ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 5, Issue 5, May 2018

Visual Impairment Aid Using Obstacle And Scenery Detection With Different Modes of Feedback

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Abstract- **Implementation of a device is presented that can be used to assist the visually impaired people. It can help the blind person to pass through the way by avoiding hurdles using haptic and voice feedback by integrating the device with mobile phone. It informs about his/her location to others(caretaker) through a message on the mobile device. It can help his/her caretaker (in case he is not near to the blind person) to locate him using the received coordinates from the communication module of device having Global Positioning System (GPS) and Global System for Mobile Communication (GSM) technology on the mobile. This device is physically realized by interfacing infrared sensors and communication module such as Bluetooth (HC-05). Scenery detection is to be done using image processing algorithms.**

Index Terms— Visually impaired, GPS, GSM, HC05, Mobile.

I.INTRODUCTION

According to The International Agency for the Prevention of Blindness, there are 253 million people are living with visual impairment. Visually impaired people have to come across many difficulties in their day to day life. Several medical conditions limit their ability to obtain sufficient information about their environment. The knowledge of surrounding is very essential for such people to evade the obstacles and reach to their desired destination. The main objective of this system is to monitor the visually impaired people with different modes of obstacle detection and alerts. This system also provides the facility of object and scenery detection with voice feedback and monitoring via GPS & GSM. GSM and GPS system helps to inform the location of the blind person to the mentioned number of his/her caretaker.

II. LITERATURE SURVEY

Syed Tahir Hussain Rizvi et al. implemented wearable glove with haptic and voice feedback [1]. It navigates the path to the blind person and informs about his/her location to others through a message on the mobile device. To locate a person Global Positioning System (GPS) and Global System for Mobile Communication (GSM) technologies are used. The system consists of Arduino microcontroller board which has all the sensors, actuators and communication modules connected to it. A Sonar Sensor is used for long distance measurement. A Voice Box Shield is inserted to convert the serial commands into sound so that the blind person can hear that information regarding the exact distance of obstacle. The drawback of this system is its size and the weight as so many devices are placed on the gloves.

Duane J. Jacques et al. used object tracking and vision-based robot control (visual servoing) which is a technique that uses feedback information extracted from a vision sensor to control the motion of a robot [2]. The System includes camera to analyse a scene and recognize a desired object, then generate tactile cues to the wearer to steer his or her hand towards the object. This system uses video data to analyse a scene and recognize a desired object by using attributes such as shape, color, and nominal size. When an object is found, the distance of its centroid from the centre of image is used for generating control signals which gives the motion cues to the user's hand. There are some challenges in the system, such as the variable lighting conditions in the uncontrolled environment caused by shadows being cast by the user on the scene, and the unanticipated, inaccurate movements of the user's arm. Another issue is thickness of the glove must also be traded off against signal strength, since some users, especially users with smaller hands could not feel anything from the motors due to the amount of fabric between motor and skin. The system does not give satisfactory result when image resolution is high as it increases complexity in processing.

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Yi-Qing Liu et al. used ultrasonic sensors in the system which consists of a crutch and a bracelet [3]. The crutch can detect the obstacles in front with ultrasonic sensors which uses angle sensor. The bracelet would vibrate when the obstacles are detected to notify the user. While walking, ultrasonic detectors in the stick emit ultrasonic waves and determine the distance of the obstacle. When the distance is less than three meters, the stick would send signals via Bluetooth to the bracelet, the bracelet will vibrate to notify the blind. Depending upon the distance of obstacle the intensity of the vibration will be changed. This system has user's location monitoring capabilities. As per the result, detection of the object depends on the size of the object. When the object size is greater like car or tree it can be detected from long distance approximately 260 cm but when object size is small like cat or brick it cannot be detected until the object get closer i.e. less than 1 meter.

Menikdiwela et al. proposed a product concept similar to the conventional white cane in appearance and it is fabricated using ultrasonic sensors, a vibrator motor scheme, a controller and a power unit inside the walking stick with haptic perception for the visually impaired people [4]. A sensor system comprises of ultrasonic sensors to acquire obstacle distance. Distance is felt by the user in terms of the vibration intensity change. This system does not include any voice feedback, scenery detection and object detection. Another limitation is it does not provide location monitoring of user.

III. PROPOSED WORK

This system is physically realized by interfacing infrared sensors and communication module (i.e. Bluetooth simulator) with microcontroller Atmega32. An android app is created for interacting with the hardware module.

The proposed system provides the following functionalities-
1) Object detection on android smart phone
2) Scenery detection on android smart phone
3) Obstacle detection with haptic(vibration) and sound feedback.

Techniques used for following functionalities are explained one by one.

1) Object detection using android smartphone:
Primarily, an RGB image is captured by an android smart phone. Then, the image is transformed into grayscale. After the grayscale image obtained, the edges are detected from the image, for detecting the edges sobel operator algorithm is used. After the resulting image obtained, blob detection algorithm is applied on the image for boundary detection of the object. Once the boundaries of objects are detected, cropping is done. The objects obtained are converted from RGB to HSV, firstly the RGB separation is done i.e. R, G and B are separated. Now, the maximum and minimum value is considered of the R, G and B. The difference between maximum and minimum are stored in temporary variable for defining the HSV values. By
using, the defined algorithm the Hue, Saturation and Value are obtained. Now the objects are compared with the already saved database of objects and the resulting output is generated, if the final result is matching, then the object is recognized otherwise it is considered as not found.

2) Scenery detection using android smartphone:
There are two parts of scenery detection, first is 'Scene Training' and second is 'Scene Detection'. In scene training database required for Scene Detection is created. All captured RGB images are converted into HSV. Then the histogram is generated, labelling is done and labelled data is stored in database. In scene detection the camera captures RGB image which is converted to HSV. The histogram is generated using new image. Then the comparison is done using Euclidean Distance with data present in database. Depending upon the result given by comparison the scene is identified. And voice feedback is given to the person.

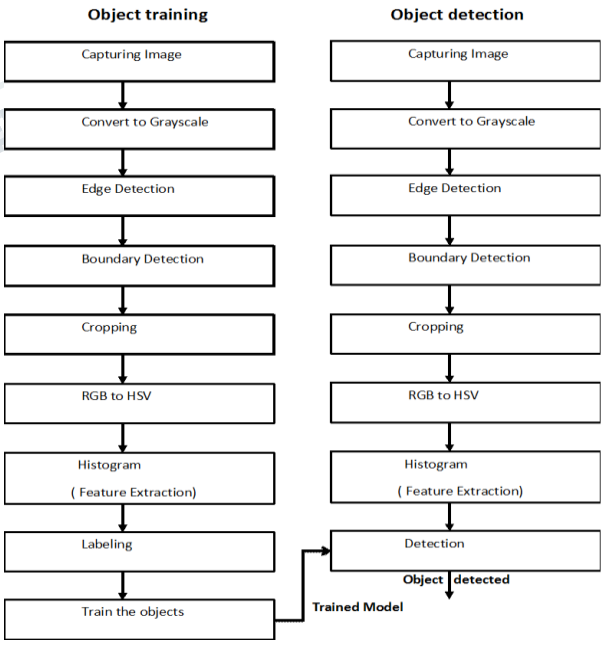

Fig. Flow diagram of object detection

3) Obstacle detection with haptic and sound feedback:

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For obstacle detection a device is made mainly using microcontroller atmega32, Bluetooth simulator HC05 and IR sensors. This device has interfacing with the android application through HC05. As soon as the device is given power supply, IR sensors starts sensing the nearby obstacles. A threshold limit is set in the android applications for obstacle's distance. If IR sensors senses any obstacle below that threshold, microcontroller starts sending digital values to the application and application gives sound feedback as "Obstacle detected". If the obstacle comes closer then app starts giving haptic feedback. Application also sends the GPS values of the visually impaired person to his/her caretaker through text message after a regular time period.

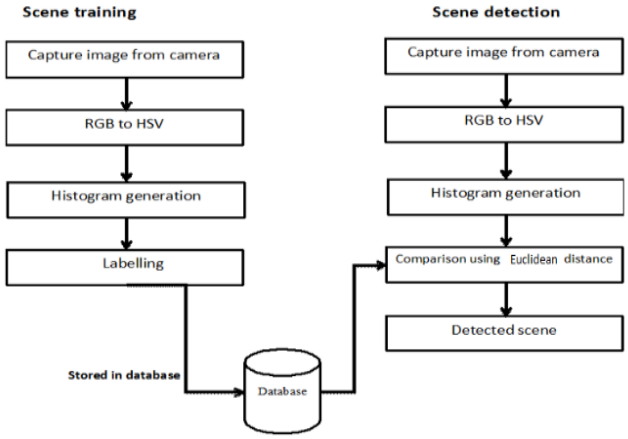

Fig. Flow diagram of scene detection

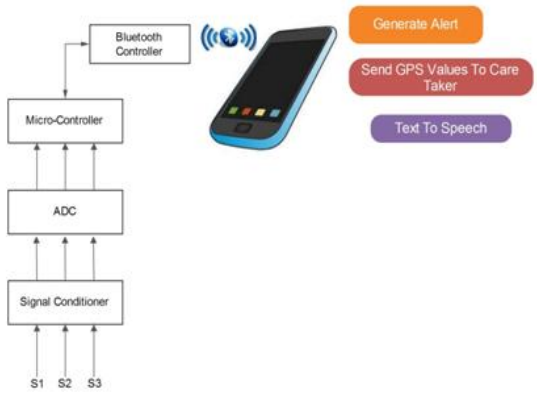

Fig. Block diagram of proposed system

IV. USED HARDWARE COMPONENTS

The following hardware components are used in the proposed system.

1) Atmega(32)

Atmega32 is an 8-bit high performance microcontroller of Atmel's Mega AVR family. Atmega32 is based on enhanced RISC (Reduced Instruction Set Computing) architecture with 131 powerful instructions [1]. Most of the instructions execute in one machine cycle. Atmega32 can work on a maximum frequency of 16MHz.It has fourteen digital input output pins and six analog input pins. It has a flash memory of 32 KB. It has an EEPROM of 1 KB and a SRAM of 2KB. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1MIPS per MHz. The most common implementation of this chip is on the popular Arduino development platform, Arduino Uno and Arduino Nano models. Other devices such as sensors, actuators and communication modules are connected with this microcontroller board.

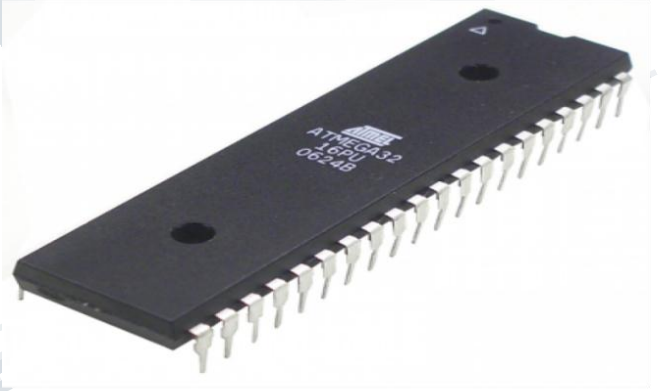

Fig. Atmega(32)

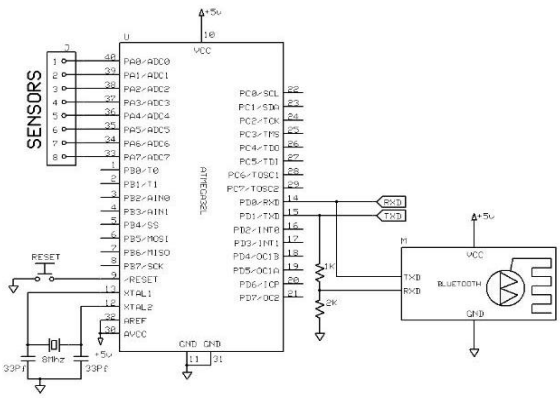

Fig. Pin diagram of proposed system

2)Infrared Sensor

ISSN (Online) 2394-6849

International Journal of Engineering Research in Electronics and Communication Engineering (IJERECE)
Vol 5, Issue 5, May 2018

An infrared sensor is an electronic device which is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. They are also capable of measuring the heat being emitted by an object and detecting motion. An IR sensor is basically a device which consists of a pair of an IR LED and a phototransistor which are collectively called a photocoupler or an opto-coupler. The IR LED emits IR radiation, reception and/or intensity of reception of which by the phototransistor dictates the output of the sensor.

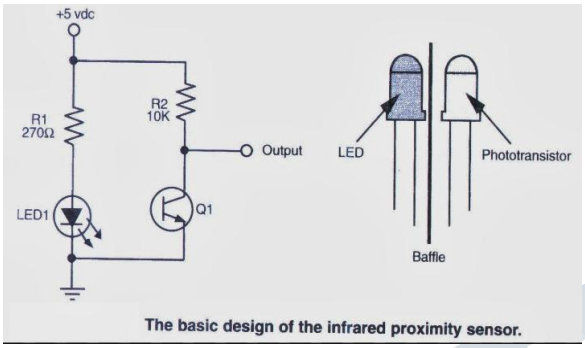

Fig. Infrared sensor

3) Bluetooth Simulator

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Proposed system is using Bluetooth simulator for interfacing between hardware and software.

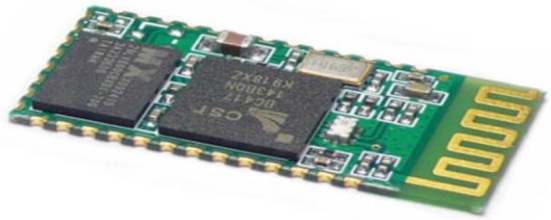

Fig. Bluetooth simulator

V. FINAL PROTOTYPE

This figure shows the final prototype of the device.

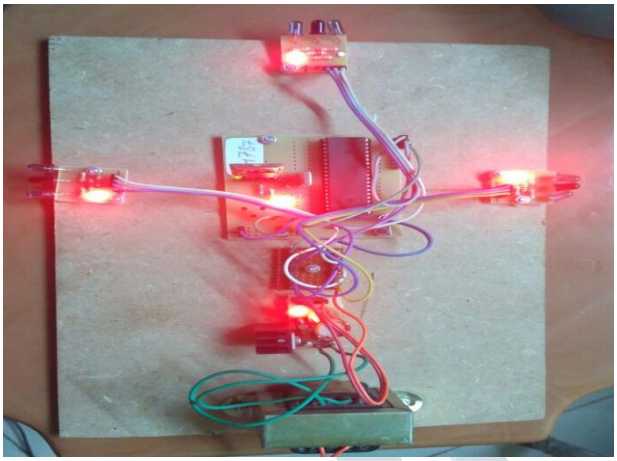

Fig. Final prototype of the device

In the application, sensor values deflect within the range 0 to 255. Threshold value is set as 200. If any obstacle crosses the threshold value, voice feedback is given that "Obstacle is detected".

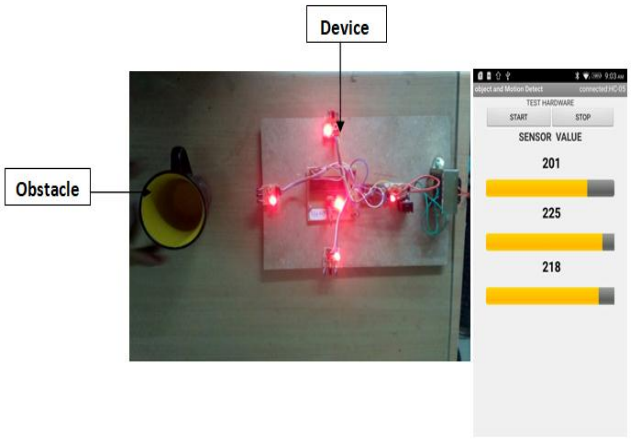

Fig. Obstacle detection

VI. FUTURE SCOPE

This system includes voice feedback for blind person, but the navigation system can be added to give path from source to destination. The size of the wearable device can be made more compact and user friendly by integrating all hardware and sensors onto smaller chip or board while making it as final industrial product.

CONCLUSION

In this paper, implementation of a device for visually impaired person is presented. Proposed system is designed to scan the hurdles in a specific path and to notify the user

with the aid of haptic and voice feedback. It does not only notify about hurdles but also informs the location of the user to the caretaker.

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