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AN EYE FOR A BLIND: ASSISTIVE TECHNOLOGY

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Abstract - *This paper putforths the idea about a device and an android application for visually impaired person that helps them live a better life. The project focuses on a device that has sensors and few other computing components mounted on to it. Here four different modules are considered. Obstacle detection is used to detect a hurdle around the visually impaired with the help of Infrared sensors and alert is generated. Android phone inbuilt GPS system and Google Map is used to implement the live tracking module. Fall detection is used to inform the guardian if the person is involve in any sudden mishap (like a fall) and then an alert will be sent. Scene detection helps in identifying the object or a scene of the surrounding area of that person with the help of camera inbuilt in smart phones.*

Key Words: **Infrared Sensor, Obstacle, Image Processing, Scene, Accelerometer, Cloud, Distance measure, HSV Colour model.**

1. INTRODUCTION

In recent years, numbers of people suffering from blindness have increased rapidly. The basic reasons behind these are the ever growing accidents taking place in day to day life. In order to avoid such mishaps we have designed a system which will implicitly help the blind to life a secure and better life. Being visual impaired always gives an inferiority complex to the person due to what he feels completely dependent and depressed [1]. This system will also help the person to be independent and live an ordinary life. Across the globe and in India, the rapid growth of visually impaired has led to a phenomenal progress in this invention sector.

Devices which are already available in the market may be bulky and costly which cannot be affordable by a common man. Considering the above aspect, the system is made compact by mounting few components on a single board making it less bulky and cost efficient. The system can then be purchased by people who are financially weak.

Assistive devices are a key aspect in wearable systems for biomedical applications, as they represent potential aids for people with physical and sensory disabilities that might lead to improvements in the quality of life. This project is comprises of Obstacle detection, Live tracking, Scene detection, Fall Detection.

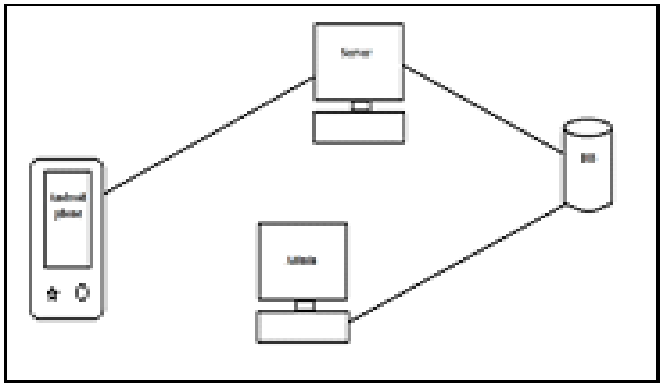

Fig -1: Skeleton of Device.

2. EXISTING SYSTEM

Technology is a ray of hope for disables to live an independent life. This technology is nothing but an Assistive Technology [1] [10] [11]. This technology is usually high in price. Guide cane is one existing system which when compared to the normal white stick commonly used by the blinds is heavier [5]. A servo motor and a joystick are mounted on the top of the system which helps in the navigation. 10 ultrasonic sensors made it more bulky and it also could not detect an object at the line of sight [7]. Precisely, it could detect the obstacles within a specified periphery in all directions making the conclusion to be vaguer.

Similarly, a smart cane was also invented. Four buttons printed with different directions are present on the stick. In order to detect the direction of a blind person RFID tags are provided. Previously, the system consisting artificial vision, object detection and location information using GPS was proposed [5] [8]. It provides with the Static and Dynamic information of the surrounding around blind person. Arduino board has been interfaced with the array of ultrasonic sensors and standalone GPS receiver with magnetometer was also used [3] [2].

A torch on the top, a horn for traffic, vibrating sensors, high intensity LED's which was equipped on the stick. Ultrasonic sensors used here were having a range of 20-350cm. On the other side infrared sensors to detect small obstacles are also used which help them having the range of 2-10cm.

The system thus was so designed having button sensors on hollow stick. The stick provides the medical condition by calculating or checking the high pulse rate or low blood pressure of the person.

3. PROPOSED SYSTEM

The system is so designed for a visually impaired person who consists of an android application on android phone that uses the inbuilt Bluetooth, camera and accelerometer.

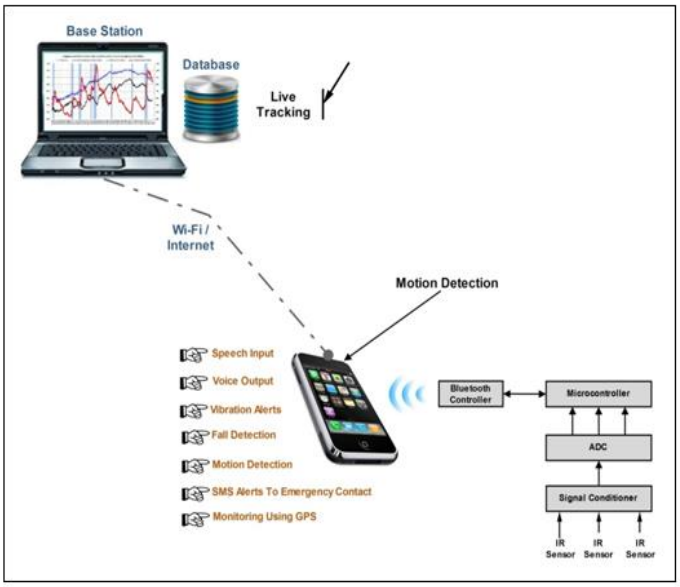

Fig -2: System Architecture.

Smart phone is connected to the device which consists of various hardware components using the Bluetooth connection, and it is connected on a single network with the server. The various Modules of the system are as follows:

3.1 Obstacle Detection

Infrared sensors are mounted on the board. These sensors will calculate the value and detect the obstacle. The visually impaired will be notified with the help of TTS (Text to Speech).

3.2 Live Tracking

This module is used to detect the location of the visually impaired with the help of GPS (Global Positioning System). The guardian has the ability to find the exact location of the blind.

3.3 Scene Detection

A training data set comprises of the scenes of different surroundings. By keeping the camera on of an android phone, the phone will try to detect the scene as per stored in to the database. With the help of TTS it would notify the user about the scene where he is present.

3.4 Fall Detection

While a mishap takes place with the blind, the guardian will be notified by sending a message. Along with this a buzzer will activate and inform the people around him. First, the system will ask for a mobile number on to which it will send a message and then this number will get stored in the database.

4. HARDWARE REQUIREMENTS

Various hardware components are required for building the system and computing the results. Different hardware components required are as follows:

4.1 Infrared Sensors

Infrared sensors are mounted on three sides. They are light in weight. They detect the objects at the line of sight. Infrared sensors having range of 15cm are mounted on left, right and front side. It detects the obstacle within its range.

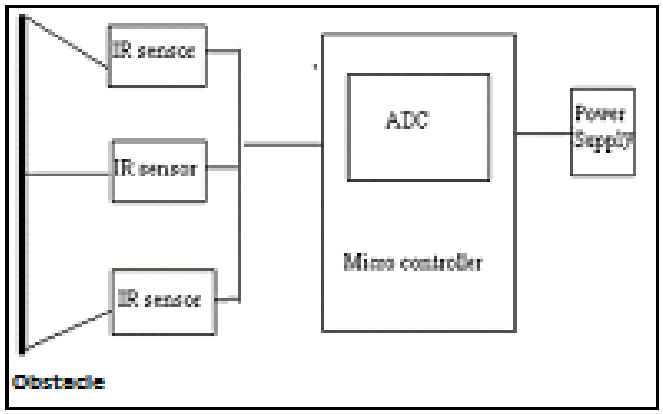

Fig -3: Infrared Sensors

4.2 ADC

Analog to Digital convertors are used to convert analog signal to the digital signal. The original data that is received by the system is in the analog form after pre-processing, the data is processed to obtain the digital values.
Threshold is calculated as soon as the values from sensors are obtained. This value would lie in between 0-255. If the value lies in between 0-127 then it is considered to be low whereas if it is on the upper side that is 128-255 then it is considered as high.

4.3 Micro controller (ATMega32)

ATMega32 is a microcontroller of AVR Family. It have 4 ports consists of 40 pins.

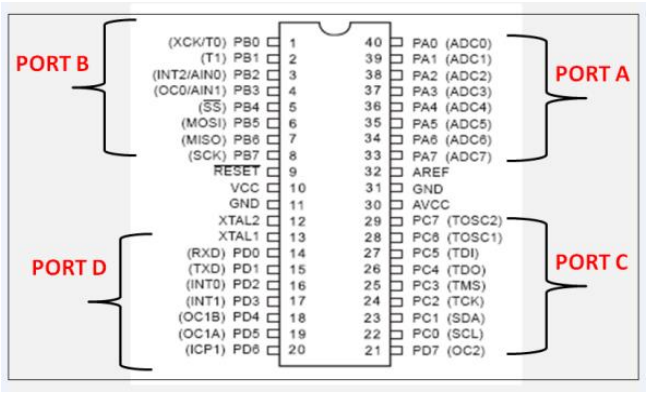

Fig -4: ATMega 32 Pin Diagram.

4.4 Accelerometer

Accelerometer is built in into the Phones. It helps to detect the fall in a sequential order. It gives the value of x, y, z coordinates. Whenever a fall is detected the value of the particular infrared sensor decreases rapidly.

4.5 Max32

The MAX232 device is a dual driver/receiver that includes a capacitive voltage generator to supply TIA/EIA-232-F voltage levels from a single 5-V.

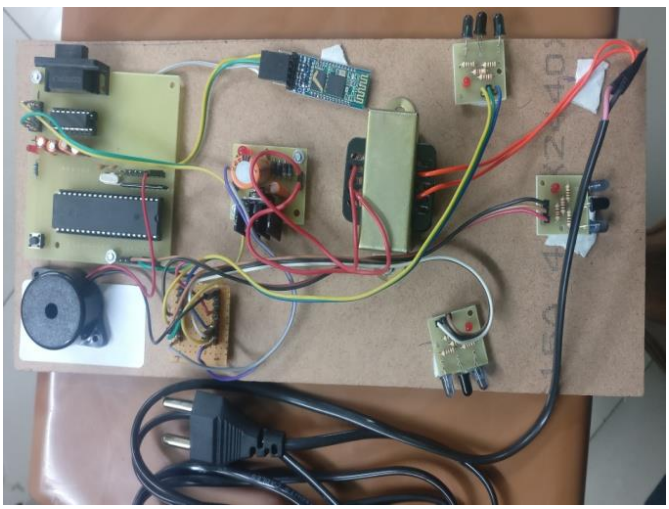

Fig -5: Hardware

4.6 Other Hardware Components

Bluetooth is used to connect the android phone to the hardware. This Bluetooth component will have a predefined MAC address.

Buzzer gets activated as soon as a fall is detected. It is used to notify the people near the blind person.
Battery used is of 5 volt. The entire hardware works on this battery. It makes sure that right and required amount of energy is supplied to every component.
Capacitors - there are 2 capacitors, one is of 22pF, and second one is of 10uF.
Few Register and LED's are also used.

5. SOFTWARE REQUIREMENTS

(i) Glassfish Server
(ii) JDK 1.6 and above
(iii) IDE Eclipse ADT
(iv) NetBeans 7.1 and above
(v) AWT or Swing and TomCat Server
(vi) MySQL Database [1].

6. SYSTEM WORKING

An android application is provided named 'blind stick'. This application consists of an IP address which is a by default address for a particular laptop. If this IP is not present then an IP is assigned dynamically. An emergency number is to be provided at an initial stage to inform the guardian and to store the guardian's number in the database. A continue button will redirect to the main menu activity page. This page contains 4 buttons:

6.1 Walk through Objects

On pressing this button, automatic Bluetooth and TTS activation takes place simultaneously. Further it will provide with all nearby active devices. If no devices are found, it will scan by itself. On detecting the hardware with active Bluetooth, the android phone will pair with it. Android phone and the hardware are connected by Bluetooth whereas the android phone and the server are connected through the hotspot. Two buttons are provided, ON SYSTEM AND OFF SYSTEM. An option has been given to either start the system manually or by TTS by pressing the speak button provided at the centre of the screen. By pressing the ON SYSTEM button manually, the system starts detecting the IR values. 3 IR sensors are provided, first to detect the left hand side, second to detect the right hand side and third to detect the front side. The sensors would detect the values. Whenever an obstacle is present on either side of the hardware the value of an IR sensor would rapidly decrease. On detecting an obstacle the phone will vibrate and give a TTS of where the obstacle is present.
A recognise button on the main screen will automatically open a Camera which is used to capture images. It also has detected object button which is used to detect objects with the help of the trained data, previously captured images which are stored in the database. Detect scene button is used to take a video and later helps it to compare with the real

time surrounding in order to detect the scene where the blind is present. Motion detection is used to ensure that the blind is not in a stationary position and is optional.

6.2 Train New Objects

Three sub options are provided with this button:

6.2.1 Scene Training

It is used to capture the video/scene or the pictures. In order to start with the video, one needs to select this button.

6.2.2 Object Menu

Object menu helps to store a number of objects. Each object can be named according to the characteristics

6.2.3 Scene Menu

Scene menu helps to capture various different scenes. Once all scenes and objects are captured, the system approves the data set by confirming it with the user.

6.3 Detect Objects/Scenes

This button will help to detect an object with the help of a camera, which when focused at an object would try to relate with an object stored in the training data set. It would inform the blind about the object detected which is placed in front of him through TTS. Similarly, scene detection is used to detect the surrounding where the person is located.

6.4 Reset Memory

It will erase all the data in the training data set.

As described earlier after the connection of the smart phone with the hardware device and the server via Bluetooth and the IP address the starts its working. When the application show the connected status the system is ready to work.

Tap on/ provide speech input to walk through obstacle then switching the system on the device gets ready to detect the obstacles. Here the IR sensors on the hardware device placed on its Left, right and front side emits the radiation continuously. When any obstacle appears near the device the rays emitted by the IR will be reflected back on the IR receiver and the signal is then transmitted to the ADC. ADC converts the analog signal into digital signals that are required for the further computation. Atmega32 microcontroller accepts these digital signals and performs computation which will compare these values with the threshold value. If the value is less than the threshold value the obstacle is detected and an alert message is given by the smart phone in the form of speech output. Simultaneously the status of the obstacle detected is updated on the server.

Meanwhile if any mishap happens and there is a sudden fall the built in accelerometer in smart phone collects the x, y, z-coordinate values. Euclidian distance formula is applied to calculate and compare the current coordinate values with the threshold value. if the value is less than the threshold value the fall is detected and an alert message is given by the smart phone in the form of speech output as well as the buzzer activates for a specific period of time to inform the people around. An alert message is sent to the registered number about the fall detected along with its location. Simultaneously the status of the fall detected is updated on the server.

For scene detection, number of objects and scenes needs to be stored and trained. This is done using train data button on that application which implicitly turns on the camera. Now the objects and scenes are captured and are registered. The training is performed on this data set with the help of RGB-HSV algorithm and stored in the database. When an impaired person wants to recognize the scene/object he needs to provide a voice input/press recognize button which open the camera. Now he has to capture the scene/object that is to be recognized. These captured scene/objects are then compared with the trained data set. If the match is found the voice output is generated about the registered information saved while training, otherwise it gives output as null.

For tracking the location of an impaired person, GPS in the smart phone is by default turned on which collects the latitude and longitude values and maps this location with the Google map. The latitude longitude values are updated as the person travels more than a kilometer than his actual location. This location is then stored on the server.

7. RESULTS

To examine the performance of the system that employs the Atmega32 microcontroller as well as the daily used smart phones unit testing is performed. Various experiments are conducted using the following variables and the assumptions.

i. Various types of the materials are used as an obstacle and is checked if it is detected such as stone. That is any type of opaque object can be detected using the IR radiations and obstacle detection is successfully implemented.

ii. In case of the Live tracking the location is updated on to the server after every 1km distance travelled by the visually impaired person and thus the guardian can keep track of its ward.

iii. Fall is detected as soon as the smart phone faces a sudden fall movement. Accelerometer is able to capture the x, y, z coordinates and calculate the acceleration in very short span of time and provide a speech output using the Text to Speech as well as the buzzer is activated for 3 sec. Along with this the alert message is sent to the registered number of guardian.

iv. For the scene detection, the object are trained. If the objects or the scenes are captured properly the training is completed successfully. When the user wants to identify any type of object again the scene needs to be captured using smart phone camera. If the scene is present in the dataset the available information about the object is provided using TTS and if not it give the output as NULL. Hence, the scene detection is successfully implemented.

Here as we are using the IR sensors of limited range of up to 15cm the obstacle on any side is detected within the range. Most of the material provides the characteristic of infrared ray reflection so most of the obstacles are detected without any constraints.

The detection of the scene and the object depends on the trained dataset so if the training is done precisely the detection is performed successfully.

Good internet connection is required for the calculating and mapping latitude and longitude with the location using Google Maps.

8. CONCLUSIONS

Therefore we conclude that, this application is an integration of Obstacle detection, fall detection, Scene detection and Live tracking which assists the visually impaired person to tackle few hurdles in day to day life [1]. Various objects stored in the dataset are recognised using camera. The IR sensors mounted on three sides that are right, left and front helps to detect the obstacle. The given application that consist of various combinations of the working modules makes the system more reliable and efficient taking into consideration the real time issues of the visually impaired person. Smartphone usage help the user to grab an immediate response to the fall event, and using the TTS feature alarms the neighbouring people, so the impaired person can receive an instant help along with the notifying his guardian. Visually impairer's location can be detected with the help of the GPS provided by Google.

9. FUTURE SCOPE

i. Infrared sensors of better quality could be used in order to increase the range. An alternative to these sensors are the laser sensors which are more powerful as compared to infrared sensors while considering the distance aspect.

ii. Battery of higher volt can be used.

iii. The hardware can be more compact by using advanced components. It can be embedded in particular device in future.

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