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Smart Tool Kit For Visually Impaired People

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Abstract

Blind stick is an innovative stick designed for visually disabled people to improve their navigation. The visually impaired have to face many challenges in their daily life. The problem gets worse when the stick is misplaced. This paper presents a technical concept to provide a smart ultrasonic aid for blind people. Our proposed project first uses ultrasonic sensors to detect obstacles and potholes ahead using ultrasonic waves. Unlike the other projects, it uses RF transceiver which notifies the blind person through the buzzer in a constrained area to find the misplaced stick by the blind person himself. In turn if the smart stick is misplaced in a far of place, a message is sent to the concerned care taker. The aim of the overall system is to provide a low cost and efficient navigation aid for a visually impaired person, who gets a sense of artificial vision by providing information about environmental scenarios of static and dynamic objects around them. The output is in the form of vibrations or sequence of beep sound which the blind person can sense and hear. In this connection, we are incorporating the blind stick with a wrist band through which the blind person can track his stick. Adding up to this, we have integrated the above features using the mobile application which in turn helps the caretaker to track the blind person in case of emergencies.

Keywords-Ultrasonic sensors, Arduino transceiver, Encapsulating security payload(ESP), Visually impaired people, Mobile application.

Introduction

God has gifted sense of vision to the human being which is an important aspect of our life. But there are some unfortunate people who lack the ability to visualize things.

The visually impaired have to face many challenges in their daily life. The problem gets worse when they travel to an unfamiliar location. Only few of the navigation systems are available for visually impaired people and can provide dynamic navigation through speech output.

None of these systems work perfectly for both indoor and outdoor applications. The proposed device is used for guiding individuals who are partially sighted or blind. This device is used to help blind people to travel with the same ease and confidence as sighted people. RF transceivers are installed and also integrated into blind person's walking stick. The whole device is designed to be small and is used in conjunction with the white cane.

This device is connected to an android phone through Bluetooth. An android application is designed based on RF transceivers read and updates person's location information on the server.

In addition to this one more application is designed for family members to access the blind person's location through the mobile application whenever needed.

Related works

Though only a few systems are commercially available, extensive research has been conducted to facilitate the mobility of the visually impaired, mostly in the area of navigation and obstacle detection [1]. Little research has focused on walking on a straight path as well as following a given path while avoiding obstacles. However, when considering the practicality of such systems, they are suited only for test or training environments

A. Bluetooth Detection

Once the Arduino board is connected with an Ultrasonic Range Finder, it detects the distance information and prints it on the serial monitor. [3] To transfer this information to an Android phone, we use a Bluetooth Shield. This Bluetooth Shield enables the pairing between Arduino Board and the Android Phone. Once the distance value is obtained, it is send to an android device via Bluetooth.

B. Heat Detection

The heat detection is carried out using LM-35 Temperature Sensor. It helps in detecting the surrounding hot objects within the range -55 to 150 degree Celsius. LM 35 absorbs thermal radiations around the hot objects and converts it into voltage. The voltage is converted back into degree Celsius with the help of an Arduino program [2].

C. Obstacle Detection

K-Sonar [4] is a cane that can detect an obstacle at 5 meters in advance. This advanced detection not only enables users to avoid obstacles, but provides spatial information to recognize landmarks in the environment. The Palm sonar [6] is a palm-attached electronic mobility aid that uses an ultrasonic beam to assist the vision impaired to walk through obstacles toward destination without collision. Tele tact [7] is an infrared beam which sends a vibration through the cane when the infrared beam strikes an object, and the frequency of which increases or decreases according to the proximity of the object. These are only few of many navigational assisting canes that has been developed for visually impaired. However, none of these systems estimates the width of the obstacle or guides the user to avoid the obstacle.

D. Obstacle Avoidance

Guide Cane [5] is a robot cane designed to help visually impaired travelers to navigate safely and quickly among obstacles and other hazards. It comprises of a sensor head (ultrasonic sensor array) mounted on a steerable but unpowered two-wheeled steering axle. During operation, the user pushes the Guide Cane while the sensor head continuously detects obstacles and steers the device around it. The user feels the steering command as a very noticeable physical force through the handle and is able to follow the path of the Guide Cane. Even though this somewhat compensates for both the veering issue and obstacle avoidance, it requires a heavy robot cane which limits his freedom of movement. Surveys suggest that most of the visually impaired are concerned about the appearance of navigational assistance aid if worn in public

System Design and Implementation

The literature survey above indicates the existence of various equipment to assist a visually impaired user to navigate in the environment. Few of them focus on maintaining a relatively straight path. However, none of them incorporate a feasible solution that helps visually impaired to walk along a straight path in the presence of obstacles. Hence in our project we incorporate the usage of ultrasonic sensor which alerts the blind person regarding the presence of and obstacle or a pothole.

As an initial step this paper demonstrates the usage of ultrasonic sensors but further there is usage of GSM module as well as RF transceiver to alert the care taker and the blind person respectively in case the stick is misplaced.

A. Sensor Platform

This project is the sensor platform developed for research purpose. It is a modified stick, which contains two ultrasonic sensors. Purpose of this platform is to sense the user path to detect presence of an obstacle or a pothole. Therefore, one of the ultrasonic sensors are used to detect the obstacle presence [8] and another one is used to detect any pothole. Large number of hardware components are used, how each of these components are used to obtain the desired result are explained in detail in the following section.

Figure 1 shows the developed Smart tool kit for the research purpose. Ultrasonic distance measurement sensor is connected at the end of the cane at a height of 2cm from the lower tip, allowing obstacle detection in the range of 70cms and pit detection when a pit is present in the depth above 15cms in the user's path. Usage of GSM module in our project is a major advantage. This module overcomes the disadvantages which we came across in other papers. Global system for mobile communication(GSM) is an architecture used for mobile communication in most of the countries.

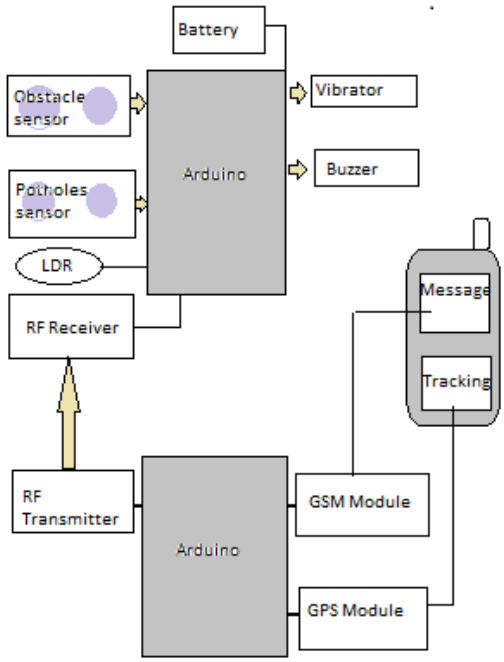

Fig. 1. smart tool kit

Gsm Module And Rf Transiciever

It is basically used to establish communication between a computer and a GSM system. Smart tool kit uses GSM module when the stick of the blind person is misplaced. Whenever the stick is misplaced a major inconvenience is caused, in order to avoid any danger causing to the blind person whenever the stick is misplaced the blind person should press a button which is in a form of a wrist band once the button is pressed a message is sent to a concerned caretaker regarding the given situation. Whereas the RF transceiver is used when the blind person loses his stick in a constrained area i.e. the stick is within his reach, in such case a buzzer rings through which the blind person can reach his stick if its present in the same room as he is.

Design Conceptualization

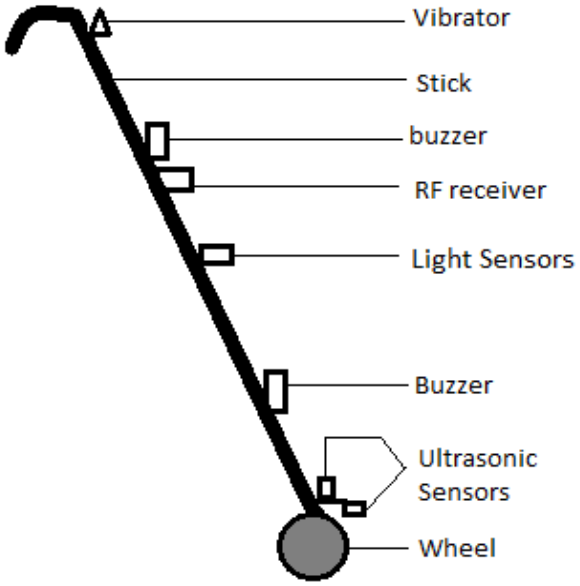

Fig. 2. Design approximation of the proposed model

On the basis of the analysis done, following design basics were conceptualized.

Easy to navigate:

Ease of navigation by avoiding the need to swing around the stick to detect and avoid obstacles since there are two sensors one for obstacle detection and the other for pit detection.

Detect Obstacles:

Detection of obstacles using non-contact means i.e. with the use of ultrasonic sensor.

Detection of pits:

Detection of potholes, low columns by using the same sensor in different direction. Since one of the sensors is mounted in an inclined top position and the resulting wave fronts can strike overhangs, any obstacle at a considerable height as in relation to the holder can be detected.

Streamlined for Indian scenario:

The stick which is developed can be used in Indian scenario wherein the crowd is generally unruly and the traffic conditions are bad. This is achieved by the fact that the integration of stick with sensors prevents the need for relaying on shore lining and other techniques employed generally by the blind for obstacle detection as, they invariably cause inconveniences to the fellow traveler.

Design Assumptions:

Stick should be only used for guiding purposes and not for upholding body weight.

Wrist band

The wrist band which is to be worn by the blind person whenever he wants to use the blind stick consists of two buttons. The first button primarily concentrates on the stick being misplaced in a wider range of area. In such cases the message is sent to the concerned caretaker once the button is pressed by the blind person. This is achieved by usage of GSM module. Adding Unto this, there is button two which is pressed by the blind person when the stick is in the same room as he is so that the stick has a buzzer attached to it, hence the stick would make a beep sound when this button is pressed. The stick is also attached with a GPS module which in turn helps the caretaker to track the blind person if he chooses to have a day out.

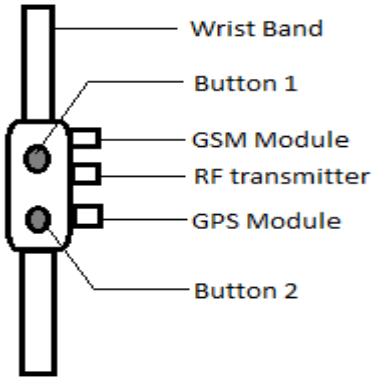

Fig. 3. Wrist band

Gps module and mobile application

Adding up to all the above features we also have added the usage of a GPS module through which we can track the blind person. In order to track the blind person using GPS we have developed a mobile application which uses the longitude and latitude on Google Maps through which expected output can be achieved.

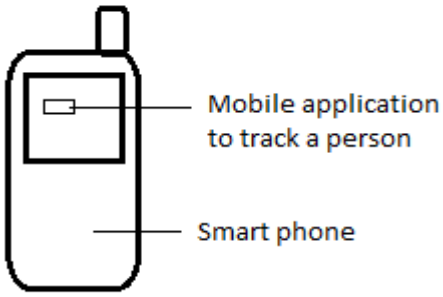

Fig. 4. Mobile Application On A Smart Phone

Light Sensor

Light sensor which is used is a very important aspect of our project. The senor keeps the blind person aware if he is entering a relatively dark area which in turn can cause him any danger. In such circumstances the light sensor used here will make a buzzer noise when the threshold of the darkness reaches and hence the blind person can know about it in advance.

Discussion

This paper has presented the feasibility of implementing the Smart Tool kit to detect the presence of obstacles and pits in the path of the user, and to detect the veering off from a desired direction of movement of the user. This work can be used to develop a system that includes a smart phone to track the blind person when he is going alone, that helps the caretaker to overcome any fear about the blind person. So, the system will be fully autonomous which allows the user to navigate freely. According to demonstrated results, the model developed in this paper can estimate the maximum possible width of the obstacle present on the path with an overall success rate of 84%. For nearer obstacles, the model has shown success rates as high as 90%. The success rate has gradually decreased when the distance to the obstacle increases. Hence, the reliability of the model has decreased with distance to the obstacle. The reason for this is the relatively low accuracy of ultrasonic sensor readings at higher distances.

Conclusion and future works

Paper commences on a discussion of how human tendency to veer has become a severe challenge to the visually impaired when traveling in the presence of obstacles. This paper is mainly concentrating on how to reduce the difficulty faced by a blind person in his day today life. Implementation of this system can bring about major changes in the lives of visually challenged people. The following model can be used to cut down the problems of visually challenged. The cost effectiveness can adapt to Indian scenarios as discussed in the paper. As the existing system can change to particular needs, it is viable for long term use as well as future development.

Further this project can have several other operations which is listed as future works. The blind stick can have audio signals so that the blind person can travel in a given direction without any interference. The audio signal which is used in our GPS application

through our mobile phone can be incorporated here. Heat sensors can be attached so that whenever there is any danger related to the temperature then the blind person will be aware of it. The ultrasonic sensor can be placed on the servomotor for 180-degree rotation so that it detects obstacles in 180- degree range.

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