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IOT Based Smart Shoe

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Abstract: The increasing number of visually impaired people requires the development of assistive devices around the world. The problem can be solved by using a device that would serve as a smart guide to the people. IoT based Smart shoe system is made with the help of ultrasonic sensors paired to an Arduino UNO board. Internet of things is all about making physical objects communicate with other objects or even with humans. It is an enabling technology which has a rapid development and growth in the market. It is built using IoT Technology in which the shoe will be embedded with various sensors, Microcontroller and buzzers. The shoe warns the user by making noise with the buzzer when he/she walks in front of an obstacle. The system makes use of GPS and GSM modules to find the location for easy tracking. So, the smart shoe communicates and coordinate with each other to ensure that the user does not collide with any obstacle in his way. It will be further useful to determine the heart beat rate, distance travelled and location of the person. Further this work is quite helpful to the Blind people as they face great difficulty to travel independently. They have to depend on others in many aspects of their life. So, the Smart shoe design provides a long-term solution for the blind to walk on roads independently.

Keywords: IoT, Arduino UNO, Ultrasonic Sensors, GPS, GSM, Buzzer.

1. INTRODUCTION

Blind people find it difficult to move in this world as they get distracted by the obstacles, they may even get lost [1]. So in the proposed system the above mentioned cases are taken into consideration and implementation is provided. In order to help the blind people for detecting object the proposed system make use of ultrasonic sensors to track the person [2]. The system makes use of GPS and GSM modules to find the location. It is built using IoT Technology in which the shoe will be embedded with various sensors, Microcontroller and buzzers. The shoe warns the user by making noise with the buzzer when he/she walks in front of an obstacle [3]. This device has ultrasonic sensors in front of the shoe. The ultrasonic sensor detects the obstacles. The data recorded by the ultrasonic sensor is sent to the cloud for further analysis. A guardian can monitor the graph and visuals on each individual in real time by logging into the cloud [4].

This paper presents a prototype model of smart shoe. This Smart Shoe is mainly used to detect the obstacle distance, calories and heartbeat of a person. Our proposed model can also track the location of a person with the help of GPS. This shoe helps the visually impaired people to walk independently. The main objective of this project is to reduce the cost and to provide a better solution for the visually impaired [5].

2. RELATED WORKS

Many methodologies such as Smart stick for blind, Smart stick using LASER sensors, electronic cane for Blind, Electronic Path Guidance for Visually Impaired People, Review on Obstacle Detection and Vision, A Smart Infrared Microcontroller Based Blind Guidance System has been proposed by many authors and the detailed explanation about these methods is as follows.

S.Gangwar (2013) [6] designed a smart stick for blind which can give early warning of an obstacle using Infrared (IR) sensors. After identifying the obstacles, the stick alerts the visually impaired people using vibration signals. However, the smart stick focused only for obstacle detection but it is not assisting for emergency purposes needed by the blind. And also, the IR sensors are not really efficient enough because it can detect only the nearest obstacle in short distance. S.Chew (2012) [7] proposed the smart white cane, called Blind spot that combines GPS technology, social networking and ultra- sonic sensors to help visually impaired people to navigate public spaces. The GPS detects the location of the obstacle and alerts the blind to avoid them hitting the obstacle using ultra-sonic sensors. But GPS did not show the efficiency in tracing the location of the obstacles since ultra-sonic tells the distance of the obstacle.

Benjamin et.al., (2014) [8] had developed a smart stick using laser sensors to detect the obstacles and down curbs. Obstacle detection was signalized by a high pitch “BEEP” using a microphone. The design of the laser cane is very simple and intuitive. The stick can only detect obstacle, but cannot provide cognitive and psychological support. There exists only beep sound that triggers any obstacle and there is no any assistance to direct them. Mohd Helmyabd Wahab and Amirul (2013) [9] developed a cane could communicate with users through voice alert and vibration signal). Ultrasonic sensors are used to detect obstacle in

front, since ultrasonic sensors are good in detecting obstacle in few meters range and this information will be sent in the form of voice signal. This voice signal is sent via speaker to the user. Here blind people might find it difficult in travelling without any emergency alert.

Alejandro R. et.al., (2012) [10] designed an assistive technology device called the electronic long cane to serve as a mobility aid for blind and visually impaired people. The author implements the cane with an ergonomic design and an embedded electronic system an obstacle is detected; the cane vibrates or makes a sound. However, this system only detects obstacle above the waistline. Joao Jose et.al., (2013) [11] designed a smart stick prototype. It was small in size, cheap and easily wearable navigation aid. This blind stick functions by addressing the global navigation for guiding the user to some destiny and local navigation for negotiating paths, sidewalks and corridors, even with avoidance of static as well as moving obstacles. Rather than that, they invented a stereo camera worn at chest height, a portable computer in a shoulder-strapped pouch or pocket and only one earphone or small speaker. The system is inconspicuous, and with no hindrance while walking with the cane. Also, it does not block normal sound in the surroundings. Shruti Dambhare et.al., (2011) [12] designed an artificial vision and object detection with real-time assistance via GPS to provide a low cost 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.

By observing above methodologies, there are few drawbacks such as smart stick in hand cannot detect every obstacle in their way [6,8,11] and it detects only at a shorter distance. Smart cane doesn't have ability to trace the GPS efficiently and cannot make the noise in the form of buzzer [7,9,10]. Real time assistance cannot detect the obstacles at a longer distance [12].

3. MATERIALS AND METHODS

3.1. Requirements:

- **Hardware Requirement:**

Arduino UNO, Ultrasonic Sensor, MEMS Sensor, Heart beat Sensor, Buzzer, GPS, GSM, LCD, push button switch.
The specifications of these hardware is presented in table 1:

Table 1: Hardware Specifications

S.no	Hardware Name	Specification
1	Arduino UNO board	It is 8-bit ATmega328P microcontroller. It has 14 digital I/O pins.
2	Ultrasonic Sensor (HC-SR04)	Distance: 2cm-400cm, Angle approximately 115 degrees, Operating Voltage: 5V
3	Micro-electromechanical systems (MEMS) sensor	MEMS sensor has acceleration bandwidth upto 640 HZ. Power Supply:2.5V-3.3V
4	Heart beat sensor	Operating voltage: +5V Operating current: 100 mA
5	Buzzer	It is an electrical device which makes sound.
6	LCD screen	Current consumption :1 mA Display module: Alphanumeric LCD Backlight color: Green and Blue
7	GPS	Operating frequency: 4Hz Protocol: NMEA0183 Working Temperature: -40degree c to +85degree c
8	GSM	Operating voltage :3.2V to 4.8V dc Output pin voltage :5V dc Output pin current :25mA
9	Push button switch	Crisp clicking by tactile feedback

Arduino Uno is a microcontroller board based on the Atmega328p.It has 14 digital input/output pins (of which six can be used as pulse width modulation outputs), six analog inputs, a 16 MHz quartz crystal, a USB Connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The algorithm of the proposed model is developed in Embedded C and simulated on Arduino IDE. Arduino IDE is an open-source platform which is used to program the microcontroller to perform some specific tasks. In this work, we are using Arduino IDE software version 1.0.6.

3.2 Software Details:

- Arduino IDE software:

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS and Linux. The environment is written in C and based on Processing and other open-source software. This software can be used with any Arduino board.

- Embedded C:

Embedded C is a set of language extensions of C programming language. It includes a number of features not available in normal C, such as fixed-point arithmetic, named address spaces, and basics I/O hardware addressing. Embedded C uses most of the syntax and semantics of standard C.

3.3 Proposed model:

The objective of this multi utility shoe is that it is used for special purpose as a sensing device for the blind people. It is used widely to detect objects using ultra sonic sensor. If any object is present, the ultra-sonic sensor detects the object and sends the data to the Arduino.

This work aims to determine the distance of an object, calculate the distance between sending the signal and receiving back the signal. GSM and the GPS are used to detect the location. This work uses buzzers to give a feed back to the user about the position of the nearest obstacles in range. In this project we also calculate calories, heart rate of a person with the help of MEMS sensor and heart beat sensor respectively. The idea is to make the user independent and protect him/her from potential obstacles which can be fatal for the user.

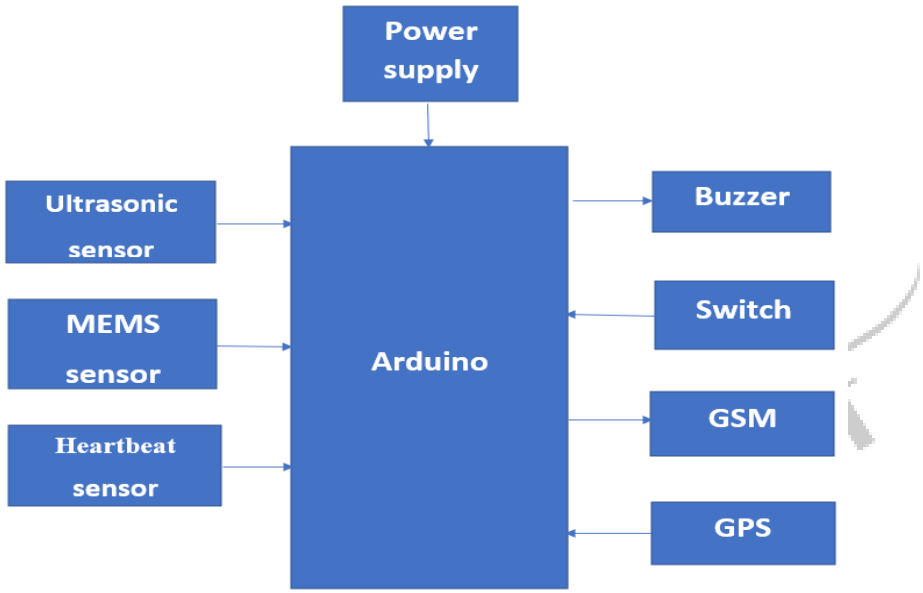

Figure 3.1: Block Diagram of Proposed System

4. EXPERIMENTAL RESULTS

Using the signal received when the distance is less than 100cm, the buzzer and GSM module are triggered which warns the user of the oncoming obstacles. The status of the proposed system in usage mode, when there is an obstacle in front of person the buzzer rings which guides the user to avoid the obstacle and he/she can move around safely. The proposed system is capable of covering more area Infront of the user as compared to the existing systems.

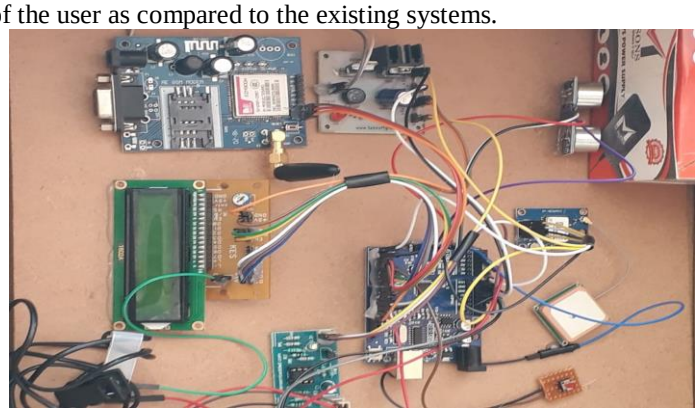

Figure 4.1: Proposed smart shoe prototype

The Proposed smart shoe prototype is shown in figure (4.1) when switched on starts detecting the obstacles using the Ultrasonic sensors. If any obstacles detected, the output is shown on LCD screen.

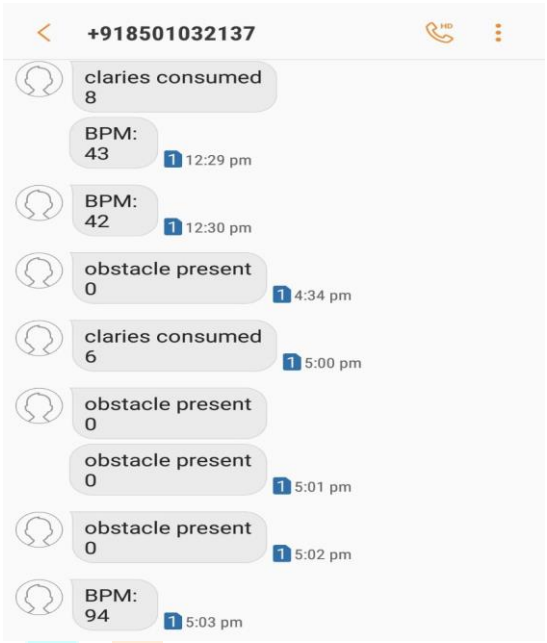

Figure 4.2: Message Output

When the power supply is given, the ultrasonic sensor detects the obstacles, if any obstacle is found in its way, it sends the information to Arduino, then the buzzer makes sound to move away from those obstacles and it also sends the obstacle distance to the guardian in the form of message. The proposed system even calculates the heart rate, calories of a person which is shown in fig 4.2.

Figure 4.3: Output of calories by Thing Speak

Output of Thing Speak is shown in fig. 4.3. In Thing Speak the output is shown in the form of graph. The graph is plotted between date and number of calories burnt.

Figure 4.4: Output of heart rate by Think Speak

The above figure 4.4 shows the heart rate of a person. Heart rate is calculated in the form of beats per minute. And the graph is plotted between date and beats per minute in Thing Speak.

CONCLUSIONS & FUTURE SCOPE

The development of an IoT based Smart shoe is presented in this paper is quite useful to the blind people will able to move from one place to another without others help, which leads to increase autonomy for the blind. The developed smart Shoes that is incorporated with multiple sensors will help in navigating the way while walking and keep alarming the person if any sign of danger or inconvenience is detected. The developed prototype gives good results in detecting obstacles paced at distance in front of the user; it will be real boon for the blind. At the same time global positioning system (GPS) can be linked with the Smart Shoe for navigation. This work can be enhanced by collecting the electricity while walking, which can be stored in a Piezoelectric sensor for further use. This can be helpful to save the power. LTC3588 module can be used to harvest the energy provided by piezoelectric transducers to charge the battery and supply the circuit simultaneously.

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