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# Effective Fast Response Smart Stick for Blind People

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***Abstract*— Visually impaired people find difficulties detecting obstacles in front of them, during walking in the street, which makes it dangerous. The smart stick comes as a proposed solution to enable them to identify the world around. In this paper we propose a solution, represented in a smart stick with infrared sensor to detect stair-cases and pair of ultrasonic sensor to detect any other obstacles in front of the user, within a range of four meters. Moreover, another sensor is placed at the bottom of the stick for the sake of avoiding puddles. Speech warning messages and the vibration motor are activated when any obstacle is detected. The stick is capable of detecting all obstacles in the range 4 meter during 39 ms and gives a suitable respect message empowering blind to move twice his normal speed because she/he feels safe. The smart stick is of low cost, fast response, low power consumption, light weight and ability to fold.**

***Keywords*— *Infrared Sensor, Ultrasonic Sensor, Electronic Travel Aids (ETAs), Visually impaired, Blind Navigation.***

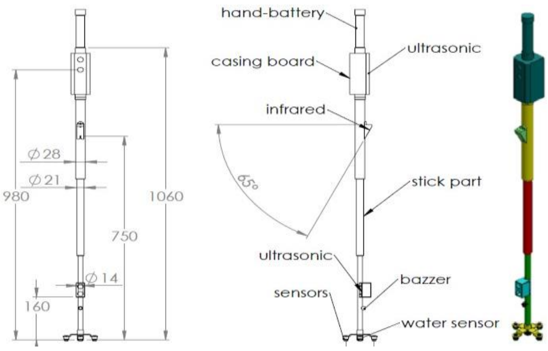
## I. INTRODUCTION

Vision is the most important part of human physiology as 83% of information human being gets from the environment is via sight. The 2011 statistics by the world health organization estimates that there are 285 billion people in world with visual impairment, 39 billion of which are blind and 246 with low vision. The traditional and oldest mobility aids for persons with visual impairments are the walking cane and guide dogs. 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.

To record information about the obstacles presence in a road, active or passive sensors can be used. In case of a passive sensor, the sensor just receives a signal. It detects the reflected, emitted or transmitted electro-magnetic radiation provided by natural energy sources. In case of using an active sensor, the sensor emits a signal and receives a distorted version of the reflected signal. It detects reflected responses from objects irradiated with artificially generated energy sources. These kind of active sensors are capable of sensing and detecting far and near obstacles. In addition, it determines an accurate measurement of the distance between the blind and the obstacle. Overall, in the obstacle detection domain, four different types of active sensors may be used: infrared, laser, ultrasonic, in addition to radar sensors.

## II. OBJECTIVE

The main objective of our project is to provide a voice based assistance to blind people. Here we have developed an intelligent system that helps blind person to travel independently and works efficiently. Current navigation device for the visually impair focus on travelling from one location to another. Our project focuses on designing a device for blind people that help them to travel independently and also it must be comfortable to use. The proposed device is used for guiding individuals who are blind or partially sighted. The device is used to help blind people to move with the same ease and confidence as a sighted people.




### *A.* ***Sensors***

several factors such as, cost, atmospheric condition, kind of We used a combination of 2 types of sensors infrared and ultrasonic for the following reasons:

a) Infrared sensor

recognize small obstacle but with less accuracy than laser sensors. However using laser sensor is costly which contradicts our aim in obtaining affordable aiding devices. They perform almost the same within 2 meter.

b) Ultrasonic sensor work well for close obstacles unlike laser one, when an object is so close the laser sensor (less than 15 cm) can't get an accurate reading. Moreover, it should be noted that radar sensors can easily detect near and far obstacles with equal perform once, but their medium accuracy doesn't allow them detecting small obstacles.

TABLE I. GENERAL CHARACTERISTIC OF SOME ACTIVE SENSORS

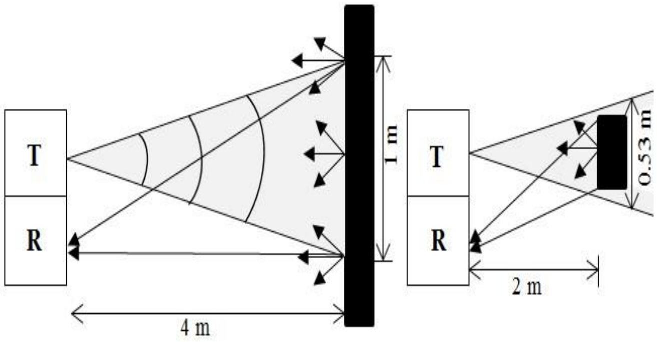
| | Laser | Infrared | Radar | Ultrasound |
|---|---|---|---|---|
| Principle | Transmission and reception of light wave | Transmission and reception of pulse of IR light | Transmission and reception of microwave | Transmission and reception of acoustic waves |
| Range | SLR: 15cm to 120cm LLR: about 10- 50 m | From 20 cm to 150 cm | about 150-200 m | From 3 cm to 10 m |
| Beam width | narrow | fairly thin | Depended on size of antenna | wide |
| Atmospheric condition | affected | affected | Affected | Not affected |
| Cost | Very high | Low | High | Low |

SLR: short laser range, LLR: Long laser range

Infrared sensor chosen has a detection range distance that goes from 20 to 200 cm, a resolution of 0.5 cm, a frequency of 26.3 Hz and an analogical output that goes from 0 to 5 V.
Ultrasonic sensor used 40 kHz transmission signal. The 40 kHz frequency is produced by a transmission sensor of twocentimeter diameter; it can generate 2.4644 beams of narrowness. This is a reasonable size to be installed in the stick.
We use the infrared sensor to detect upward and downward stairs because the sensor spot is roughly 6 cm. This feature enables the user to identify precisely, any kind of stairs in front of him.
We use a pair of ultrasonic sensor. An upper one at a height 90 cm to detect upper obstacles and another sensor at a height 30 cm to detect low obstacles.

Detection using ultrasonic sensor is based on two factors:

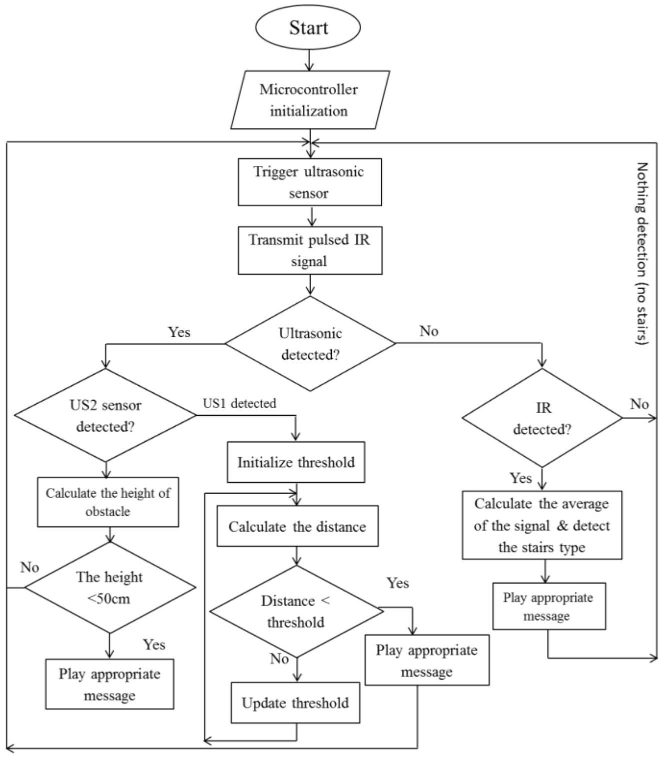
- Time of flight (TOF), the amount of delay between the emission of a sound and the arrival of an echo depending on the distance of an obstacle, which is directly proportional to the distance.
- Beam size: Obstacle size is depending on amount of reflected wave. Obstacles whose dimensions are larger than the beam size, all of the sound waves will be reflected to receiver. If the obstacle size small as compared to the beam size, the part of the ultrasonic sound wave will be reflected to the receiver and the rest will be lost as shown in Fig. 4.

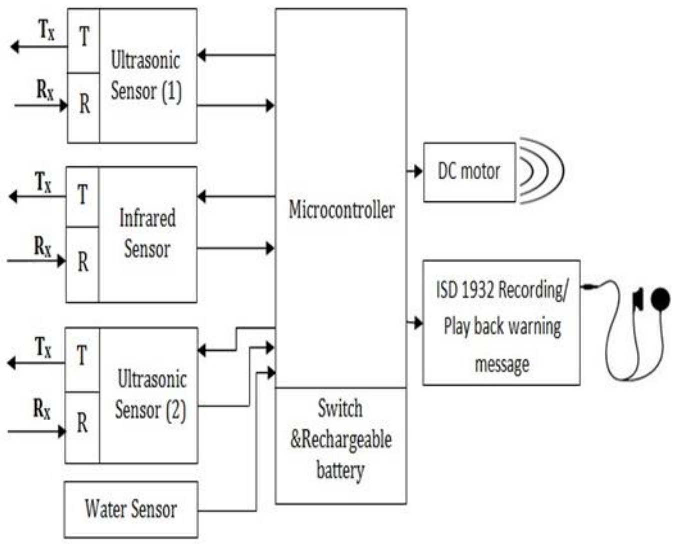



### *B. PIC Microcontroller 18F46K80*

Researchers in [17, 18] used the microcontroller 16F877A. It has 3 disadvantages (1) it has no internal oscillator so we will need an external crystal as a clock source. (2) It has memory 256 bytes of EEPROM. (3) It has 8 channels of 10-bit Analog-to-Digital (A/D) converter.
The microcontroller 18F46k80 (MCU) [16] used to control the embedded system. The PIC microcontroller we used is simplified computer with a processor, memory and support for peripherals. The PIC simply runs the program in its memory when it is turned on and it doesn't have an operating system. It has 200 ns instruction execution, 1024 bytes of EEPROM data memory, self-programming, an 2 ICD, 2 Comparators, 11 channels of 10-bit Analog-to-Digital (A/D) converter, 1 capture/ compare/ PWM functions, a synchronous serial port that can be configured as either 3-wire SPI or 1- 12wire C bus, a USART, and a Parallel Slave Port. Regulator LM7805 used to regulate the volt to +5V which input to microcontroller if the input voltage exceeds +5V.

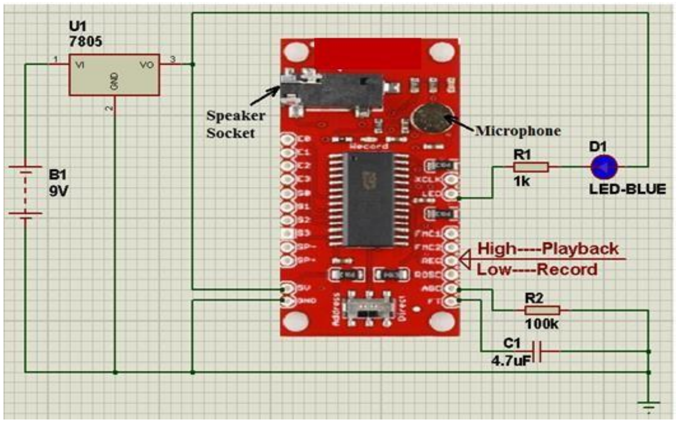
As shown in Fig. 5. When the MCU is started, it produces a 40 kHz wave with the duration of 300µs. It generates the pulse that will drive the ultrasonic emitter. After sending the pulse, the ADC of MC will read and convert the received wave from each ultrasonic receiver into a digital form. If the ultrasonic sensor received the signal, MC will calculate the distance. If the infrared sensor received the signal, MC will calculate average of the signal shape and amplitude. Accordingly, MC invokes the right speech warning message through an earphone. The proposed system was simulated using Proteus software (Simulation Program) [19] as shown in Fig. 6. The program code was written using C language.




*Speech Warning Message*

Many researchers [5, 6, 14] used vibration array or buzzer based audio frequency clips for announcing any detection of obstacles. The proposed stick uses pre-recorded speech messages for conveying any detection of obstacle. It uses ISD1932 [20] circuit that contains a multiple-message recording and playback device. This circuit can record up to 64 seconds per message. It includes microphone inputs and speaker outputs as shown in Fig. 7.




***D.*** *Water Sensor*

Water sensors available are used to detect water levels inside tanks and very expensive. Our objective is to detect water existence regardless its level. So we used a costless alternative. Two wire probes are shown in Fig. 8; they fit at the bottom of the stick to sense obstacle like water pits, puddles and water spread. Once wires touch water, the circuit is shorted, this interrupts the microcontroller, activates the vibration motor and play warning message saying: "Attention there is water".

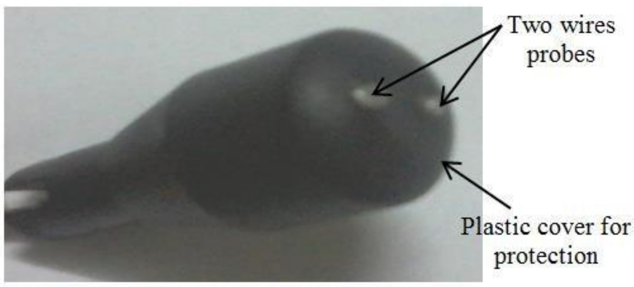



Figure 8. Water sensor

***E.*** *Vibration Motor*

*This is the type of DC vibration motors used in mobile phones. It requires a voltage supply of 3V to 5V with current around 125 mA. This type of motors can be programmed to control its speed by using the PWM (Pulse Width Modulation) method. The PWM signal is generated from the TMR2 timer via interrupt control on RC2 and RC1 pins to gate this PWM to active the vibration. The diameter of the motor is 0.5 cm and the thickness is 2.5mm.*

*F.* ***Calling the Stick*** We used FM "frequency modulation" wireless communication to help the blind person to find the stick if it is far from him.

Fig. 9 shows an RF transmitter that generates radio frequency waves in its circuits, and to this 'carrier signal', it adds the information part by modulating the carrier signal. This composite signal (carrier plus information) is then fed to an antenna. An RF receiver receives the signal at the same frequency from the atmosphere, by altering the Electric and Magnetic fields from its own antenna.

The receiver circuits then strip the information part of the signal from the carrier part, and amplify this to a useful level for audio.

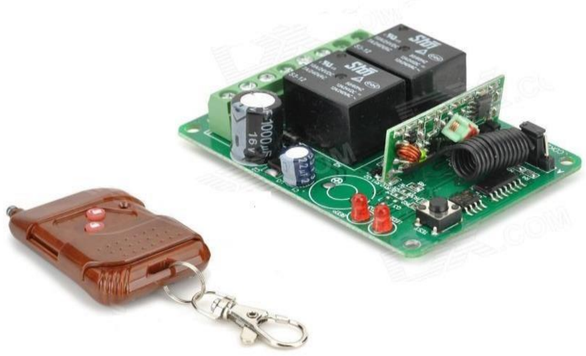


Figure 9. RF transmitter and receiver

## III. RESULT

To evaluate the performance of the proposed method the experiments were conducted. The results in this paper shows the beginning of our efforts to build a compact travelling aid that allows the visually impaired to negotiate everyday environment. As previously mentioned, the sensor circuits give information about the environment. The circuit that has been designed for the object detection has provided an accuracy of 1 meter

## IV. CONCLUSION

The Smart Stick acts as a basic platform for the coming generation of more aiding devices to help the visually impaired to be more safe. It is effective and afford. It leads to good results in detecting the obstacles lying ahead of the user in a range of four meters, detecting stairs and water pits.

This system offers a low-cost, reliable, portable, lowpower consumption and robust solution for navigation with obvious short response time. Though the system is hard-wired with sensors and other components, it's light in weight. Further aspects of this system can be improved via wireless connectivity between the system components, thus, increasing the range of the ultrasonic sensor and implementing a technology for determining the speed of approaching obstacles. While developing such an empowering solution, visually impaired and blind people in all developing countries were on top of our priorities.

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