distance of the nearest item from the ultrasonic sensors. The sensors have a range of 2cm to 250cm. There are two of these sensors, each at a 45-degree angle to the vertical axis.

Simultaneously, the PI camera captures each frame and transmits it to the object detection model, which only detects objects in the vicinity of the person if the identified object's accuracy exceeds 50

The system gives the person feedback on the possible directions to go based on the distance between the sensors and the outcome of the object detection using the Pi camera.

Finally, the following hardware is required: a. Raspberry Pi 3B b. A pair of Ultrasonic sensors c. A headset with a microphone and speaker The entire system is contained in a vest.

Table 3.1: Device Specification

Device or Component name	**Specification**
Raspberry PI 3 B+	Power source: +5V, +3.3V GND, Vin, I/O pins: 26, PMW: 4 channels, Microprocessor: Broadcom BCM2837 64bit Quad Core Processor, Max Current: 16mA, Flash memory: 16Gbytes, Internal RAM: 1Gbytes DDR2, Clock freq.: 1.2Ghz, Board connectors: 40 GPIO, LAN, HDMI, 4x USB 2.0, Audio Jack, Camera Serial Interface
Ultrasonic Sensors	Power Supply: 5V, Current: 15mA, Frequency: 40Hz, Range: 2cm – 250cm/2.5m, Resolution: 0.3 cm, Measuring Angle: 15 degrees, Dimension: 4.5cm x 2.0cm x 1.5cm
PI camera module	Size: 25x24x9mm, Resolution: 5Mp, Video modes: 1080p30, 720p60 and 640x480p60/90, Sensor: OmniVision OV5647, Depth of field: 1m to infinity, Focal length: 3.60mm +/- 0.01, S/N ratio: 36dB
SD Card	Size: 8GB memory, Speed: 6Mb/s
Headset	With built-in Mic and speaker

3.2 Software Perspective

Object detection and avoidance are the two primary steps. The goal of object detection is separated into two parts:

- The first is to capture a frame
- The second is to identify the object in that frame

An object identification algorithm can be used to identify the item of a frame, and the frame can then be captured using a camera. Object avoidance is dependent on item detection, as the system must first be aware of the object in order to avoid it, which can be accomplished via sensors. Simple rules can be established based on the sensors to avoid the object and navigate the vision-impaired individual.

The majority of the work takes place in the system's software, which includes object detection and avoidance. SSD MobileNet is the object detection model employed, and it is based on the concept of single-shot detection, which is more power-efficient and has a better speed-accuracy trade-off.

3.2.1 TensorFlow Models

Object detection finds the object's location in terms of bounding boxes as well as anticipates it. This is precisely what we require in our project to detect the presence of an object and identify the discovered object's class. An SSD is made up of two parts:

- A backbone model
- A SSD head.

As a feature extractor, the backbone model is commonly a pre-trained image classification network. This is often a ResNet network trained on ImageNet that has had the final fully linked classification layer removed. As a result, we have a deep neural network that can extract semantic meaning from an input image while maintaining its spatial structure, although at a lesser resolution. For embedded systems, the SSD MobileNet is the most efficient model. It is programmed to use the least amount of energy feasible while maintaining the highest level of precision.

The TensorFlow library includes a pre-trained object identification model that may be used on a variety of platforms. The model we used in our project was pre-trained using coco-dataset, which has 90 classes ranging from Person, Car, Bus, Chair, Table, and so on, all of which can be accurately identified by the model using bounding boxes. This model achieves a 22 per cent accuracy and a response time of 21 milliseconds, which implies it takes 21 milliseconds to compute a single frame, however owing to hardware constraints, the frame rate is reduced.

3.2.2 SSD Architecture

According to [9], the SSD method uses a feed-forward convolutional network to generate a set array of bounding boxes and scores for the occurrence of object class instances in those boxes, accompanied by a semi suppression step to provide final detections. The early network layers are based on the base network1, which is a common architecture for high-quality picture categorization (truncated before any classification layers).

The network is then enhanced with auxiliary structure to create detection methods with the following important characteristics:

3.2.3 Flutter Development

A mobile application has been integrated to provide the essential directions for a specific destination. We built the app from the ground up using Google's Flutter framework under tight deadlines. We used packages to read all of the messages on a phone and get the message containing the PI controller's destination. We chose flutter because it makes development simple and is adaptable to future developments.

The Raspbian operating system is utilised for the controller. The complete code has been written in the Python3 environment. The Raspberry Pi team recommends Raspbian as the official operating system for developing real-time apps on the Raspberry Pi.

The controller connects with the mobile app which is built using the Flutter framework for fetching the directions from the Google Maps Directions API. It also consists of the Maps SDK Integrated to show the current location of the user using a visual Map.

3.3 Algorithm

- *Step 1:* Boot the Raspberry Pi 3 B+ using 5v power supply and connect it with the camera module and sensors.
- *Step 2:* Check the proper working of sensors, camera, Mic, and speaker.
- *Step 3:* Ultrasonic sensors should be at mounted properly with strategic positioning of the camera.
- *Step 3:* Run the code from the python3 environment.
- *Step 4:* Once the code starts running, say the destination as an input which gets converted to text via Google Speech-To-Text. If the destination is not properly picked the system asks for the destination again.
- *Step 5:* When the message is received on the connected phone, Open the Blind Assistance App.
- *Step 6:* Wait for a few seconds until the Directions for the destination is fetched from Google Directions API. Once it is complete the voice-based directions start on the phone.
- *Step 7:* At the same time the Object detection based on SSD Architecture begins with voice feedback on the directions to take in a radius of 1.5meters.
- *Step 8:* The object avoidance is categorised into 2 types:
  1. Object is beyond 1.5 meters then say "Go straight"
  2. Object is within 1.5 meters then check for the distance from the ultrasonic sensors, if the distance of an object is more from the right sensor, then say "Take 2 steps towards Left". If the distance is more from left sensor say, "Take 2 steps towards Right".
  3. If the distance is very less from both sensors say, "STOP". This is the critical situation.
  4. In the 2nd and 3rd case, start the object detection to say the object near him. Example: "Chair is in your Vicinity"
- *Step 9:* Step 8 along with step 6 keeps repeating until:
  1. Internet disturbance
  2. Person reaches destination
  3. Manual termination
- *Step 10:* This voice feedback continues until the person reaches the destination.
- *Step 11:* Once confirmed that the person has reached, turn off the device and other components.

3.4 Flowchart

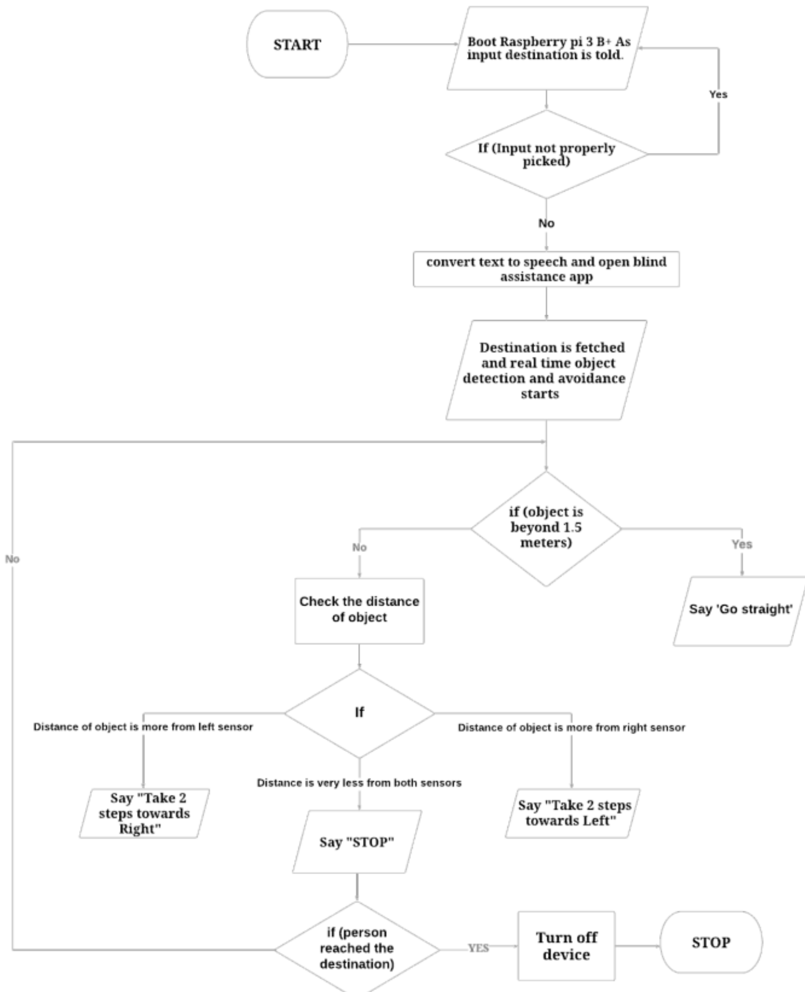

Figure 3.1: Flowchart

3.5 Bill of Materials

Table 3.2: Materials

SL No.	Part Name	Specification	Quantity
1	Raspberry PI 3 B+	Broadcom BCM2837 64bit Quad Core Processor, 1GB Memory, 40 GPIO, LAN, HDMI, 4x USB 2.0, Audio Jack, Camera Serial Interface	1
2	Ultrasonic Sensors	45mmx20mmx15mm, 2cm-250cm Range, 15mA working current, 15° angle	2
3	PI camera module	480x640 min-resolution	1
4	SD Card	480x640 min-resolution	1
5	Headset	With built-in Mic and speaker	1
6	Resistors	680 ohm and 1.5K ohm	2 each
7	Jumper wires	Male-female and Male-Male	5 each
8	Power Adapter	5v 3Amp output	1
9	LAN cable	-	1

Chapter 4

Testing and Results

4.1 Testing Environment

The item was tested numerous times in a well-lit environment with enough lighting. Some of the exact things provided in the object detection class list were present in the room to test the model's accuracy. It was ensured that the chamber was soundproofed from the outside world. The hardware is connected as a whole system in the setup of the connectors indicated below.

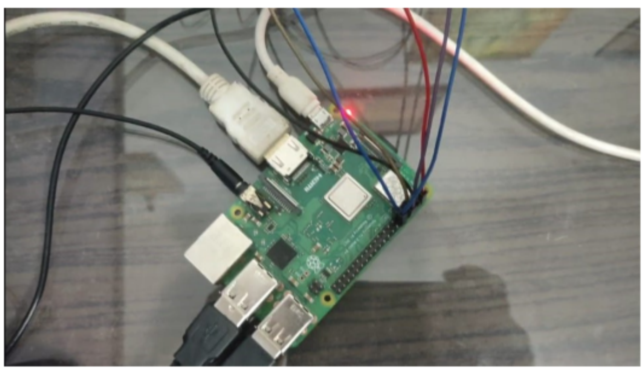

Figure 4.1: Raspberry Pi on Boot-Up

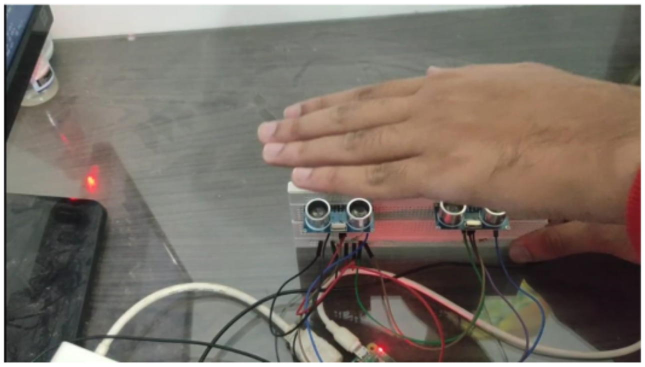

Figure 4.2: Testing of the ultra-sonic sensors

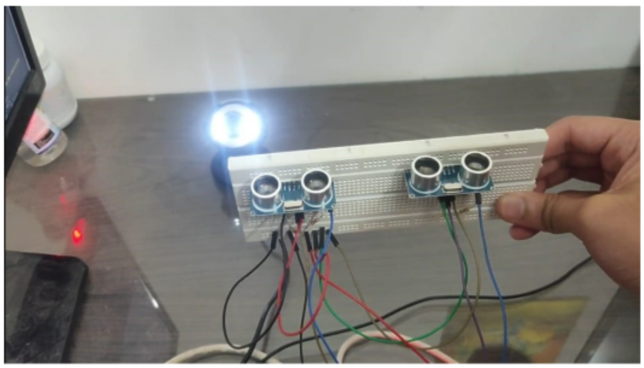

Figure 4.3: Camera for object detection and ultra-sonic sensors for avoidance

4.2 Results

We used the destination "Railway station Hubli" as an example, and when the gadget was examined for accuracy, it accurately identified the actual statement. It also questioned us about the destination again when we replied nothing. This is immediately communicated to the smartphone application, which responds with the instructions stated.

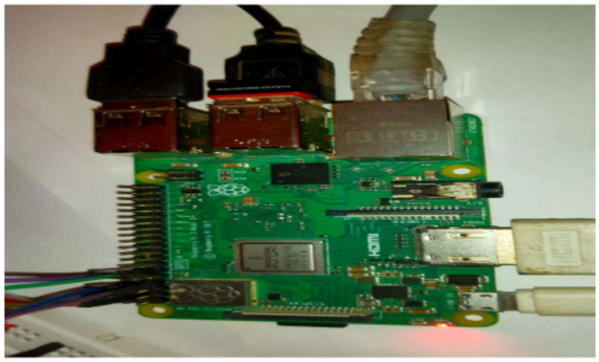

Figure 4.4: Raspberry Pi connected and boot-up

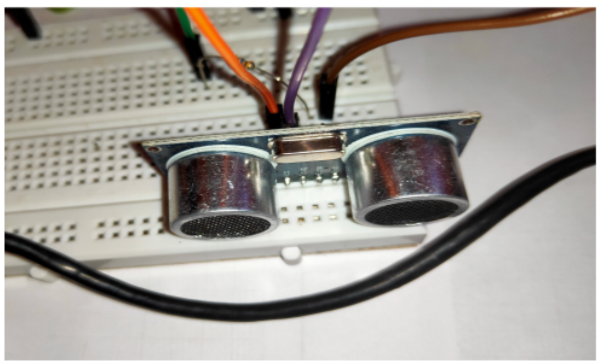

Figure 4.5: Ultra-sonic sensors starting with the avoidance algorithm

The above-mentioned two categories, within 1.5 metres and beyond 1.5 metres, were evaluated, and the findings were found to be in line with our expectations/predictions, with an average accuracy of 80

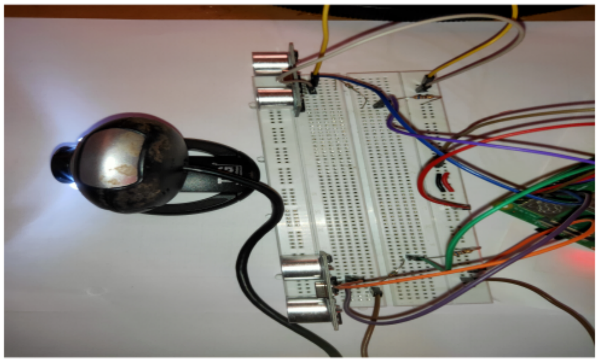

Figure 4.6: Camera positioned in between the ultrasonic sensors so as to detect the objects that are in the vicinity

The system was likewise put through its paces and responded appropriately. The technology provided accurate audio input for when the person should halt and when the person should take two steps to the right or left depending on the situation. We also ran testing in natural settings with enough noise and found that the system had no trouble picking up the voice message.

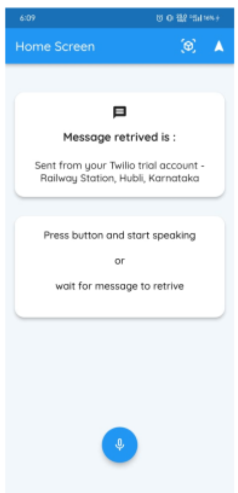

Figure 4.7: Flutter App: Screen 1, where the message is received

Figure 4.8: Flutter App: Screen 2, Destination given by the user is sent to Google Maps API and the destination "pin" is dropped marking the start of the journey

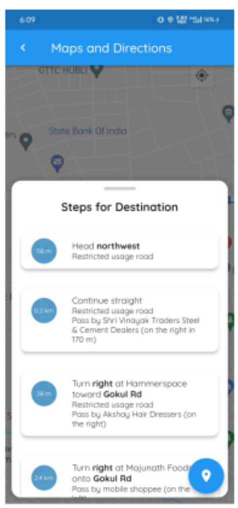

Figure 4.9: Flutter App: Screen 3, Navigation begins and turn-by-turn real-time feed is fed via the headset

Chapter 5

Conclusions and Future Scope

5.1 Conclusion

The overall system is user-friendly since the user only needs to say the destination and the model will take care of the rest. The voice command can also be used to launch the mobile app. The proposed system is created with all ages in mind, is user-friendly, and does not require any prior training or understanding of advanced technologies.

The suggested vision-based guidance and navigation system for the visually impaired is planned, built, and validated through a series of tests before being iteratively improved. The device adheres to the notion of creating a high-performance device that is also cost-effective in practice. The device employs disruptive technology to enable updates and the addition of new features.

If the device isn't capable of handling proper outdoor conditions, it's not fully functional. For real-time use, the suggested device has been put through several outdoor circumstances. This is a pressing need for the visually challenged community, and we've made a little contribution with this device, which can be extensively used with adequate production.

This does not mean that the person can become reliant on the device, as there are times when humans fail to respond quickly as well. Keeping all of these factors in mind, this is simply a device that will assist the visually impaired in doing some of the same things that other people do, such as going to the store without fear of danger.

We did our best to complete the project within the time frame provided, and we believe that this is the first step in the development of the project and that it may be improved significantly.

5.2 Future scope

A device or system that supports a blind person has a huge future potential. Because such a system is not widely used today, its future demand will undoubtedly increase whenever a reliable "blind aid system" enters the market.

Designing an energy-efficient, user-friendly, and compact 'blind assistance system' is critical in a country like India. With the increase in population and transportation, a system like this will be in more demand in the future.

Infrastructure construction in many regions is moving at a breakneck pace, resulting in frequent changes in the path a blind person must travel. As a result, such a system will be extremely beneficial to anyone who is blind. As a result, such a system would be extremely beneficial to a blind person travelling to a new location and walking comfortably.

As a result, we can upgrade the present equipment in a variety of ways. One solution is to utilise a better object detection model or better technology to calculate the distance between a person and an object, and so on.

Bibliography

[1] R. Lagisetty, N. K. Philip, R. Padhi, and M. S. Bhat, "Object detection and obstacle avoidance for mobile robot using stereo camera," in *2013 IEEE International Conference on Control Applications (CCA)*, pp. 605–610, 2013.

[2] K. Rajan and E. Kalaiselvan, "Intelligent navigation system for blind people with real time tracking," in *INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH TECHNOLOGY (IJERT) NCEASE – 2015*, vol. 3, 2015.

[3] C. K. Lakde and P. S. Prasad, "Navigation system for visually impaired people," in *2015 International Conference on Computation of Power, Energy, Information and Communication (ICCPEIC)*, pp. 0093–0098, 2015.

[4] V. A. Bhavesh, "Comparison of various obstacle avoidance algorithms," in *INTERNATIONAL JOURNAL OF ENGINEERING RESEARCH TECHNOLOGY (IJERT)*, vol. 4, 2015.

[5] V. S. P. B. D. G. L. Dunai, G. P. Fajarnes and I. L. Lengua, "Real-time assistance prototype — a new navigation aid for blind people," in *IECON 2010 - 36th Annual Conference on IEEE Industrial Electronics Society, 2010*, pp. 1173–1178, 2010.

[6] G. Balakrishnan, G. Sainarayanan, R. Nagarajan, and S. Yaacob, "Wearable real-time stereo vision for the visually impaired.," vol. 14, Citeseer, 2007.

[7] T. H. Riehle, S. M. Anderson, P. A. Lichter, N. A. Giudice, S. I. Sheikh, R. J. Knuesel, D. T. Kollmann, and D. S. Hedin, "Indoor magnetic navigation for the blind," in *2012 Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, pp. 1972–1975, 2012.

[8] B. R. Ackland P, Resnikoff S, "World blindness and visual impairment: despite many successes, the problem is growing. community eye health," 2017.

[9] W. Liu, D. Anguelov, D. Erhan, C. Szegedy, S. Reed, C.-Y. Fu, and A. C. Berg, "Ssd: Single shot multibox detector," in *Computer Vision – ECCV 2016* (B. Leibe, J. Matas, N. Sebe, and M. Welling, eds.), (Cham), pp. 21–37, Springer International Publishing, 2016.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17

PAGE 18

PAGE 19

PAGE 20

PAGE 21

PAGE 22

PAGE 23

PAGE 24

PAGE 25

PAGE 26

PAGE 27