

Design of a GPS based Virtual Eye for the Blind People

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Abstract

Till date blind people struggle a lot to live their miserable life. Their problems have made them to lose their hope to live in this competing society. They seek help from others to guide them whole day. This project aims to make the blind person fully independent in all aspects. The proposed system is based on Global Positioning System (GPS) and Obstacle detection and object avoidance technologies. The aim of the overall system is to provide a low cost and efficient navigation aid for blind which gives a sense of artificial vision by providing information about the environment scenario of static and dynamic object around them.

Keywords: GPS module, Microcontroller, GSM module, Speech IC, Ultrasonic sensors.

1. Introduction

Sight is considered to be the most essential of all the senses, people lacking this sense are looked upon with pity by others. Visually impaired persons face numerous difficulties to perform their day to day task. They are totally or partially dependent on someone for help. Till date blind people are managing to travel with walking stick and obstacle detecting cane and other devices. These have improved their lifestyle significantly from nothing to something but haven't set them totally free. They show them odd among other people, which leads to complexity in them. Thus the assisting devices available in present scenario are not sufficient for supporting them completely.

The most important drawback of these aids are necessary skills and training phase, range of motion and very little information conveyed. With the rapid advances of modern technology, both in hardware and software front has brought potential to provide intelligent navigation capabilities. Recently there has been a lot of Electronic Travel Aids (ETA) designs and devised to help the blind navigate independently and safely. Also high end technological solutions have been introduced recently to help blind persons navigate independently. To identify the position and orientation and location of blind person any of those solutions rely on Global Positioning System (GPS) technology while such system suitable for outdoor navigation, due to need for line of sight access to satellites, they still need additional components to improve on resolution and proximity detection to prevent collision of blind person with other objects and hence subject his/her life to danger. However in comparison to other technologies many blind guidance systems use ultrasound because of its immunity to the environmental noise. Another reason why ultrasonic

is popular is that the technology is relatively inexpensive, and also ultrasound emitters and detectors are small enough to be carried without the need for complex circuitry. Apart from the conventional navigation systems, a blind aid system can be provided a new dimension of Real time assistance and artificial vision along with dedicated obstacle detection circuitry.

In order to overcome these drawbacks, we have designed a system which would be of immense advantage in comparison to the devices that are used by blind people today. This system is capable of fulfilling all the requisites of visually impaired and helping them in becoming independent like normal humans. This system acts as a virtual eye for the blind people and sets them free in all aspects.

2. Related work

Over the last decades, research has been conducted for new devices to design a good and reliable system for blind people to detect obstacles and warn them at danger places. There are some systems which has some deficiencies.

Benjamin *et al.* introduce a laser cane with three photo diodes and three laser diodes function as receiver making an optical triangulation. The laser cane detects the obstacle in three different directions. One is 45° to the ground for overhanging obstacles, the second one is parallel to the ground and third one is for sharp deepness. The laser cane has no system for determining location and position. J.Na proposed an interactive guide system for indoor positioning, which can't detect the obstacles and hurdles. The system is not suitable for the outdoor activities.

S. Innet and N. Ritnoom have introduced a stick for distance measurement using infrared sensors, which is a complex and time wasting process. The stick has different vibration modes for different range which is difficult for a blind to differentiate, it needs time for training. The stick

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informs the person clearly at dangerous stage which conveys less information and safety. The stick has no location and positioning features.

Shoval *et. al* developed a Navbelt, an obstacle avoidance wearable portable computer which is only for indoor navigation. Navbelt was equipped with two modes, in the first one the system information was translated to audio in different sounds. One sound for free for travel direction and other for blocked, it was difficult for the person to differentiate the sounds. Other problem was the system would not know the user momentary position.

N. Bulusu, J. Heinemann and D. Estrin provided the possibility of locating small devices without GPS. A very simple connectivity metric method for localization in outdoor environments that makes use of the inherent RF communication capabilities is used in locating small devices.

3. System Design

In order to overcome the difficulties in the existing method and to provide the cost effective and user friendly system for blind navigation, the following design is carried out. Fig1 shows that this project mainly consist on seven parts namely GPS receiver, Ultrasonic sensors, GSM module, Microcontroller, Speech ic, Headphone, Power supply.

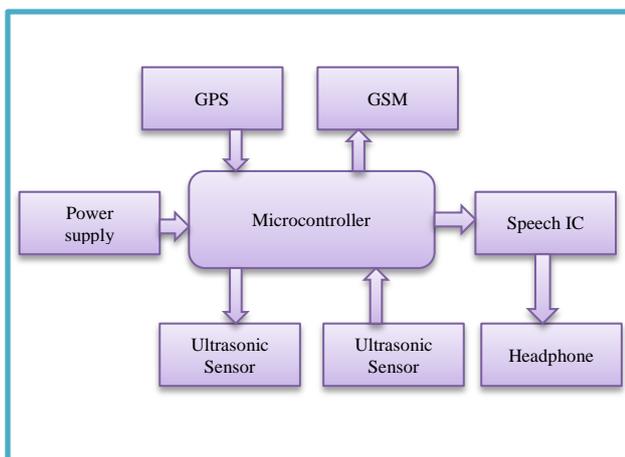


Fig. 1 Block diagram of the system

3.1 GPS Receiver

The Global Positioning System (GPS) and Global System for Mobile communications (GSM) are interfaced to the microcontroller to detect the blind person location. The proposed architecture consists of a GPS signal receiver and GSM connected to ARM7. The GPS will be sending the location information to the controller continuously. The same will be routed to the GSM modem through the controller. GSM will forward this information to the pre defined mobile nos. the user after receiving the message. If the person wants to know the location of the blind person, he has to send one message like TRACK immediately he will get the blind person location coordinates.

3.2 GSM

The SIM900 is used in this project. The SIM900 a complete Quad band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. Featuring an industry standard interface, the SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for voice, SMS,

Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mm x 24mm x 3 mm, SIM900 can fit almost all the space requirements in your M2M application, especially for slim and compact demand of design.

3.3 Microcontroller

The microcontroller used in this GPS and GSM based device with user input interface can be Preferably ARM7 based ATMEGA 328 microcontroller, since it is a low power CMOS 8 bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATMEGA328 achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

3.4 Ultrasonic sensor

In order to provide the obstacle avoidance, Ultrasonic sensor is used. Ultrasonic ranging provides 2cm-400cm non-contact measurement function, the ranging accuracy can reach to 3mm. It includes ultrasonic transmitters, receiver and control circuit. Ultrasonic use IO trigger for at least 10us high level signals. Sensor automatically sends eight 40 KHz and detect whether there is a pulse signal back. If the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.

3.5 Speech Ic

APR33A3 is used in the system. APR33A3 is 11 Minutes Audio Record & Play Model. It Offers true solid state storage capability and requires no software or microcontroller support. It provides high quality recording and playback with 11 minutes audio at 8 Khz Sampling rate with 16 bit resolution. Using on board jumpers, total duration can be divided in individual triggers of 1, 2, 4 & 8 segments which can be triggered by onboard switches or external low trigger like microcontroller pins.

3.6 Headphone

The headphone is used in this project for guiding the visually impaired persons to navigate independently by amplifying the predefined voice signals.

3.7 Power supply

Since all electronic circuit work only with low D.C. voltage. We need a power supply unit to provide the appropriate

voltage supply. This unit consists of battery, rectifier, filter and regulation.

4. Working Operation

Our project is an innovative idea of intelligent system which has basically two features the first one is Obstacle detection and the second one is Providing accurate location and position through GPS. It will provide safety and support to visually impaired Persons. The ultrasonic sensors in the system will sense surrounding and will detect the obstacles and give feedback to speech ic change the path way.

- 1) The power supply activates the circuit.
- 2) The sensor transmitter transmits the frequency, which reflects from the obstacle. Sensor receiver receives the reflected frequency and gives it to microcontroller.
- 3) The microcontroller processes it and gives signal to speech ic. Speech ic gives sound and start to inform the person that the obstacle is detected through headphone.
- 4) The GPS module receives the coordinate continuously and gives it to the microcontroller.
- 5) Microcontroller access the location from the GPS modem and transmit the location to the GSM modem which will send a SMS messages to the all saved numbers.

5. Advantages

- 1) Low design time.
- 2) Low production cost.
- 3) This system is applicable for both the indoor and outdoor environment.
- 4) Setting the destination is very easy.
- 5) This system is capable of using in public places.
- 6) It is dynamic system.
- 7) Less space.
- 8) Low power consumption.

6. Application

- 1) This system can be used in the home, hospital and colleges.
- 2) This system can be used in both known and unknown environments like airports, malls, public parks etc.

Conclusion

This project proposed the design and architecture of a new concept of Smart Electronic Travel Aid System for blind people.

The advantage of the system lies in the fact that it can prove to be a very low cost solution to millions of blind person worldwide. The proposed combination of various working units makes a real time system that monitors position of the user and provides dual feedback making navigation more safe and secure.

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