Advanced Electronic Walking Stick for Blind

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Abstract

Visually impaired persons find themselves challenging to go out independently. White cane have been used to assist the blind people's navigation. With advancement in technology electronic walking sticks with obstacle detection sensors came for their aid. However a more advanced electronic walking stick is proposed in this paper. The proposed advanced electronic walking stick has ultra-sonic sensors mounted on it. It also uses a GSM and GPS module along with a heartbeat monitoring band. GPS module is also used to determine the location of the blind person and heart beat monitoring band is also used. For short distance obstacle buzzer is used which produce beep sound and for long distance obstacle the distance between the obstacle and the stick is given as an audio output from speaker with the help of raspberry pi. Buttons are used were each button corresponds to different operations such as activate buzzer, produce audio output, scanning of currency note using colour sensor, sending help message to corresponding mobile number with the help of GSM module.

Keyword- Walking Stick, Atmega328 Microcontroller, Ultra-Sonic Sensor, GSM300, Colour Sensor, GPS Module, Raspberry Pi

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I. INTRODUCTION

Visually impaired persons themselves find difficult to walk out independently or climb stairs. Earlier White canes were used for their navigation mostly. White cane primarily aids its user to scan their surroundings for obstacles or orientation marks, but is also helpful for other traffic participants in identifying the user as blind or visually impaired and taking appropriate care. Length of the cane depends on the height of the person. White cane has lots of drawbacks and some of them are, it is difficult to use when there are obstacles such as electric cars. Electric cars are nearly silent as they approach and there is no reason to believe that drivers will be cautious not to run over the blind people. Sometimes when people are in a hurry they won't be careful and will hit the stick while walking causing problems to the blind people. With the advancement in technology and several devices are available for their mobility aids and they are called as Electronic Travel aids [1], [2]. Electronic walking stick uses an ultra-sonic sensor which is used to detect the distance between the obstacle and the stick. Ultra-sonic waves travel in the speed of sound, hence by knowing the speed of sound and the time taken by the wave to reflect from the obstacle and receive it back, distance of the obstacle can be found out. This device is extremely useful for the blind people to walk in crowded streets and stairs. But there are some more problems faced by blind people that need our attention. When a blind person enters a public transport facility such as bus they find it difficult to count the currency note. This project have incorporated a currency note identifying mechanism along with electronic walking stick.

The proposed system makes use of an ultra-sonic sensor that is used to detect the distance of the obstacle from the person holding the stick. Distance can be calculated by knowing the speed of wave and time taken by the wave to reach back to the receiver. Four buttons or switches are used and each buttons are used to activate different modes of operation. When button 1 is pressed buzzer is activated and beep sound is produced when there is an obstacle in front. Button 2 is pressed to obtain the distance between obstacle and the stick as an audio output with the help of raspberry pi. Button 3 activates the scanning process with the help of colour sensor and can be used to identify different currency notes. The value of these currency notes are then given as an audio output from the speaker. Other than this a Heartbeat monitor band is used along with a GPS and a GSM module. GPS module is used to obtain.

II. SYSTEM DESCRIPTION

Advanced electronic walking stick will help the blind by providing more convenient means of life. Electronic walking stick has ultrasonic sensors mounted on it [3]. The stick has 4 modes and each mode is selected by using 4 different buttons. For small distance obstacle a buzzer is used which produce a beep sound when that mode is activated. For long distance obstacle audio output is provided by using raspberry pi. The distance of the obstacle from the stick is spoken out from speakers by using raspberry pi. GSM module and GPS module is also provided. GSM module is used to send an SMS to corresponding person while GPS module gives the location of the person using the stick to the corresponding person along with the SMS. Heart rate monitor band is also

used to the measure the heart beat of the blind person. A colour sensor is also provided that can be used to identify the different colours of the currency note by measuring the chromaticity coordinates. Based on the colour different notes can be identified.

A. ATmega328

It is a single chip microcontroller combines 32Kb ISP flash memory with read-while-write capabilities, 1Kb EEPROM, 2Kb SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counter with compare modes, internal and external interrupts, serial programmable USART, a byte oriented 2 wire-serial interface. Device operates between 1.85 to 5.5 volts and Ram is 1024 bytes with a CPU speed of 20MIPS. Fig 1 shows the diagram of a ATmega328 board.

Fig. 1: ATmega328

B. Ultra-Sonic Sensors

Ultra-sonic sensor is a sensor that uses sound waves to detect the distance of an obstacle [4]. It measures distance between the object and the source by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back [5]. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sensor and the object. Fig 2 shows the block diagram of an ultra-sonic sensor.

Sound travel through air at a speed of 344 m/s and time can be calculated. By obtaining speed and time distance can be calculated.

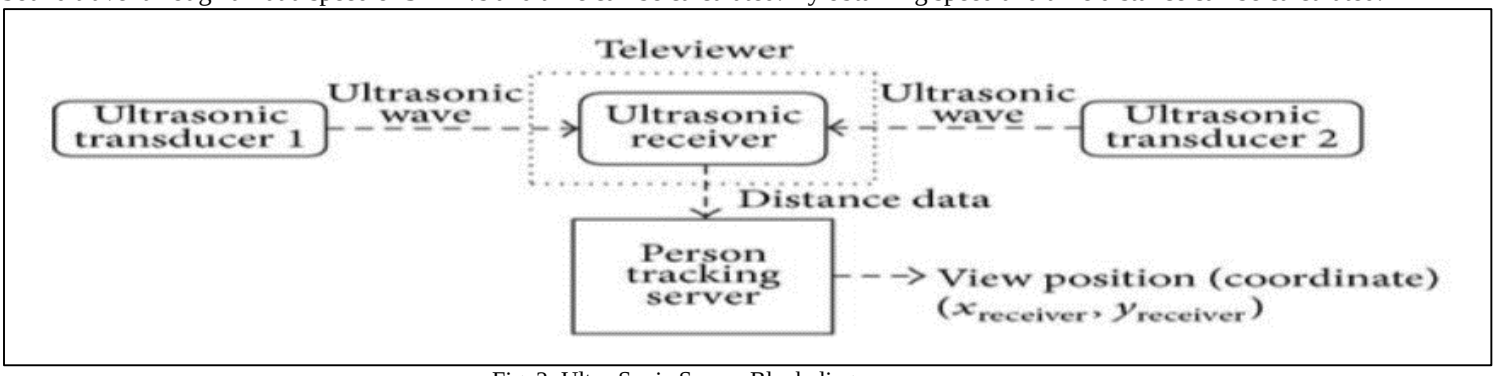

Fig. 2: Ultra-Sonic Sensor Block diagram

C. Colour Sensor

Colour sensors detects the colour of a surface. The sensors cast light on objects to be tested and calculate the chromaticity coordinates from reflected radiations and compare them with previously stored reference colours. If the colour values are within the set tolerance range a switching output is activated. A basic colour sensor is as shown in fig 3.

Fig. 3: colour sensor

D. GPS(Global Positioning System)

Number of GPs satellites are deployed on the six orbits around the earth at the altitude about approximately 20,000 km and move around the earth at 12 hour intervals.

There are several earth stations that monitor, control and maintain satellite orbit to make sure that the deviation of satellites from orbit as well as GPS timing are within the tolerance level. GPS does not require user to transmit any data.

Satellite contain very stable atomic clocks that are synchronized with one another and with the ground clocks. Any drift from true time mentioned on the ground is corrected daily. In same manner the satellite locations are known with great precision. GPS satellites continuously transmit data about their current time and position. A GPS receiver monitors multiple satellites and solve equations to determine the precise position of the receiver and its deviation from true time. At a minimum four satellites must be in view of the receiver for I to compute the un-known quantities.

Wherever we are on the planet, at least four GPS satellites are 'visible' at any time. Each one transmits information about its position and the current time at regular intervals. These signals, travelling at the speed of light, are intercepted by your GPS receiver, which calculates how far away each satellite is based on how long it took for the messages to arrive. Once it has information on how far away at least three satellites are, your GPS receiver can pinpoint your location using a process called trilateration. In this proposed system GPS module are used to obtain the location of the person holding the stick. A basic GPS module is as shown in the fig 4.

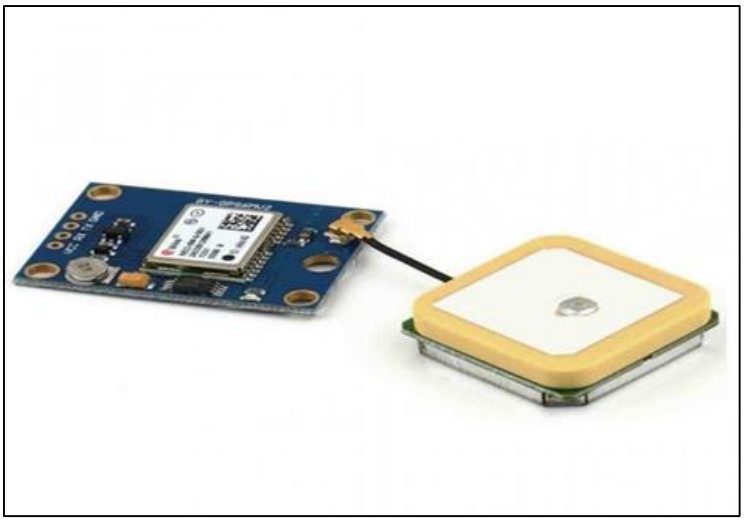

Fig. 4: GPS module

E. GSM(Global Positioning System)

GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands. GSM system was developed as a digital system using time division multiple access (TDMA) technique for communication purpose. A GSM digitizes and reduces the data, then sends it down through a channel with two different streams of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps to 120 Mbps of data rates. In the proposed system GSM module is used to send an SMS to the corresponding mobile number.

Fig. 5: GSM module

F. Raspberry Pi

It is a credit card sized computer originally designed for education purpose. Raspberry pi is an open hardware with exception of the primary chip on raspberry pi, the broadcom SOC(system on chip) which runs many of the main components of the board CPU, graphics, memory, the USB controller etc.

The Raspberry Pi is an inexpensive computer that can lend itself to many light & medium-duty tasks. It is based on a Broadcom SOC (System on a Chip) that includes an ARM7 core, a Video core iv GPU and USB controller. It has either 256MB or 512MB on the board and an SD card slot for storage. In the proposed system a Raspberry-Pi module is used to interface a speaker so as to obtain audio output of the distance obtained from the Ultra-Sonic sensor.

Fig. 6: Raspberry pi module

G. Speaker

Speaker is a device that is used to produce sound. Computer speakers are connected to computers and produce sound output that is it is an electro-acoustic transducer that converts electrical signals into sounds loud enough to be heard at a distance.

H. Battery

A container consisting of one or more cells, in which chemical energy is converted into electricity and used as a source of power.

III. PROPOSED SYSTEM DIAGRAM

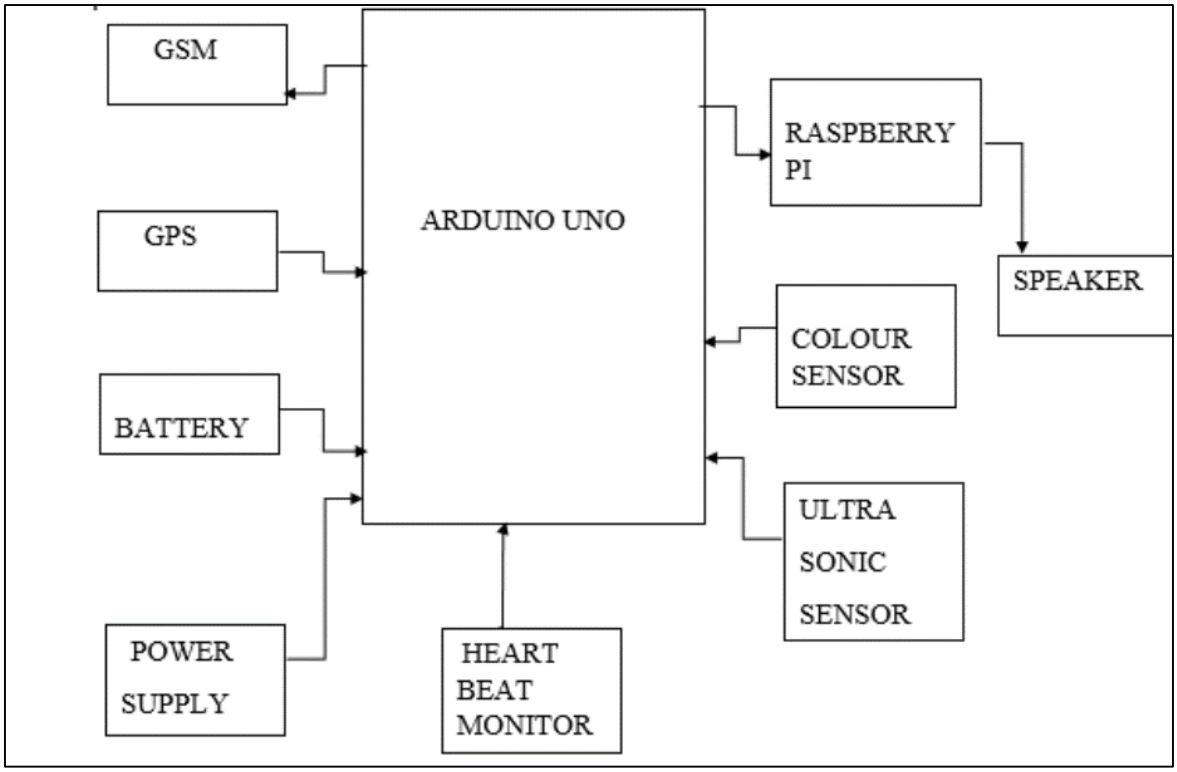

Fig. 7: Proposed System Diagram

Ultra-Sonic sensors are used to obtain the distance of the obstacle from the stick. Battery is used to provide a supply to the micro-controller as well as the Raspberry Pi. Colour sensor provided identify the colour of the currency note based on the chromaticity of the notes and helps to identify the value of each note. GPS module is used to obtain the location of the person in case there is an emergency and a GSM module is used to send an SMS to corresponding mobile number when a panic button is pressed and this SMS will contain information from the GPS module as well as from the heart beat monitor.

IV. CONCLUSION

This system can be applied in the straight path, right angle path and the curved path. At least 1m width is required for the proper management of the stick. The broad beam angle ultrasonic sensors enable wide range obstacle information.

This system can be used to reduce minor collisions and can help them to reduce the dependency on other people. With all the components used blind people can increase their travel speed by 20-35%. Limitations of this stick is that it doesn't show high accuracy in heavily crowded areas and the stick is somewhat costly because of the large number of components used.

Future works include mechanism to detect traffic signals when the blind person is walking in the roads so that there won't be any accidents due to improper crossing of roads.

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