



Blind Navigation Using Artificial Intelligence

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Abstract: Navigation plays a vital role in everyone's life, especially in the case of a person having a disability like visual impairment, the day-to-day navigation is more challenging. They always need assistance to navigate through the streets, which can be difficult because of the busy lifestyle of the people living in the present world. Therefore, in resolution to this problem, this paper presents a system to assure the blind a safe and hearable environment using Artificial Intelligence to detect the objects encountered in the path.

IndexTerms - SSDlite, Augmented Reality, MEMS.

I. INTRODUCTION

A recent study shows that fifteen percent of the world's total population is having any form of disability. Within this percentage of disabled people mentioned above, 253 million are having visual impairment problems. This figure is about to rise to higher than 550 million by 2050. If the current trend continues, the rising count can't be controlled, but an alternative solution can be modelled to simplify their life.

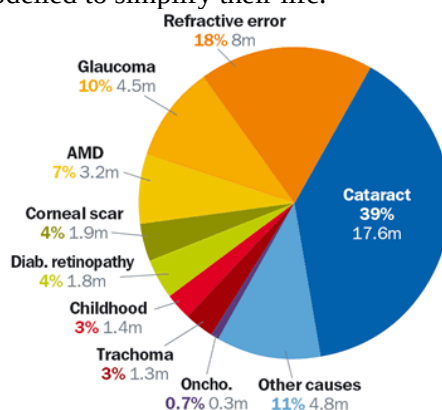


Fig1.1 Visual Impairment Piechart

The intention behind this project is to come up with a model of device which helps blind people to navigate easily with more safety & Confidence. This system involves the usage of Raspberry Pi, Artificial Intelligence, and other hardware components like ultrasonic sensor & accelerometer sensor which help in tracking distance, and speed and identifying and recognizing the objects in the vicinity. Thereby this paper provides an easy navigation solution for those having visual impairment. The use of the advanced objection detection model provides a piece of accurate information regarding the object identified in the path. The real-time panic alert provides a reliable information source to the caretaker regarding the status of the user & is very helpful in providing on-time interference.

II. METHODOLOGY

A study was carried out in the publication in providing blind people with a safe navigation system to make their daily life easy and simple. The proposed model aims to identify & recognize objects and the distance between them encountered in the navigating path and provides an alert to the user via voice output. This project uses Raspberry Pi as the main developer kit. All the peripherals are interfaced with the kit by using python code. The input image from the camera is fed into the pre-trained deep learning model deployed in the kit. This project uses a Mobilenet SSDlite V2 object detection model to detect an object in real-time and to provide to give the user with an audible alert using eSpeak module is used.

III. SYSTEM DESIGN

The system's design is shown in "Figure. 1.

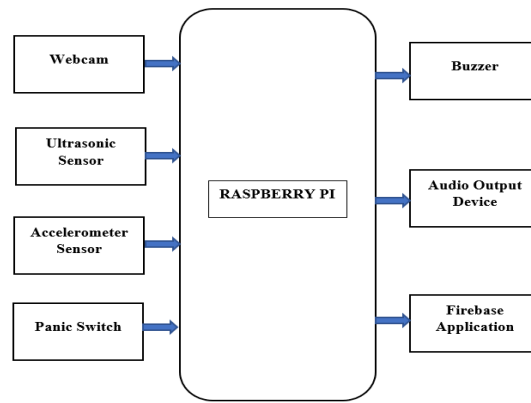


Fig. 1. BLOCK DIAGRAM

The operation is as follows:

The put forward system focuses on providing blind people with a safe navigation system to change their daily life challenges free & simple. The system aims in identifying & recognizing the obstacles and the distance between them encountered in the navigating path and provides an alert to the user via voice output. This project uses Raspberry Pi as the main developer kit. All the peripherals are interfaced with the kit by using python code. The input image from the camera is fed into the pre-trained deep learning model deployed in the kit. This project uses a Mobilenet SSDlite V2 object detection model to detect an object in real-time and to provide to give the user with an audible alert using the eSpeak module is used.

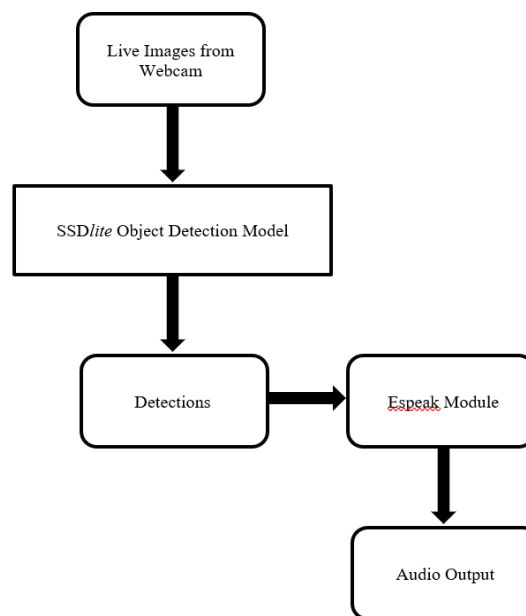


Fig. 2. ML PROGRAM FLOW

The mobilenet SSDlite V2 is very lightweight and requires only very less computational power, thereby it can be used in mobile computing devices and developer kits. The obstacle distance measurement is done by using an ultrasonic sensor this measured distance is converted into centimeters and given to the user in audible form along with the identified object. An accelerometer sensor is used for fall detection by measuring the acceleration in any one axis, if the acceleration exceeds the threshold value the caretaker gets an alert in the application. The ultrasonic sensor and camera work in parallel to detect both object and distance, a small delay is kept in between the output of both object detection and distance measurement to provide an interference-free audio output to the user. An emergency switch is added to ensure the security of the user during challenging or difficult conditions. Firebase's real-time database application is used to give notifications to the caretaker of the user in case of fall detection or panic situations. QR code containing the user's address is kept with the model to provide information to others in case of emergencies.

IV. SSD ARCHITECTURE

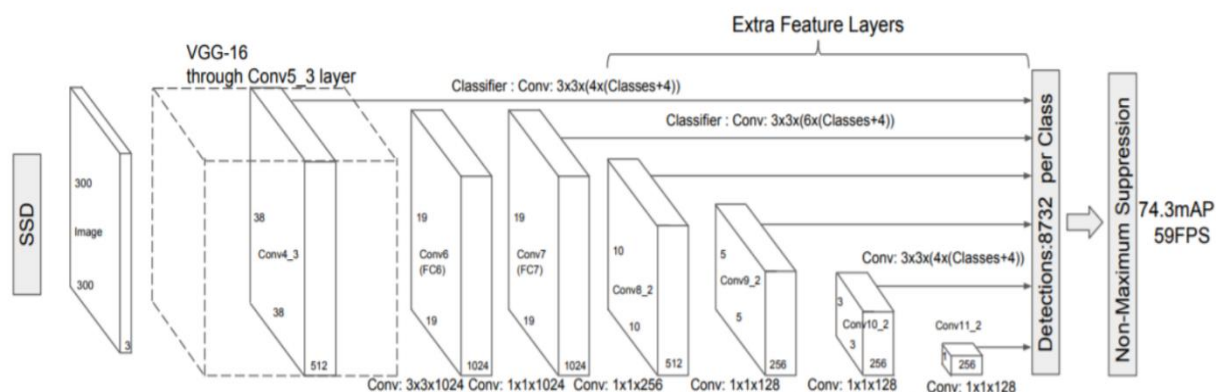


Fig. 3. SSD ARCHITECTURE

Single Shot Detector (SSD) is a compact real-time object detection model. SSD algorithm uses a 16-layer deep CNN for object detections, each prediction comprises a boundary box which has class, and confidence scores displayed with it. SSD computes both the location and class scores using convolution filters, after retrieving the feature maps the convolution filters are applied to each cell to make predictions. MobilenetV2 SSDlite produces more accurate detections using less computation power thereby more suitable for usage in mobile devices.

V. RESULT AND DISCUSSION

Figure 4. shows the result of obstacle detection which are encountered in the path using CNN based SSD Object detection model which is suitable to use in mobile devices.

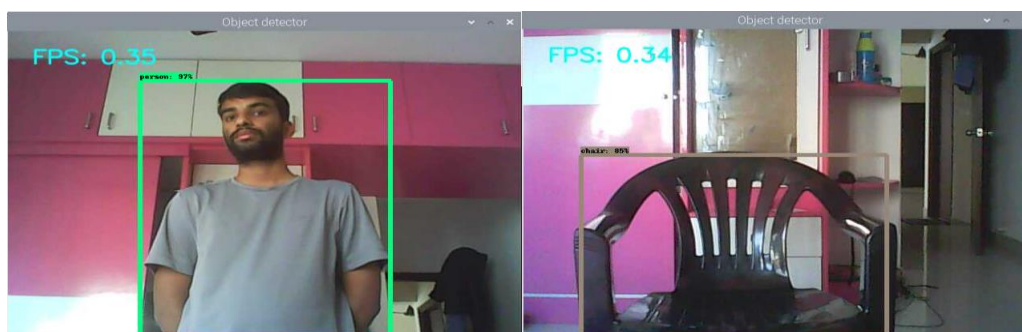


Fig.4. Object Detection

Figure 5 shows the result of fall detection, Fall Detection is done using an accelerometer sensor. A real-time alert to the caretaker is given in case of a fall using the firebase real-time database.

Screen1	
<i>Blind Navigation</i>	
Alert:	Fall
Distance:	46.30246
Object:	chair

Fig.5. Fall Detection

Figure 6 shows the distance measurement output, Real-time distance from the object is measured using an ultrasonic sensor. This measured distance is given as audio output to the user in audio form.

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pi@raspberrypi: ~/myproject/models/research/object_detection
File Edit Tabs Help
y = -2.432 ms2
z = 9.964 ms2

Measured Distance = 31.9 cm
Obstacle Ahead
x = 0.784 ms2
y = -2.432 ms2
z = 9.964 ms2

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Fig.6. Distance Measurement

Figure 7 shows the panic alert result, panic switch is used in emergencies. Pressing the switch gives an alert to the caretaker via android application backed by google firebase real-time database.

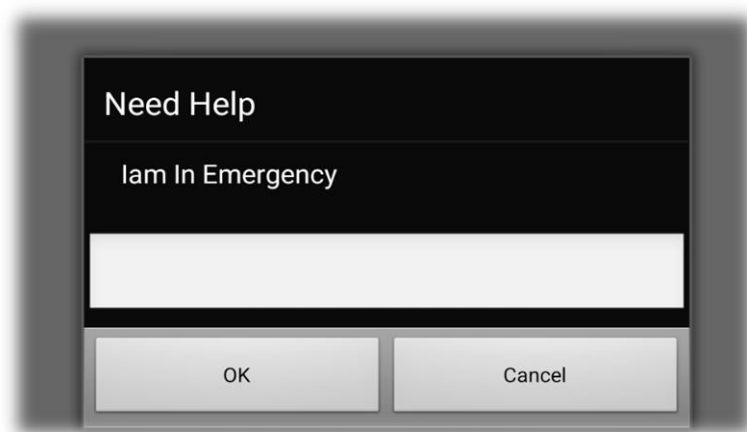


Fig.7. Panic Alert

Figure 8 shows the QR Code scan results, A QR code containing the user's address and the emergency number is also provided in the model in case used in emergencies.

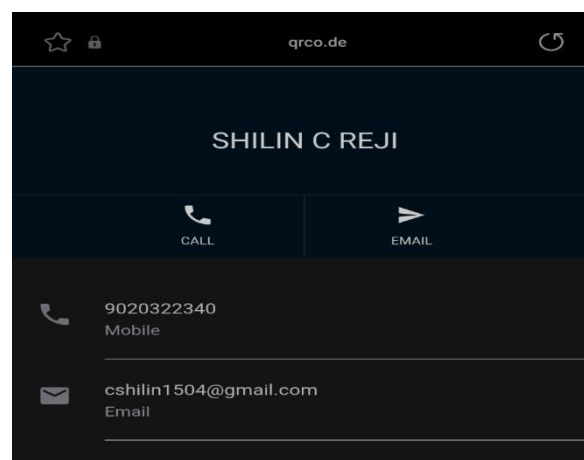


Fig.8. QR Code Scan Results

VI. CONCLUSION

The goal of this project work is to provide a safe & secure navigational service to visually impaired people. Though, the existing systems provide only alerts in the form of vibrations or sounds from the buzzer. The proposed system overcomes these drawbacks through the additional use of artificial intelligence & advanced Raspberry Pi developer kit. This Raspberry Pi developer kit has high computational power, and it is known for its ease of use. The object detection algorithm used in this project work is a Single shot detector (SSD), which has high accuracy & speed. Using all these computational components higher efficiency of predictions can be achieved. This project is still in the development stage, further improvements & implementations are yet to be made during the following stages of the project.

FUTURE SCOPE

This project can be further improved in various methodologies. This model contains limited dataset for object identification & classification. Further improvements can be made by adding more data to training & test datasets. Triangle similarity method can be used for measuring the distance from the obstacle by using camera, this method can be added in future with the help of high-resolution cameras.

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