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An Intelligent Walking Stick for the Blind

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Abstract— God gifted sense of vision to the human being is an important aspect of our life. But there are some unfortunate people who lack the ability of visualizing 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 available for visually impaired people can provide dynamic navigation through speech output. None of these systems work perfectly for both indoor and outdoor applications. In this paper, we propose a navigation device for the visually impaired which is focused on providing voice output for obstacle prevention and navigation using infrared sensors, RFID technology, and android devices. 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. The device has proximity infrared sensors. RFID tags are installed into public building 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 which gives voice navigation based on RFID tags read and also updates person's location information on the server. One more application is designed for family members to access the blind person's location through the server whenever needed.

Rest is followed by introduction, related work, proposed system architecture, advantages, conclusion, future scope, acknowledgement, references.

Keywords— Android, blind, Intelligent Navigation Device, Infrared sensors, partially sighted, PCB unit, RFID

Introduction

There are number of blind people in the society, who are suffering while exercising the basic things of daily life and that could put lives at risk while travelling. There is a necessity these days to provide security and safety to blind people. There have been few devices designed so far to help the blind.

Blindness or visual impairment is a condition that affects many people around the world. The usage of the blind navigation system is very less and is not efficient. The blind traveler is dependent on other guide like white cane, information given by the people, trained dogs [1] etc. Many virtually impaired people use walking sticks or guide dogs to move from place to place. A guide dog is trained for guiding its users to avoid the accidents from objects and barriers over a fixed path or in a fixed area. When a visually impaired person uses a walking stick, he waves his stick and finds the obstacle by striking the obstacles in his way.

The study of previously developed systems and analysis of the implementation methods used, led us to define a new system which could overcome the disadvantages in the previous systems. Therefore using the existing technologies we provide a solution to the stated problem.

The device has proximity infrared sensors which provide the vibration alert to avoid the obstacles. The RFID tags can be installed into public building and it is also integrated into blind person's walking stick through RFID sensor .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 which gives voice navigation based on RFID tags read and also updates person's location information on the server. Also, vibration alerts are provided through the smartphone on obstacle detection. One more application is designed for family members to access the blind person's location through the server, whenever needed.

This paper presents a system concept to provide a smart electronic aid for blind people. We propose to design an intelligent device which alerts the person on occurrence of obstacles based on distance between the person and the obstacle. Here, this intelligent device not only alerts but also traces the location of the person and informs the current position of the person to his relatives through the use of server.

RELATED WORK

Blind and visually impaired people find it difficult to travel in unfamiliar places because they do not receive enough information about their location with respect to traffic and obstacles on the way which can be easily seen by people without visual impairment. Now a days, there are different technologies like GSM, GPRS which help the blind people to navigate.

The systems which exist so far use GPS [2] for navigation and technologies like GSM or GPRS for sending emergency alerts to the relatives about current location of the blind person. The first system under study[3], uses GPS for outdoor navigation and RFID tags for indoors. But this solution has proved to be inefficient. The RFID sensor is used for detecting location of blind indoors and GPS is used for outdoor. For indoor navigation, the RFID sensor is attached to the walking stick of blind person and RFID tags are installed in all the areas that need to be identified. These tags serve as a landmark to the person using the cane. Each tag will be equipped with as much information as needed to clearly define the location of that precise tag (i.e. shops, names of places). The tag also contained additional information about direction and locations of other sensitive locations (i.e. Bus stops, telephone booths, subway stations, etc.). The RFID tag were covered by a protective shield to keep it safe from any harm. In outdoor the GPS is used to find the location of the particular place. The GPS which is fixed to the walking stick of blind person will help to give location information in outdoor. The Fig.1 below shows the block diagram of the same.

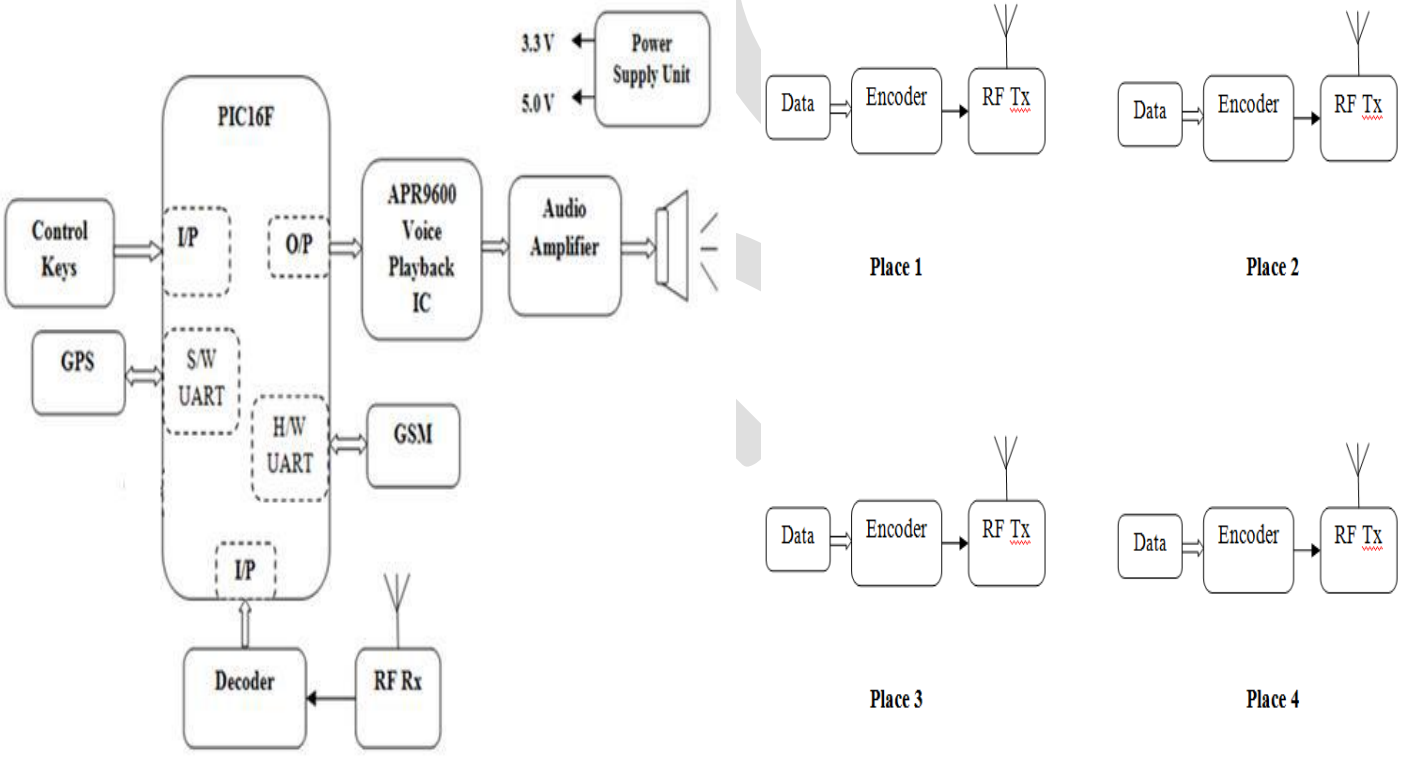

Fig. 1 Block Diagram of System using RFID tags and GPS

But this system has the disadvantage that using RFID tags along with GPS is expensive as two separate technologies are used for indoor and outdoor navigation respectively, and for location tracking. Also the logic has to be developed for identifying whether to use RFID tags or GPS system.

The other system [4] uses GPS and GPRS Technology. It also uses ultrasonic sensors for blind person's navigation which combines voice alert and vibration properties. These are developed for sending command to relative of person in the form of emergency SMS by system registered cell phone number. The system responds to it by transmitting its current coordinates in the form of Latitude and Longitude using a reply SMS to same Cell phone. The device uses the sensors to detect obstacles within the designed range and gives vibration alerts through a sound to the blind person to avoid the obstacle. This system is shown in fig.2.

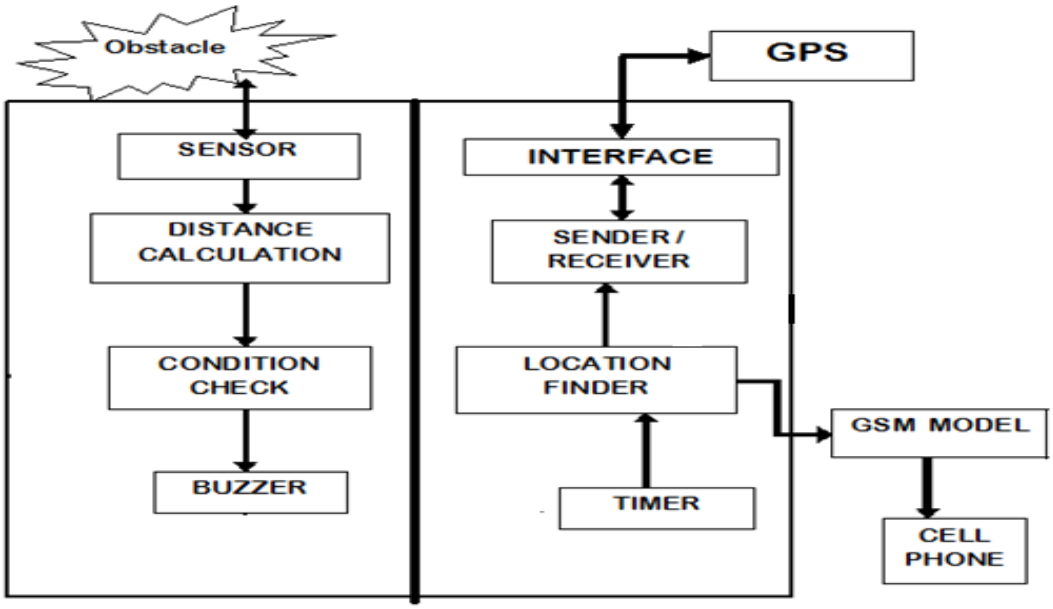

Fig 2. Block Diagram of GSM and GPS based System

This system has the disadvantage that the location of the blind person could be tracked only by using the specified cell phone number i.e. if the saved number in the system is lost or deactivated the location tracking would fail. Only outdoor navigation could be provided using GPS as GPS doesn't work for indoor navigation in India.

Thus, using these ideas we have come up with a device designed to alert the blind person with voice output as well as vibration alerts and update his recent location using GPS on a server which can be accessed by his relatives as and when need arises. The additional benefit being an SMS alert is sent in emergency situations.

PROPOSED SYSTEM ARCHITECTURE

The proposed device is focuses on the visually impaired people who cannot walk independently in unfamiliar environment. The main aim of our system is to help the blind people to move independently in the unfamiliar environment.Fig.3 shows the architecture of the proposed system.

The system has four main modules:

A. PCB unit and RFID sensor

The first is PCB unit, which consists of 89c51 microcontroller [5], Bluetooth HC05, MAX232 [6], ADC 0808 [7] and IR sensors. Along with these components, there will also be an RFID sensor.

89c51 Microcontroller is used to control the various elements on the PCB unit.

IR sensors are used for obstacle detection. IR sensors emits the infrared rays, so when obstacle, rays will be reflected to the sensors. The sensors will then transmit this data to the microprocessor which in turn, via Bluetooth transfers this information to the android application on the phone carried by the blind person. The phone gives vibration alerts and speech output to blind person.

RFID tags and sensors [8] are used to provide additional information about the location to the blind person as RFID tags are read by the sensor and speech output is given accordingly to the user.

This PCB unit is mounted on the white cane.

B. Visually Impaired Person's Android Application

Second part of the system is android application [9] in the visually impaired person's Smartphone. The relative or a family member of that person will have to start and configure the application. This android phone is connected and synchronized with the PCB unit through Bluetooth which is mounted on PCB unit. Android phone gives the speech output for obstacle detection or RFID tags read by the PCB unit to the user. It will also give vibration alerts when obstacle is detected.

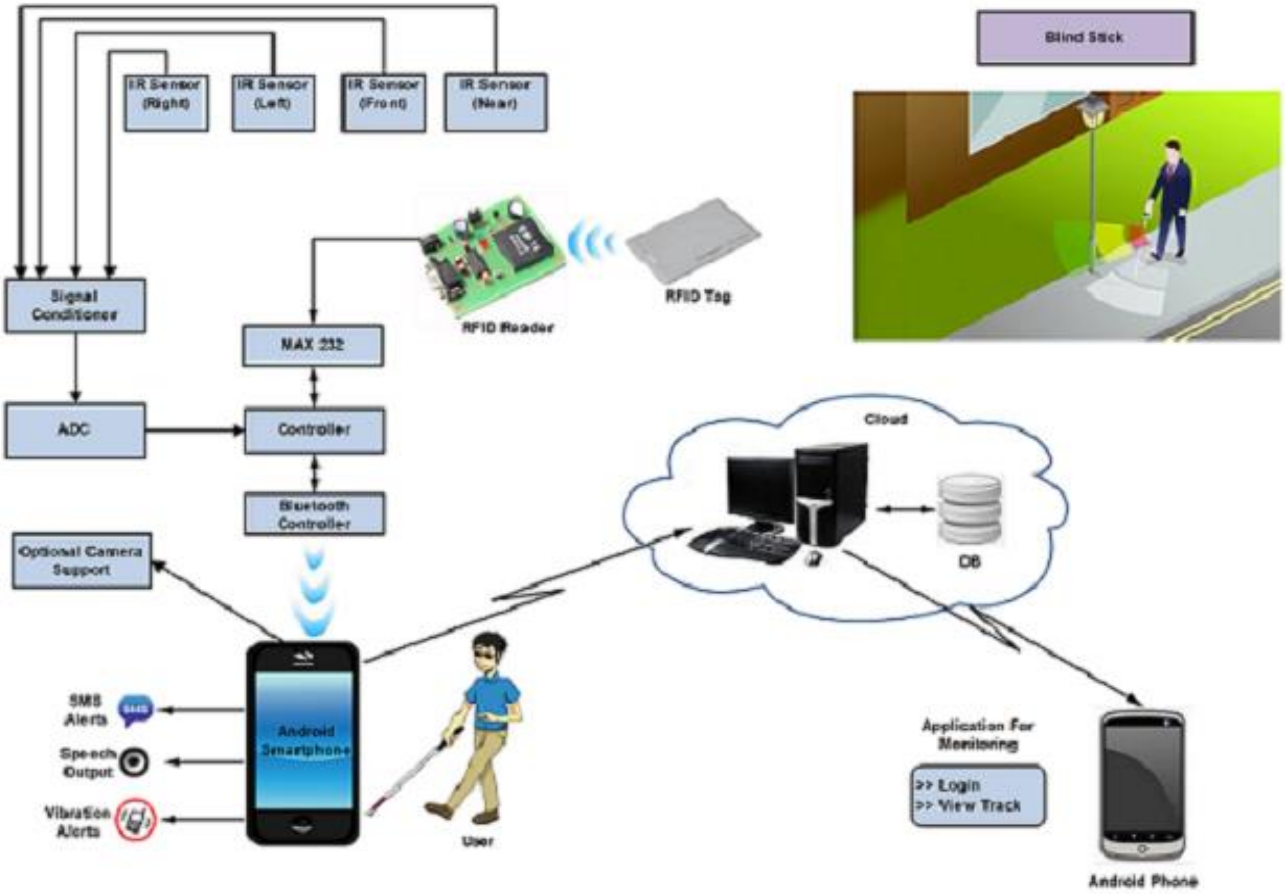

Fig. 3 Proposed System Architecture

C. Server

Third part of the system is server. Server stores the information about the location of the blind person. As blind person moves from one place to other, location will get updated on server. Glassfish server [10] is used for this purpose.

D. Monitoring User's Android Application

The monitoring user's android application is the part of the system which will be used by relatives or family members of the blind person to access his latest location stored in the server.

After integrating all these parts, the system formed, will be useful for the blind person to move from one place to other place.

RESEARCH METHODOLOGY

A. Data Sampling

The idea of the proposed system came into existence because of a short visit to a blind school. It was seen that the individuals were given training to walk with a stick along a fixed path every day with a person to guide each of them. The inception of the project was marked by the conversations held with the blind people in the school and their staff. The data collected was indicative of the facts and miseries of their daily life. The visual disability made them incapable of doing any kind of simple chores independently.

This laid us to research on the already existing technologies and conduct literature survey. The existing systems as highlighted above had some disadvantages so we have tried to design a system which aims to eliminate few of the disadvantages.

B. Technologies used

We have made use of the Android technology which has gained a lot of popularity because of it's easy to use and flexible nature. In conjunction to this, use of hardware components has also been done. The major hardware parts being RFID sensors and IR sensors.Net Beans is used for cloud service deployment using glassfish server.

The system can thus, be divided into two parts, viz. hardware part and software part.

The hardware consists of PCB unit and RFID sensors. These are mounted on the white cane.

The following components are mounted on the PCB:

i. The 89c51 microcontroller which is used, belongs to the 8051 microcontroller family. The 8051 is an 8-bit processor. It has 128 bytes of RAM and 4K bytes of on-chip ROM for memory. It consists of two timers and 6 interrupt sources. One serial port, four I/O ports, each 8 bits wide are present for serial communication I/O operations respectively. The language used for microcontroller programming is embedded C.

ii. Bluetooth HC-05 module is an easy to use Bluetooth Serial Port Protocol module. It has been designed for transparent wireless serial connection setup. It is used for the wireless communication between the PCB unit and the android phone which is held by the blind person.

iii. The MAX232 IC is used to convert the TTL/CMOS logic levels to RS232 logic levels during serial communication of microcontrollers with PC.

iv. ADC 0808 is a monolithic CMOS device. It's basically an 8 bit analog-to-digital converter. The 8 bit A/D converter uses successive approximation as the conversion technique. Registers are used for storing the information while programming. And capacitors are used for storing the power.

v. IR sensors are connected to the ADC. They are used for obstacle detection. IR sensors emit infrared rays which are reflected from the surface of any object in their range to the sensors. The distance to the object is then calculated depending on the angle of reflection and this data is then transmitted to the microprocessor which in turn, via Bluetooth transfers this information to the android application on the phone carried by the blind person. The android application compares this data to the threshold values set for the sensors and accordingly gives vibration alerts and speech output to blind person.

vi. Radio-frequency identification (RFID) [11] uses electromagnetic fields wirelessly to transfer data. It automatically identifies and tracks tags attached to the objects. The tag consists of electronic information. The tags can be of active or passive type.

The RFID sensors read the RFID tags and transmit this data to the microcontroller which is then sent to the android application via Bluetooth.

The software part consists of Blind user's Android application, Monitoring user Android application and a cloud web service. Development of Android applications was done through the freely available, open source Android SDK.

The Blind user's Android application is to be configured once by a family member or relative. The necessary details like the emergency contact number, IP address of the server and authentication details need to be provided. Also the threshold value for the IR sensors can be set here. This application has to be first connected to the PCB via Bluetooth discovery. It then receives its input from the PCB unit. This application provides vibration alerts along with speech output whenever the IR sensor input crosses the set threshold values thus avoiding collision of the blind person with the obstacle. It also has serialized database consisting of information regarding the RFID tags and the corresponding location details. Whenever the RFID tag is read by the RFID sensor, the information is sent to this application. The application then searches the database for the entry corresponding to the RFID tags and gives speech output about the location information stored. The application also updates the user's location on the cloud.

Monitoring user Android application is used for finding the location of the blind person. The application needs to be logged in using the authentication details and the IP address of the server. The location of the user is fetched whenever the button is touched.

The cloud web service [12] is basically used to store the updated location information. The monitoring application send request to the cloud for fetching the blind person's location. The cloud [13] processes this request and sends the location details.

ADVANTAGES

The system proposed in this paper will have the following advantages:

i. The system can be used both indoor and outdoor navigation.
ii. Blind person's location can be tracked whenever needed which will ensure additional safety.
iii. Detects obstacles and alerts the blind person through vibration alert and speech output.

CONCLUSION

The proposed system tries to eliminate the flaws in the previous system. It aims to solve the problems faced by the blind people in their daily life. The system also takes measures to ensure their safety.

FUTURE SCOPE

It can be further enhanced by using VLSI technology to design the PCB unit. This makes the system further more compact. Also, use of active RFID tags will transmit the location information automatically to the PCB unit, when the intelligent stick is in its range. The RFID sensor doesn't have to read it explicitly.

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