Aid for Blind People using IoT

Atharv Phadnis[1], Nikhil Nimbalkar[2], Shubham Pagar[3], K.S Charumathi[4]

[1,2,3]BE Student, Department of Information Technology Engineering , MES Pillai College of Engineering, Navi Mumbai, India.
[4]Assistant Professor[4], Department of Information Technology Engineering, MES Pillai College of Engineering, Navi Mumbai, India.

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Abstract— *Our Society has many specially abled people, to work for their betterment and specifically for the visually impaired people, we have decided to lend them assistance through our project which is a combination of IoT and App Development. Blindness is a condition in which an individual loses the ocular perception. Self-reliability and Mobility for the visually impaired and blind people has always been a problem. Blind people face many difficulties while interacting with their nearby environment. This paper focuses on developing a Smart Walking Stick using the arduino to help the visually impaired people to walk more confidently by providing information about their environment. Ultrasonic sensors are used to detect obstacles, pits that lie ahead and to alert them of the same, thereby reducing the amount of accidents while walking. The stick is programmed to connect automatically to the Android phone using USB Serial Connection , for giving auditory feedback to the user and also for determining the best route to be taken to reach a new location by integrating GPS technology.*

Keywords: **Blind People, Arduino, Ultrasonic Sensors, GPS module, GSM module, Android app, Navigation ,Gestures**

1. INTRODUCTION

1.1 Fundamentals:

Visually impaired people face difficulty while interacting and feel their environment. They have little contact with their surroundings. Physical movement is a challenge for visually impaired people, because it can become difficult to distinguish obstacles appearing in front of them, and they are not able to move from one place to another. They depend on their families for mobility and financial support. Their mobility restricts them from interacting with people and social activities. Smart walking stick is specially designed to detect obstacles which may help the blind to navigate care easily. The audio messages will keep the user alerting constantly thereby reducing accidents. This system presents a concept to provide a smart electronic aid for blind people, both in public and private space. The proposed system contains the ultrasonic sensor to detect obstacles ahead using ultrasonic waves. On sensing obstacles the sensor passes this data to the arduino. All the feedback will be given to the blind man.

1.2 Objectives:

The main aim of the system is to provide an efficient navigation aid for the blind persons which gives them a sense of vision by providing the information about their surroundings and objects around them. Also this system provides SOS as well as calling system. Since the smart walking stick is a simple and purely mechanical device to detect the obstacles on the ground. This device is light in weight and portable. It provides the best travel aid for the person. The blind person can move from one place to another independently without the others help.

1.3 Scope

Blind people face many difficulties interacting with their nearby environment. Our main aim is to provide an environment which will help blind people to navigate, sense the obstacles, provide emergency alert for their betterment. We have decided to lend them a helping hand through our project which is a combination of IoT and App Development.

2. PROPOSED SYSTEM

2.1 Implementation

In the proposed system, the ultrasonic sensor is used to sense the obstacle distance from the user. This reference distance can be used to decide whether the user can move or not. The ultrasonic sensors work on the basis of sound.

The sound waves are transmitted ahead from the sensors towards the obstacle which can sense the distance up to a distance

The sensors are placed in different locations in order to cover maximum sides possible with minimum usage of the sensors. Generally, the blind person cannot see the objects present on the ground. So the sensor keeps track of the ground clearance providing necessary security measures. For the ultrasonic proximity sensors, a sonic transducer is employed to permits the interchange transmission and gathering of sound waves. The transducer emits the sonic waves which are mirrored by an object and returned within the transducer. The ultrasonic sensor will change to receiver mode when discharging the sound waves. The time elapsed between the emission and reception of the waves is proportional to the gap of the object from the detector. As soon as the obstacle is detected, the microcontroller checks if the barrier is close enough (100 cm from the user) to prevent the passage of the blind subject.

The architecture used is layered style. Two layered are used, Android and the Arduino. There are various functions in Android. Based on functions selection, appropriate procedure calls are made. If Navigation is selected, then first the procedure call of voice input is called, to enter the destination, then the procedure for Google Api is called to start the navigation. If Gesture Activity is called, the procedure call for gesture recognition is done. Based on the gesture drawn, the appropriate number is called.

Considering the second layer, as soon as the app is launched in android, the Arduino starts reading the data through all four sensors. For each reading in ultrasonic sensors, proper procedure call is made. The procedure call for pothole distance sensing and obstacle distance sensing are different. These sensors sense the distance and send the data whether a pothole is detected or an obstacle is detected. If an obstacle, then the obstacle detection algorithm checks left and right sensors. Calculating the values from all sensors it decides the appropriate direction and suggests it to the user. The data transfer between two layers takes place via universal serial bus. The data is then received in the above layer and thus appropriate decision is displayed as well as voice output is provided.

Thus, the Graphic user interface, Gesture detection, Navigation and display of direction becomes the part of first layer and Arduino and ultrasonic sensors become part of second layer. The GSM and GPS module connected to arduino helps to send the location of blind person when the SOS button on the stick is pressed.

(A) OBSTACLE DETECTION

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Step 1: front_dist = distance received from sensor 2 or front sensor.
Step 2: if (front_dist >=100 && front_dist <=200)
        alert that obstacle is ahead.Go to step 5
Step 3: calculate dist_right and dist_left i.e. distance from right and left sensor respectively.
Step 4: if right_dist<100 && left_dist>100
        alert Turn left
        else if left_dist<100 && right_dist>100
        alert Turn right
        else if left_dist<100 && right_dist<100
        alert Path is blocked
        else alert Turn anywhere
       go to step 1
Step 5: check dist_front again for closeness
Step 6: if (front_dist <100)
        alert obstacle is very close in front
       go to step 3
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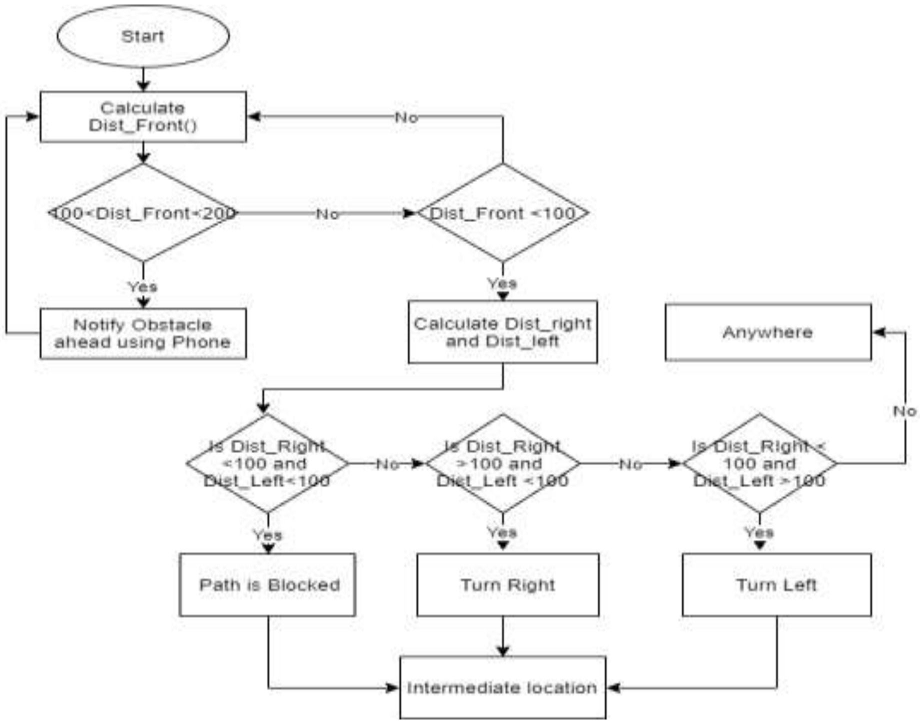

Fig1: Obstacle Detection Flowchart

(B) POTHOLE DETECTION

avg_value= (sum of 10 values)/10.

max_value= maximum of initial 10 values.

fluct_value= max_value-avg_value.

Threshold= 2*fluct_value+avg

The arduino calculates distance from ground with each loop, using the readings from the ultrasonic sensor, and compares the new value with threshold value calculated previously to check for potholes. A value greater than the threshold value indicates the possibility of presence of a pothole ahead of the user and the arduino sends a value to the android application to warn the user.

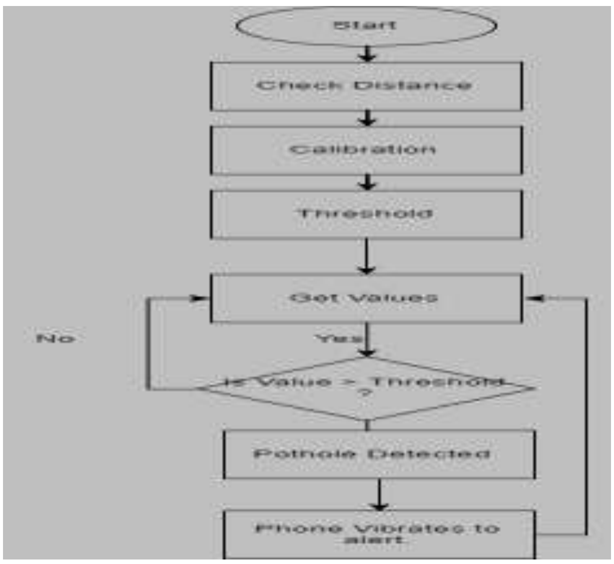

Fig2: Pothole Detection Flowchart

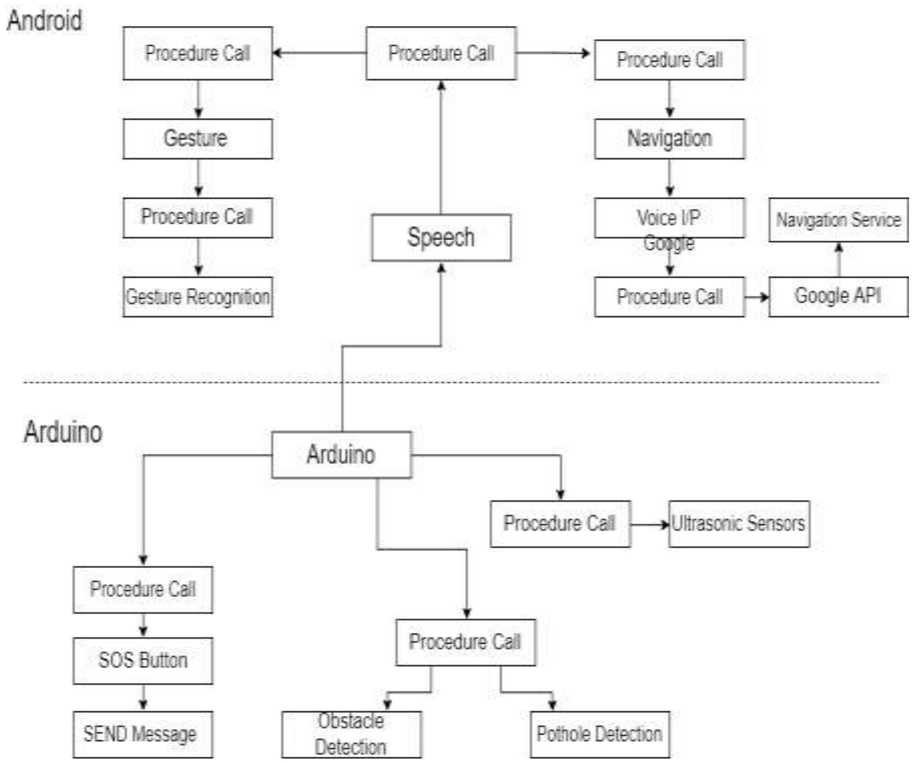

Fig. 3: System architecture for Smart Blind Stick

Fig. 4: Blind Stick Implementation

Fig 5: Obstacle Detection

Fig. 5. Pothole Detection

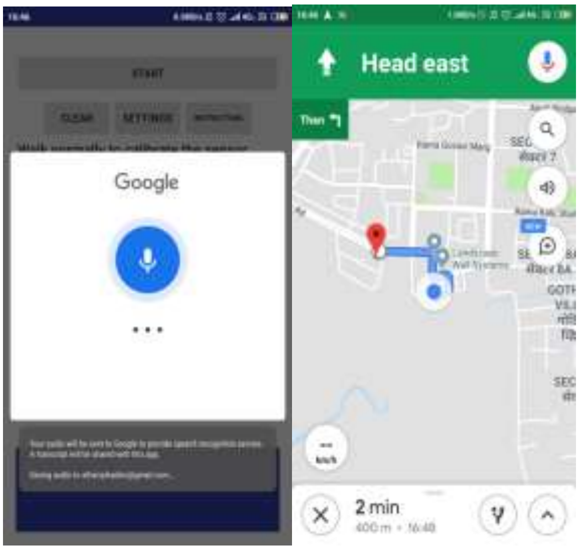

Fig. 7: Double Tap Navigation

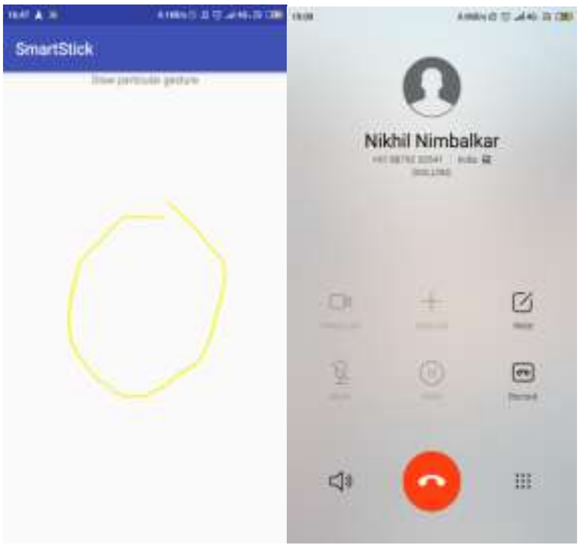

Fig 8. Gesture Recognition for Calling

2.2 Test Cases:

Table 1: Google Navigation on double click

Destination	Voice to Text Destination	Navigation Started?
Panvel Station	"Panvel Station"	Yes
CST Station	"CST Station"	Yes

Table 2: Gesture recognition for calling

Gesture drawn	Gesture Detected	Function called
"U"	"U"	call emergency contact 1
"V"	"V"	call emergency contact 2
"^"	"^"	call emergency contact 3

Table 3. Pothole Detection

Pothole	Output	Distance from ground	Result
pothole present	"pothole detected"	30	accurate
pothole not present	"pothole detected"	27	error
pothole not present	no output	18	accurate

Table 4: Obstacle Detection

Obstacle from	Output	Range (cm)	Result
front	"obstacle ahead"	142	accurate
front	"obstacle ahead turn anywhere"	76	accurate
front and left	"turn right"	70	accurate
front and right	"turn left"	81	accurate
front and left and right	"turn right"	60	Error
front and left and right	"path blocked turning suggested"	71	accurate

3. CONCLUSION

The smart walking stick, constructed with at most accuracy, will help the blind people to move from one place to another without others help. This could also be considered a crude way of giving the blind a sense of vision. This stick reduces the dependency of visually impaired people on other family members, friends and guide dogs while walking around. The proposed combination of various working units makes a real-time system that monitors the position of the user and provides dual feedback making navigation more safe and secure. The smart stick detects objects or obstacles in front of users and feeds warning back, in the form of voice messages rather than vibration. The advantage of the system lies in the fact that it can prove to be a low cost solution to millions of blind people worldwide.Another advantage of the system is that it helps the blind people in both indoor and outdoor, care-free navigation. The devices placed in the stick makes it comfortable and easy to handle. The smart stick helps in detecting obstacles placed at a distance in front of the user. The system is suitable for both indoor and outdoor environments. The information regarding obstacles is given through voice alerts, eliminates the difficulty of understanding vibration patterns which was used in earlier systems. The system is a moderate budget mobile navigational aid for the visually impaired.

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