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Smart Personal Security Alert Walking Stick For Visually Challenged People

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Abstract: ***According to the estimate from World Health Organization (WHO) about 285 million people are visually impaired worldwide. In order to reduce the barriers that visually impaired people face in daily life, a smart stick that helps them to walk more confidently and independently is proposed. The main aim of the proposed system is to develop an electronic stick for visually impaired people to detect the obstacles, pits and manholes on the ground to make them free to walk. In this system ultrasonic sensor, vibrator, speaker, microcontroller, GSM module and battery are used. Sensors play a key role in this system. It enables the visually impaired people to walk alone safely, and prevent any possible accident. The system allows the detection of obstacles in the front, pits on the ground, and stair cases in the path of the person. Both buzzer and voice messages are used to alert the blind people. An additional feature of personal security alert is included in the proposed system. This feature not only helps the blind people, it also sends alert messages to the care taker of visually impaired people in case of accidents. The proposed system is found to be effective and at affordable cost.***

Keyword: Visually impaired persons; Ultrasonic Sensor; Global System for Mobile Communication (GSM); Speaker.

I. INTRODUCTION

Visually disabled peoples are often dependent on external assistance which can be provided by humans or special electronic devices as support systems. In these days it is very necessary to provide security and safety to the blind people. Our research focus on pits detection, obstacles detection, and detecting the accidents caused for the blind people and the message is passed to the care taker through global system for mobile communication (GSM) [8].

It is difficult for blind people to move or live without the help of other people. So this stick is used to guide them during their mobility. Existing systems are used to detect and recognize objects that emerge on the floor but a considerable risk prevails when there is a sudden pit. Thus we are motivated to develop a smart stick to overcome these limitations. It is decided to modify and enhance the walking stick to detect objects by sensors, the user then becomes aware of the obstacles. This makes the people to move or walk easily without the help of others. Electronic Travel Aid's [1] is used in the device which contain sensor to alert the blind through vibration and sound. And they help the blind to facilitate their needs in unfamiliar environment. When the cane hits the object or falls off of the edge of stair, then the user will be aware of the obstacles.

The smart white cane is specially used to detect the obstacles which may help the blind to navigate carefree. The vibration feedback and sound message will help the user to alert and reduces the accidents. The stick will warn the user whenever there is a step ahead and communicate whether they are going up or down. The vibration feedback is an indication of the obstacles which is closer to the people in the walking path. And it also used to detect the pits on the ground, The depth of the pit is measured and that produces the different

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sound for the blind people. Different sound is played and the voice message is given to the user in order to reduce the navigation difficulties. Existing systems are able to detect and recognize objects that emerge on the floor but with considerable risk that not identifying the objects are at a sudden depth. Thus we are motivated to develop a smart stick to overcome these limitations.

In this system, the major role is played by the embedded system. In this system, the components are Ultrasonic sensor, Pit sensor, Playback device, Global System for Mobile communication (GSM), Embedded system, battery, Vibrator, Buzzer and speaker [2].

Ultrasonic sensors have a big size, high weight and high power consumption. This ultrasonic sensor has a better range compared to infrared sensor. Comparing to other sensor ultrasonic sensor is more accurate. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance of the obstacles. And the measure of distance is used by embedded system to alarm the user.

Pit sensor is used to analyze the pits present in the path, it calculates the depth of the pit and that signal is sent to the embedded system. Vibrator is used to alert the blind people when the obstacle is close to the user. The speaker is used to produce the voice message to the blind, if they go out of the desired path.

II. RELATED WORKS

In some existing system, multiple sensors were used which is used to find the obstacles on the ground. The other sensors like water sensor, fire sensor etc are also used. Usage of too many sensors makes the system more expensive. So it is not affordable to the blind poor people. There are several number of blind people in the society. In day to day life impaired persons faces some difficulties while moving and traveling to their destination [9]. In existing system, the blind people used a long wooden stick which can be easily foldable. Magnet is placed at the bottom of the walking stick to protect the blind from nails. To overcome these drawbacks for visually impaired persons, smart walking stick for the blind people has been developed in order to help the society.

III. THE PROPOSED SYSTEM

The block diagram of the proposed system is shown in Fig.3. It has a microcontroller which is commonly connected with the following components: a pair of ultrasonic sensor to detect the obstacles, pit sensor, play back device to produce the voice message to the user. The micro controller gets the input from ultrasonic sensor. If the distance is below the specified range and alarm is generated through the buzzer and voice message through play back board.

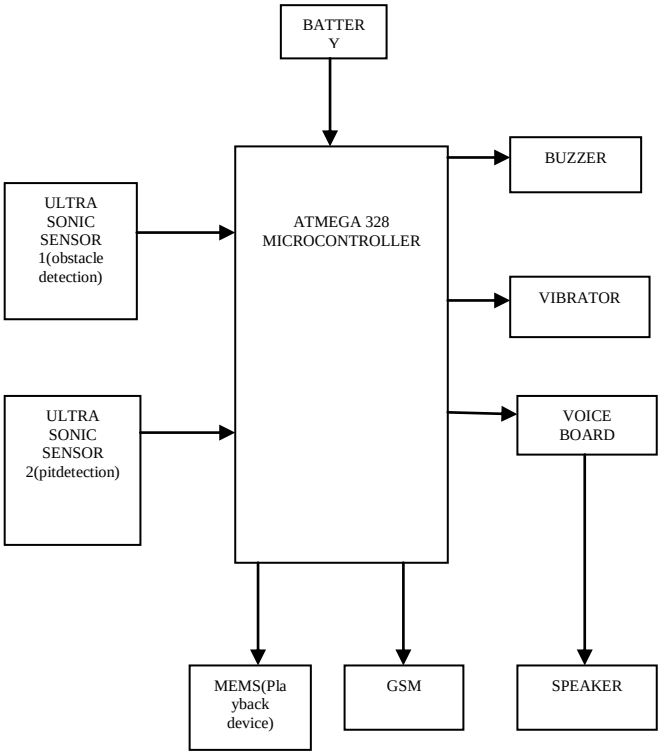

Figure 1: Block diagram of proposed device

When the signal is received at the microcontroller, it begins to compare between transmitted and received signals to identify the obstacles in the way of blind. If the microcontroller finds a difference in the transmitted and received signals, it invokes the appropriate speech warning message through the earphones.

A. MICROCONTROLLER ATMEGA 328

ATMEGA 328 Microcontroller consists of 28 pins. Microcontroller is a single chip processor (CPU), non-volatile memory for the program, volatile memory for input and output and time. This microcontroller is used to take the input and produces the output by the digital signal [7].

Microcontroller is a small computer on a single integrated circuit which stores a set of instructions. The coding is written in this chip using Arduino software. The ultrasonic sensor, headphones, GSM and other devices are connected to the microcontroller. This micro controller will calculate the distance between the obstacles and stick. The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The reason of using this microcontroller is because it has the ability to store and run programs. This controller is easy to use. The coding or programming of this microcontroller is also easier.

Hence the microcontroller plays the main role in this system and also used to execute this program.

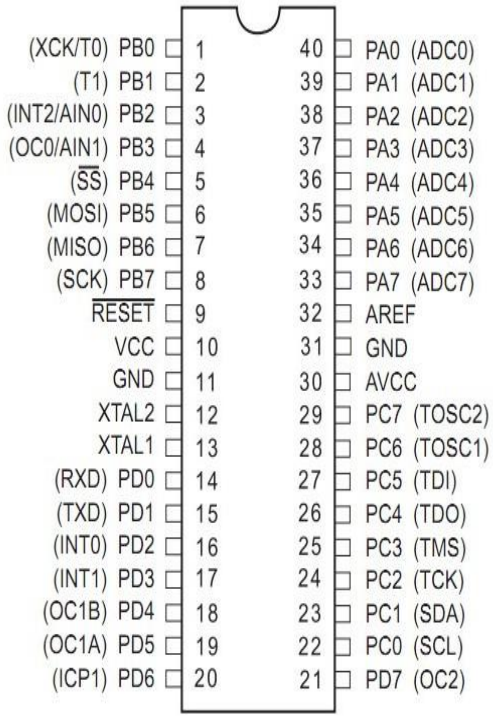

Figure 2: Pin diagram of Atmega 328 microcontroller

B. ULTRASONIC SENSOR

The ultrasonic sensor is used to detect any obstacle that lies on the ground. There are four pins used in this sensor such as VCC, Trigger, Echo and GND. Ultrasonic sensors generate high frequency 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. The detection of ultrasonic sensor used in this system ranges from 50 to 120 cm.

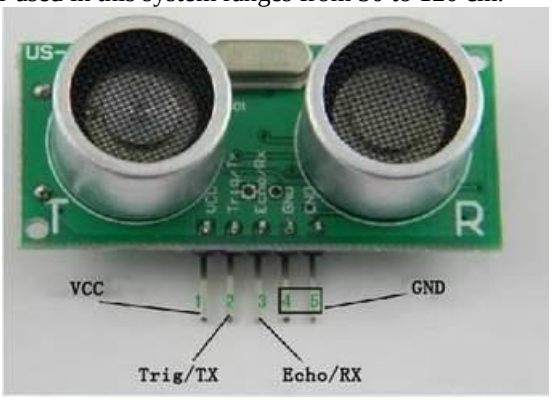

Figure 3: Ultrasonic Sensor

It is used to find the obstacles on the ground in any direction. The pits are detected by other sensor at the range of 20 to 50 cm. The depth of the pit is informed to the user through the speaker.

C. PLAY BACK BOARD

The pits are detected by the ultrasonic sensor. This playback board is used to store the predefined message. When any obstacles or the pits found on the ground, it produces the voice message to the user through the speaker. The liquid crystal display (LCD) is additionally used to display the information on the board. When the pit is below 20 to 30 cm it produces voice message (as stair case) and also when it is above 30 to 50 cm it produces the voice message (as deeper pit) to the user through the speaker.

Figure 4: APR33A3 Voice Recorder

D. GLOBAL SYSTEM FOR MOBILE COMMUNICATION (GSM)

Global system for mobile communication is used to produce the information to the particular number which is used in the coding. There are five pins in the Accelerometer and it produces the output in the 3-dimensions. The pin (y0) takes the input and it is connected with microcontroller. The Accelerometer is a sensor it is used to detect the accidents, when their range is above 400, which is caused to the visually impaired persons. This Accelerometer sensor is placed at the top of the stick. When the accident occurs to the user, it sends the message to the particular number stored in GSM. [4]. In this system, sim card is used in the global system for mobile communication (GSM) to send the message to the other user.

E. BUZZER AND VIBRATION MOTOR

The buzzer consists of two pins (5V, Ground). The 5volt pin is connected to the pc2 in the micro controller. The ultrasonic sensor detects the obstacles and it gives to the microcontroller as the input and produces the output with buzzer and vibration motor. The vibration motor is placed in the handle of the stick and the buzzer in placed in the board. When the obstacles are detected at the range of 80 to 120 cm it produces the buzzer sound. When the obstacles are detected at the range of 50 to 80 cm it produces both buzzer sound and

vibration. Thus the main role of this component is used to alert the user.

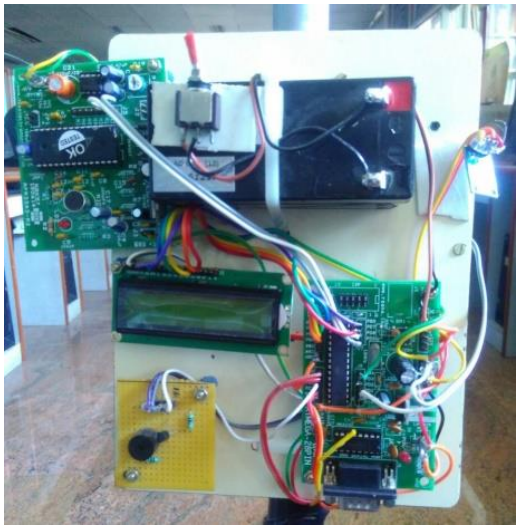

Figure 5: Vibration and Buzzer Alarm

IV. SYSTEM IMPLEMENTATION

A. OBSTACLES DETECTION

The ultrasonic sensor detects the obstacles. When the sensor receives the message it calculates the distance of the obstacles and passes the information to the microcontroller. When the obstacles is above 100cm, it produces the buzzer sound to the user and if the obstacles is above 50cm, it produces the vibration and buzzer motion.

INTERFACING MICROCONTROLLER

The inclined sensor is used to detect the pits on the ground. When the pits are detected by the sensor, it passes the message to the microcontroller through the analog signal. The microcontroller transmits the signal to the playback device. The playback device records the message and produces voice message to alert the blind people.

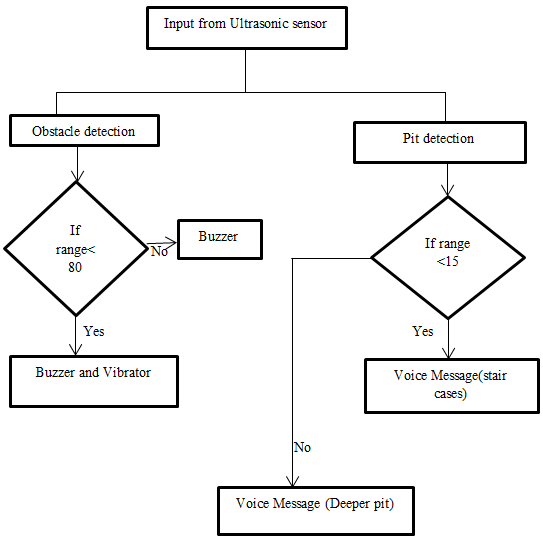

Figure 6: Working flow of obstacle and pit. Detection module

B. INTERFACING VOICE BOARD

The pits are detected by the ultrasonic sensor. And it displays the distance of the pit in the liquid crystal display (LCD). When it detects 20 to 30 cm, it produces the voice message (as stair cases) to the user through the speaker. When it detects the pit in 30 to 50 cm, it produces the voice message (as deeper pit) to the user through the speaker.

C. ACCIDENTS DETECTION

This accelerometer consists of five pins; it produces the output in 3- dimensional. The pin (yo) takes the input and it is connected with the micro controller (pc4). It detects the accidents when their range is above m/s2. And it also writes the distance on the liquid crystal display (LCD). Then it sends the message to the particular mobile through global system for mobile communication GSM.

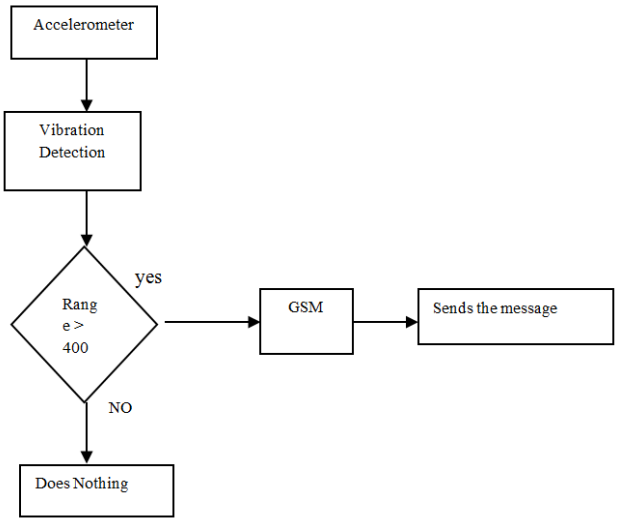

Figure 7: Working flow of GSM

V. SYSTEM WORKING

In this project, when the switch is turned ON, it begins to detect the obstacles by the ultrasonic sensor. This ultrasonic sensor detects the obstacles and sends the input to the micro controller through analog signal. When the obstacles are at the range of 80 to 120 cm to the user stick it produces the Buzzer sound to the user. And at the same time when the obstacle is at the range of 50 to 80 cm [6], it produces the both buzzer and vibration to the user. The inclined senor is used to detect the pits on the ground; it passes the message to the microcontroller through the analog signal. The microcontroller transmits the signal to the playback device. When the pit is in range of 20 to 30 cm,(as stair case) it produces the voice message through the speaker correspondingly and when pit is above 30 to 50 cm,(as deeper pit) it generates voice message. In this system, it also detects the accidents occurred to the blind. Accidents are detected by the accelerometer sensor, when the accelerometer range is above 400 it sends the alert message to the particular number coded in the system [5].through the GSM.

Figure 8: Working model of proposed Smart Stick

VI. CONCLUSION AND FUTURE ENHANCEMENT

In this paper, a solution is proposed to help blind to move safely and detect obstacles in their path. Solution was composed of a stick with a pair of Ultrasonic sensors mounted in it. The horizontal sensor was able to detect high level obstacles whereas the inclined sensor was able to detect the low level obstacles on ground and stair cases. The accidents are detected by the Accelerometer sensor. Thus the appropriate messages are given to the blind people and care taker. A system can be used to find the position of' the user using the global positioning system (GPS)[3] and guidance to the blind will be given to their destination by voice navigation so that they can feel very comfort and easy to walk. The location of blind people can be known using the GPS.

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