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Assistive Vision for the Blind

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ABSTRACT *: Around 285 million people are visually impaired worldwide. 39 million are blind and 246 million have low vision. This project aims at improving the day to day lives of blind people by providing them some information about their environment. Keeping in mind the challenges faced by the Blind, We have come up with an embedded device and 3 android applications. The embedded device helps in walking independently and the android applications help in reading, searching for local objects required frequently and navigating to the desired destination.*

KEYWORDS: *Optical Character Recognition, Computer Vision, GPS.*

I. INTRODUCTION

This invention relates to the development of technology to assist the blind. It is a substitute for their eyes. According to a survey conducted by the World Health Organization (WHO), 285 million people are visually impaired worldwide. 39 million are blind and 246 have low vision.

Problems faced by the blind people:

[1] They cannot walk independently due to the presence of local obstacles around them.
[2] They cannot read text printed in books, newspapers, etc. due to the absence of vision.
[3] They cannot find local objects required in our daily routine like our toothbrush, keys, cup, etc.
[4] They cannot navigate to the desired destination as they do not know the path to the destination.

To overcome these problems, we developed three android applications and an embedded device. The Embedded Device is portable, handy and easy to use. It is used to detect obstacles while walking. It is a good replacement to the conventional stick used while walking. The android applications help in reading, searching for important objects and navigating to the desired destination.

II. COMPLETE DESCRIPTION AND CONSTRUCTION

A. The Embedded Device

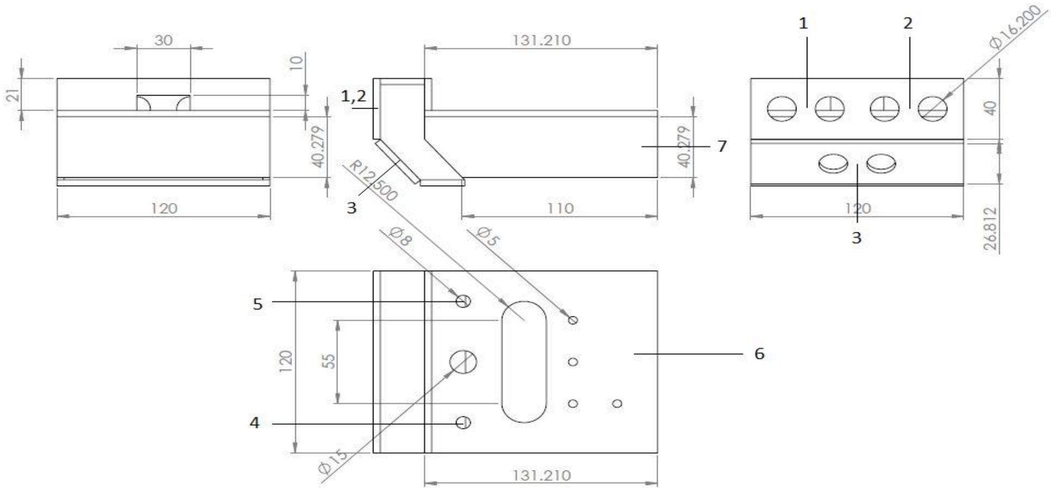


Figure 1 Embedded Device

The Embedded Device is as shown in figure 1. It consists of three Ultrasonic Sensors [1, 2, and 3], four Vibrator Motors [6], one on/off switch [4] and a calibration button [5]. The entire circuit along with the power supply lies inside the box [7]. The Ultrasonic sensors are used for measuring the distance from the obstacles. As they have a narrow range, two sensors [1 and 2] have been used for a wider range. Another advantage of using two ultrasonic sensors is that it gives us an approximation of whether the object lies in region 1, 2 or 3. This is shown in figure 2. There is a third ultrasonic sensor [3] inclined at 40° with the vertical. This stays horizontal while walking, thus helps in detecting staircases, potholes, footpaths, etc.

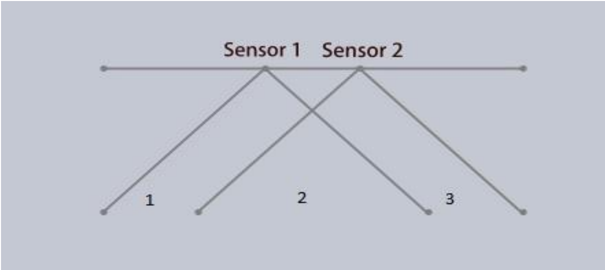


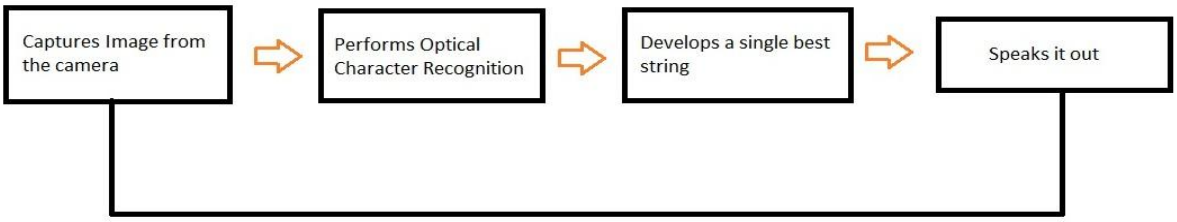
Figure 2 Ultrasonic sensors

The device has an on/off switch on the leftand a calibration button on the right. The purpose of the calibration button is to set references of the ground level for different users. It also consists of four Vibrator motors to provide haptic feedback based on the location of the obstacle.

B. Android Application: Reading

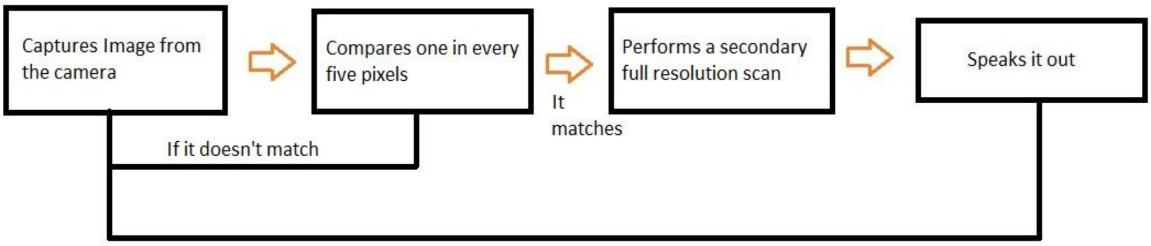
Figure 3 Reading Application

This application helps the blind people in reading text printed in books, newspapers, etc. It extracts text from the image being captured by the camera of the Android phone and speaks it out. We have used the Tesseract Optical Character Recognition Engine for extracting text from the image being captured. We have developed the continuous mode feature in this application, so that it keeps on reading the text appearing in front of the camera frame. To avoid errors in the text recognized, it takes in 5 consecutive frames for text recognition, based on which a single best string is generated, and then uses the android text to speech to read this string out.



C. Android Application: Object Detection

This application helps in detecting the objects required frequently in day to day activities. We used the OpenCV library on Android. OpenCV is a library of programming functions for computer vision. We attached Specific color markers to the objects. Color recognition involves checking the RGB values of pixels in the image captured by the camera. If the RGB values of a group of pixels match the RGB values of the markers, it has detected a particular object on which that specific marker was attached.



To increase the frame rate and to improve the performance of the phone, we have developed it such that it compares one in every five pixels, and if its RGB values match the values for the marker, it performs a secondary full resolution scan in the neighborhood of that pixel to get a count of the pixels that match the marker. This also gives an approximation of the distance of the object from the android phone.

D. Android Application: Navigation

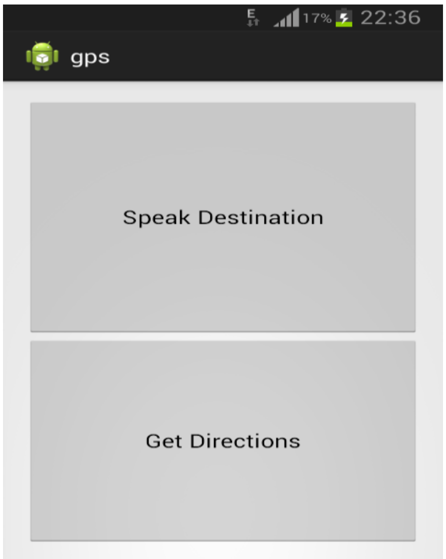
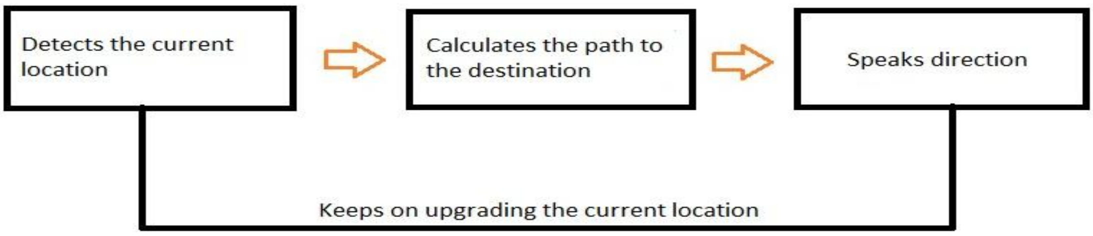


Figure 4 Navigation Application

This application helps in navigating to the desired destination. The application automatically detects the current location of the user using the GPS of the Android phone. It has two buttons, one is to speak the desired destination and the other is to get directions. Entering the desired destination is made easy using the speak destination button present in the application. It keeps on updating the current location of the user with time and speaks directions when necessary. The buttons are large enough so that the blind **person can use them easily.**



Working: The embedded device is held in the hand while walking. The two ultrasonic sensors on the front face of the device provide a wider range for detecting obstacles. Depending upon the location of the obstacle the motors vibrate with amplitude inversely proportional to the distance of the obstacle. Depending upon the region of the obstacle, whether the obstacle lies in region 1, 2, or 3, respective motors vibrate. While walking the third ultrasonic sensor stays horizontal, so if there is a footpath or a staircase the first and fourth vibrator motor vibrate simultaneously, whereas if there is a pothole, the fourth vibration motor vibrates.For reading application, the camera on the Android phone can be pointed to the text to be read. It extracts text from the image being captured by the camera of the Android phone and speaks it out. It takes 5 consecutive camera frames, and develops a single best string based on these frames and speaks that out.For searching required objects, the camera can be pointed anywhere in a room, as it detects the object it provides a voice output stating that it has detected a particular object. The object assigned to a particular marker can be initially entered in the android application based on which it speaks what object has been detected. To ensure a higher frame rate along with good performance of the device, it compares the RGB values of one in every five pixels with the RGB range of the markers, if it matches, it performs a secondary full resolution scan in the neighborhood of that pixel to get the number of pixels that match the marker, which also provides an approximation of the distance of the object from the user. For navigation, the desired destination is entered using the speak destination button. Then it calculates the path to the destination from the current location of the user as it has already detected the current location using GPS. Once the speak direction button is pressed, it speaks the first direction to the destination. After this is automatically speaks the directions whenever necessary by keeping track of the user's current location every time.

III. ACKNOWLEDGEMENT

We gratefully acknowledge the financial and technical support of SYSCON, IIT Bombay through the project.

IV. RESULTS AND CONCLUSION

Based on pilot studies conducted on a group of blind people, we concluded that, the reading application is good for reading small pieces of texts like labels, medicines, currency notes, etc. The accuracy of the navigation application depends on the accuracy of GPS in the region. The object detection application is good for detection of objects in around a radius of 2 meters. It is affected by the lighting conditions in the region where the object is located.The reading application can detect all languages, however text to speech engines for many languages are not available. This will be implemented with the development of text to speech engines.

The embedded device provides a good feedback for the distance and position of obstacles from the user. Proper alignment is essential while holding the device for better results.

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