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On 17th & 18th March 2016

Voice Enabled Smart Walking Stick For Visually Impaired

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ABSTRACT: The blind's ability to navigate in a particular place and organize their daily activities is of vital importance for their well-being. Our paper proposes a scheme that provides a moderate budget and efficient navigation aid for blind which gives a sense of artificial vision by providing information about the environmental scenario of static and dynamic objects around them. The system is intended to provide benefits in two domains - private space and public space. It consists of a simple walking stick equipped with ultrasonic sensors to give information about the environment like, object detection, pit sensing and water sensing. GPS technology is integrated with pre-programmed locations to determine the optimal route to be taken. The user can choose the location from the set of destinations stored in the memory. Also a voice enabled equipment switching is provided which will be beneficial to the blind person in private domain.

KEYWORDS: Object detection, ultrasonic sensors, equipment switching, voice recognition module, GSM module, walking stick

I. INTRODUCTION

Vision is the most important part of human physiology as 83% of information human being gets from the environment is via sight. The count of visually impaired people rises every year. The 2011 statistics by the World Health Organization (WHO) estimates that there are 285 billion people in world with visual impairment, 39 billion of which are blind and 246 with low vision [10].

In everyday life they undergo problem of navigation to reach from one place to another safely and timely. They often depend on external assistance which can be provided by humans, trained dogs, or special electronic devices as support systems for decision making. The most important drawbacks 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 have brought potential to provide intelligent navigation capabilities. This system presents a concept to provide a smart electronic aid for blind people, both in public and private space. The system is intended to provide overall measures artificial vision and object detection, real time assistance via global positioning system (GPS) [4]. In this system embedded system plays a major role. In this system we are using the Ultrasonic sensor, Pit sensor, Water sensor, GPS receiver, GSM module, Voice synthesizer, microcontroller and speaker.

Smart walking stick is specially designed to detect obstacles which may help the blind to navigate care-free. The audio messages will keep the user alert and considerably reduce accidents. A voice enabled automatic switching is also incorporated to help them in private space as well. This blind guidance system use ultrasound because of its immunity to the environmental noise. Another reason why ultrasonic is popular is that the technology is relatively inexpensive, and are small enough to be carried without the need for complex circuit.

II. LITERATURE SURVEY

Numerous attempts have been made in the society to help the blind. "Project Prakash" [1] is a humanitarian mission to

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help the blind children especially by training them to utilize their brains to learn a set of objects around them. In [2], the stick has a ping sonar sensor to sense the distant objects. It also has a wet detector to detect the water. The micro-controller used is PIC microcontroller. The microcontroller circuit is on the outside of the stick but is protected with a code so its security cannot be breached. The only feedback given to the user is through the vibration motor. In [3], three sensors are used viz. ultrasonic, pit sensor and the water sensor. Even this is a PIC based system. The feedback given is through the vibration as well as the speaker/headphones. There is a GPS system where-in the user has to feed his location. In [4], the author has made a detachable unit consisting of an ultrasonic sensor and a vibration motor. It can be fit on any stick. It detects obstacles up to 3m. The vibration feedback varies in the intensity as the obstacle comes nearer. Many different approaches have been taken with the primary purpose of creating a technology to aid the visually impaired. The priorities set by different authors are different leaving a scope of improvement in every application.

Smart Cane has been designed by students from Central Michigan University where this invention uses Radio Frequency Identification (RFID). RFID is used to detect objects or obstacles in front of the user and detects the RFID tag that has been placed in several areas to navigate the users. This invention is just like a normal stick but is equipped with a bag, worn by the user. The bag supplies electricity power to the invention and informs the user through speakers inside the bag. For users who do not have the ability to hear, there are special gloves that will vibrate at every finger, in which different vibrations in each finger have different meanings

III. BLOCK DIAGRAM AND DESCRIPTION

In this system we are using the Ultrasonic sensor, Pit sensing unit, Water sensing unit, GPS module, GSM module, Voice synthesizer, relay , speaker, embedded system and Battery. The ultrasonic sensors are used for the different sensing units in the system.

Ultrasonic sensors works on a principle similar to radar which evaluates attributes of a target by interpreting the echoes from radio or sound waves respectively. They generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. That signal is send to the embedded system. The main advantage of ultrasonic sensors is its immunity to noise when compared to other sensors.

GPS receiver is used to track the current position of the human and is given to the level converter. The level converter is used to change the logic of the signal from the GPS receiver which is acceptable by the embedded system. By giving voice messages, we can set the position of the destination from a list with the help of a memory card. The voice synthesizer and speaker are used to produce voice messages if the human goes out of the desired path. Battery present in the system is used to give power to all the units present in the system.

The pit sensor is used to detect any pit or dents present in the way. It is determined by calculating the depth of the pit with the help of ultrasonic sensor. A water detector is designed to detect the presence of water. Two pins will be present at the bottom of the stick, as soon as it touches the water; it will short the circuit and cause a closed circuit which obtains the output that we desire. This sensor is useful in a normally occupied area near any appliance that has the potential to leak water.
The GSM module and relay are for the equipment switching purpose. It helps in transferring the information regarding the desired operation on the equipment and produces the corresponding switching action.

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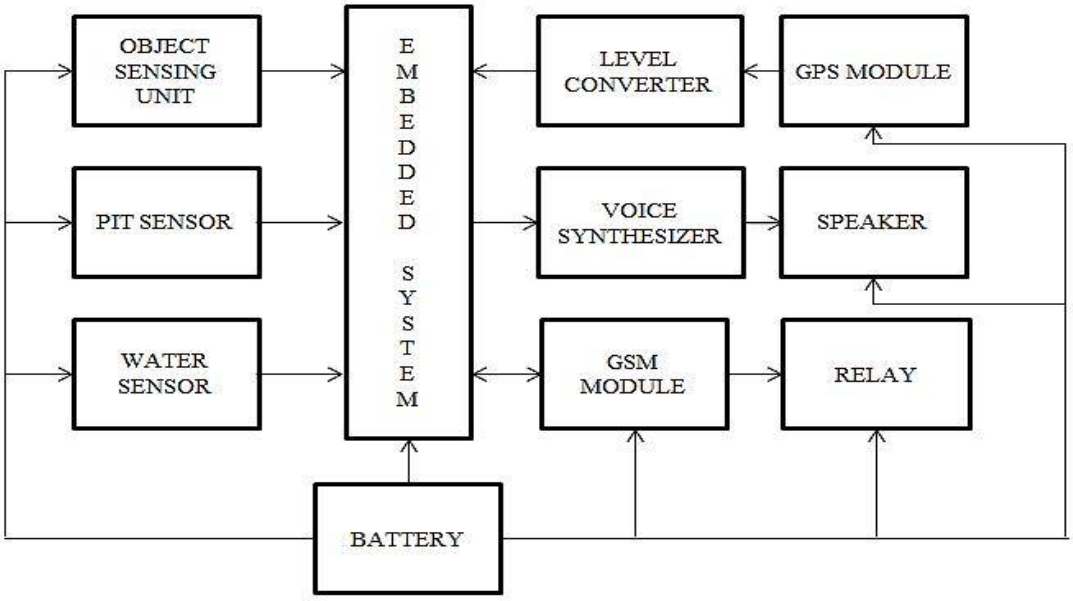

Fig.1 Block Diagram

The GPS based blind device with user input interfacing, alert the blind person when reaches destination by voice. The microcontroller which is the heart of the device, stores the data of the current location which it receives from the GPS system. So that it can make use of the data stored to compare with the destination location of the user. By this it can trace out the distance from the destination and produce a message to alert the user in advance.

IV. CIRCUIT AND EQUIPMENT CONTROL DESCRIPTION

The circuit diagram consists of a GPS module, two ultrasonic sensors, microcontroller, GSM module, voice recognition module, speaker and microphone. There are two microcontrollers and GSM modules, one in the stick and the other in control unit placed in switch board. The voice input can be given through a microphone, which is then sent to a voice recognition module. The voice recognition module interprets the message and gives it to the microcontroller. All the inputs are connected to the microcontroller. The output of the system is given in the form of voice messages which are given out through the speaker. One ultrasonic module is placed in front of the stick for object detection and the other one is placed below the stick for pit sensing. For water sensing, two pins will be placed below the stick. One pin will be given with supply and the other pin when comes in contact with water will short circuit and corresponding message will be generated. The GSM module present in the stick conveys the information regarding the equipment switching to be done with that control unit present in switch board.

The microcontroller used is ATmega328/P which belongs to 8-bit microcontroller family. The ATmega328/P 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/P achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

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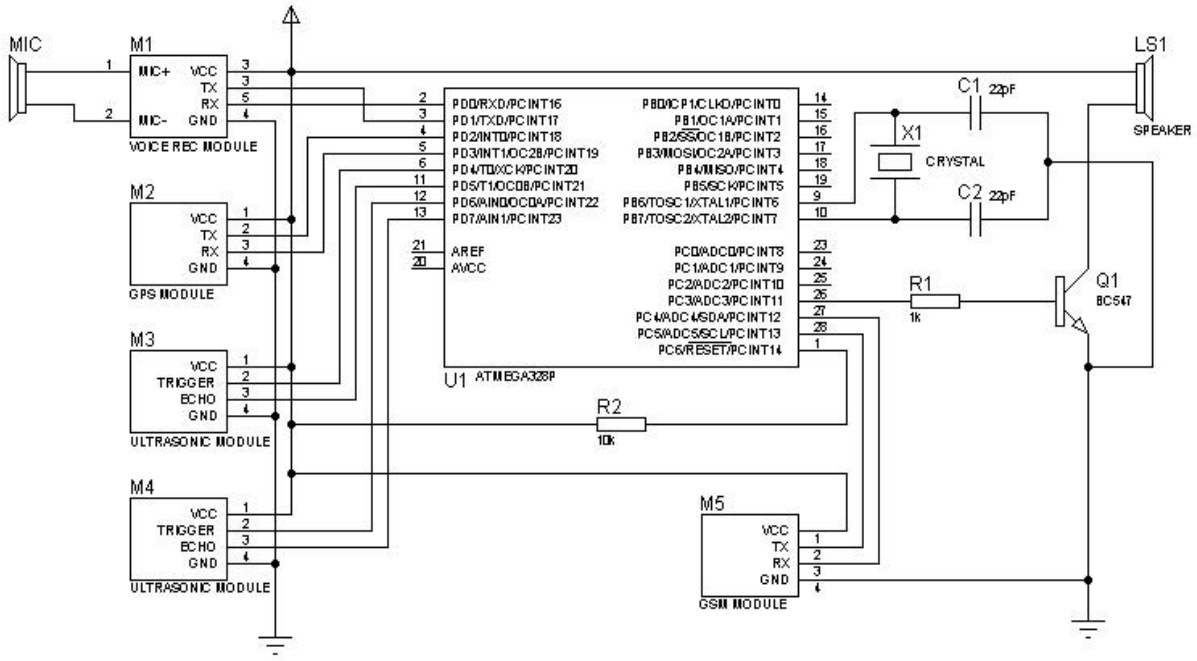

Fig.2 Control circuit of sensing units in stick

GPS devices may be able to indicate, the roads or paths available, traffic congestion and alternative routes, roads or paths that might be taken to get to the destination, if some roads are busy (now or historically) the best route to take, the location of food, banks, hotels, fuel, airports or other places of interests, , turn-by-turn navigation directions to a human via text or speech and the shortest route between the two locations.

The GPS module used in this system belongs to NEO-6 family of stand-alone GPS receivers featuring the high performance u-blox 6 positioning engine. These flexible and cost effective receivers offer numerous connectivity options in a miniature 16 x 12.2 x 2.4 mm package. Their compact architecture and power and memory options make NEO-6 modules ideal for battery operated mobile devices with very strict cost and space constraints. The 50-channel u-blox 6 positioning engine boasts a Time-To-First-Fix (TTFF) of under 1 second. The dedicated acquisition engine, with 2 million correlators, is capable of massive parallel time/frequency space searches, enabling it to find satellites instantly. Innovative design and technology suppresses jamming sources and mitigates multipath effects, giving NEO-6 GPS receivers excellent navigation performance even in the most challenging environments.

The GSM (Global System for Mobile) / GPRS (General Packet Radio Service) TTL –Modem used is SIM900 Quad-band GSM / GPRS device, that works on frequencies 850 MHZ, 900 MHZ, 1800 MHZ and 1900 MHZ. It is very compact in size and easy to use as plug in GSM Modem. The Modem is designed with 3V3 and 5V DC TTL interfacing circuitry, which allows User to directly interface with 5V Microcontrollers (PIC, AVR, Arduino, 8051, etc.). It is suitable for SMS as well as DATA transfer application in mobile phone to mobile phone interface. The users of GSM use Subscriber Identity Module (SIM) cards for the connection with the service provider. SIM cards are small in size, with removable memories and hold a lot of data and numbers of identification which are required to access any wireless service provider.

The relay used is an electromechanical device that is actuated by an electrical current. The current flowing in one

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circuit causes the opening or closing of another circuit. Relays are like remote control switches and are used in many applications because of their relative simplicity, long life, and proven high reliability.

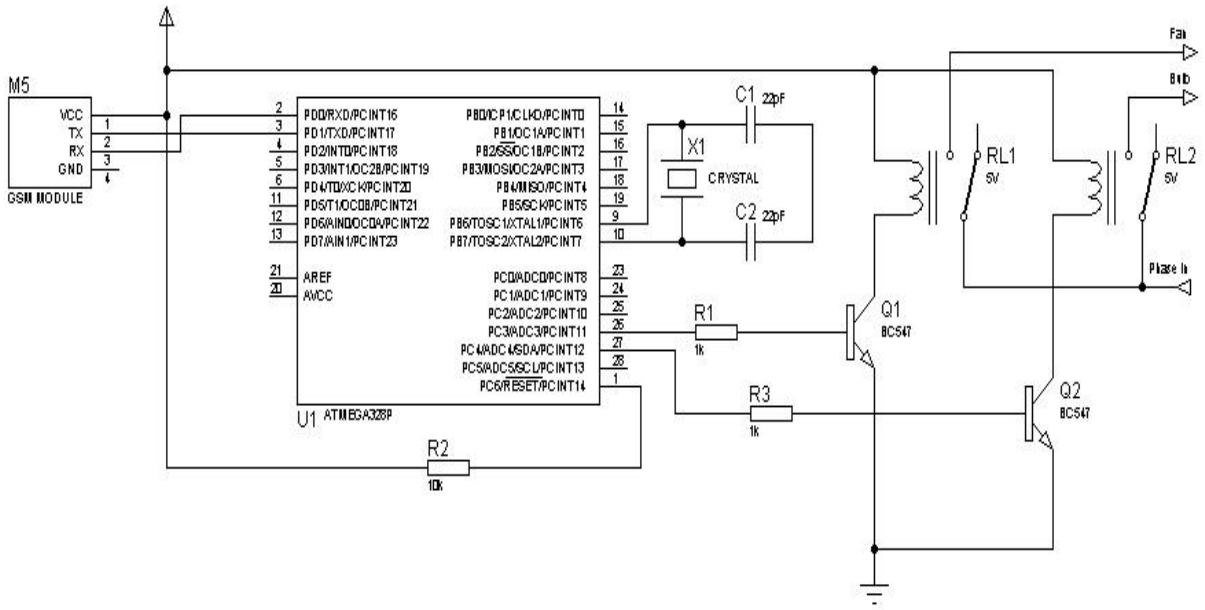

Fig.3 Equipment Control Unit

Once a switching command is given by the blind, the GSM module in the stick sends this message to the other GSM module present in the switch board. The equipment control unit is placed in the switch board of the room for the equipment switching purpose. It consists of GSM module, relay, and microcontroller. The information regarding the switching of AC equipment and the required operation to be done is carried out through the relay with the help of pic microcontroller. In this equipment control diagram, two relays are shown, one for light and the other for fan. Only the information regarding phase is given to the relay from the equipment.

V. SOFTWARE TECHNIQUE

The Arduino IDE is the software that is used to develop the source code of the PIC microcontroller, ATmega328p. It is a Window based Integrated Development Environment (IDE) for the Microchip Technology Incorporated PIC microcontroller families. Arduino Uno board contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. Proteus software is used for designing the circuit and pcb layout of the two circuit units, by loading program into the microcontroller.

VI. ADVANTAGES AND DISADVANTAGES

The main advantage of this system is that it helps the blind people in both indoor and outdoor, care-free navigation. The whole system placed in the stick makes it comfortable and easy to handle mobility aid. The smart stick not only helps in detecting obstacles paced at a distance in front of the user, but also provides real time assistance via GPS. The incorporation of room equipment switching along with this system makes it even more useful, thus making it suitable for both indoor and outdoor environment. The information regarding obstacles is given through voice alerts that eliminate the difficulty of understanding vibration patterns which was used in earlier systems.
The system developed here is a moderate budget navigational aid for the visually impaired. However minimizing cost leads to compromises in performance. It is advised that the design be improved before commercial production. Some

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improvements that could be made are as follows:

- Increasing the range of the ultrasonic sensor.
- Implementing a technology to determine the speed of the approaching obstacle.

VII. CONCLUSION

The smart walking stick, if constructed with at most accuracy, will help the blind people to move from one place to another without others help. This could also be considered a crude way of giving the blind a sense of vision. This stick reduces the dependency of visually impaired people on other family members, friends and guide dogs while walking around. 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. The smart stick detects objects or obstacles in front of users and feeds warning back, in the form of voice messages rather than vibration. Also the incorporation of automatic room equipment switching in the stick will be useful while they are indoor. The advantage of the system lies in the fact that it can prove to be a low cost solution to millions of blind person worldwide.

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