Proceedings of the
International Conference on Mechanical Engineeringand Renewable Energy 2015
(ICMERE2015) 26 – 29 November, 2015, Chittagong, Bangladesh

ICMERE2015-PI-271

WALKING ASSISTANCE SYSTEM FOR VISUALLY IMPAIRED PEOPLE

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Abstract*-This paper presents a clear idea about walking assistance system for the visually impaired people. It gives a system to provide a low cost and efficient navigation aid for blind people. Our proposed system detects nearest obstacle via ultrasonic and sends feedback to inform the user through an android application about the object and its distance from the user along with the feature of sensing presence of water. The system is implemented on a cane, which blind people normally uses for walking. Ultrasonic sensors, water sensor. Arduino mega, Bluetooth module and android application are used in this purpose.*

Keywords: Ultrasonic sensor, Blind assistance, ETA, Arduino, Water sensor.

1. INTRODUCTION

In human physiology, vision is the most important part of all senses as about 83% of information from the environment is gathered by sight for human being. According to the statistics of World Health Organization (WHO), by the year 2011 there are 285 million people are visually impaired and 39 million people are fully blind, 90% of these visually impaired people are living in low income settings and 82% of these people are aged 50 or above[1].

The traditional and oldest mobility aid for the visually impaired people is the Walking cane [2], which is also called White cane or Stick. The guide dogs are another mobility aid which are widely used for helping the visually impaired people for walking safely. The main drawback is these aids need necessary skills and training and moreover the aids are conveyed very little information about environment.

With the development of technology, recently many electronic Travel Aids (ETA) are introduced for the visually impaired people [3]. Ultrasound is widely used in these systems because of its immunity to the environmental noise [4]. Moreover ultrasonic technology is become popular as it is cheap and ultrasonic emitter and detectors small enough to carry and it needs no complex circuits [5].

The traditional walking cane system is useful for detecting static obstacles on the ground and different surface holes using tactile force feedback system. The device is not suitable for the dynamic obstacles and obstacles which are not located on floor [6]. Guide dog aiding system is very useful to detect obstacles, stairs and navigating the streets and provide safe guidelines for safer journey of the visually impaired people. But the drawback of this system is the dogs need special training and trained dogs are too expensive to afford for the people who are living in low income settings [7]. Moreover blind people are usually are aged person. So caring of another living being is difficult. Laser cane is another device which is getting popularity too [8]. The CyARM is recently developed which uses tactile feedback [9].

In this paper, a blind assistance system is presented using ultrasonic sensor at different angles and with the aid of an android application [10]. It also includes features of water presence sensing [11]. The system we have developed consists of sensing the surrounding environment by the ultrasonic sensors and sensing the water using water sensors and sending feedback to the user about the closest obstacles with providing the distance of the obstacle from the stick [12].

2. WORKING PRINCIPLE

The main aim of this system is to design and implement a walking assistance system for blind or slightly visually impaired people based on voice output through android application. Figure 1 shows the block diagram of walking assistance system.

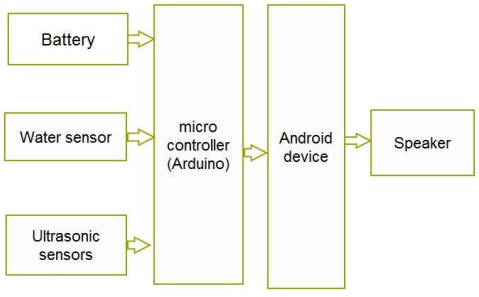

Fig.1: Block diagram of Assistance system

Ultrasonic sensors sense the obstacles in its path by transmitting sonic bursts. When any obstacle comes in the ultrasonic sensors vicinity, the sonic wave reflects back from the surface of the obstacle and received by the sensor. Three ultrasonic sensors are used in this system instead of using traditional one ultrasonic sensor. Multiple use of sensors give many advantages including obstacle detection in right and left side along with front side, covering greater area and providing better reliability.

Almost all previous systems were done using buzzer or voice chip where buzzer sound is annoying and voice chip's output is complex. In this system, an android application built with eclipse apkmaker is used. This application works through mobile phone's Bluetooth which connects with the device's Bluetooth module (HC-05).

Water sensor is used for the purpose of water presence detection. The sensor boards resistance is 2 mega ohms in dry condition, which is reduced to 100 kilo ohms in wet condition.

2.1 Ultrasonic Sensor

Ultrasonic sensors are used for detecting different types of obstacles whether it is non-metalic or metallic, powder or liquid,colored or transparent. Variables like target surface angle, reflective surface roughness and changes in humidity or temperature can affect the operation of ultrasonic sensing. HC-SR04 ultrasonic sensors are used in this system which have resistance to ambient noise, EMI or infrared radiation or vibration and are capable of detecting objects over long distances. Figure 2 shows the pin connection of HC-SR04 which provides non-contact measurement function 2cm- 400cm.

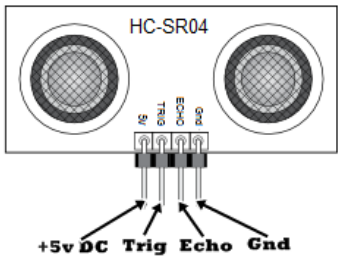

Fig.2: Pin connection of HC-SR04

2.2 Water Sensor

Water sensor is used to detect the presence of water which includes a board and a control board. The board has a large conductive area for water detection. Normally at dry state its resistance is high and when the board detects water its resistance becomes low and LED goes bright. The sensitivity of the sensor is adjusted via variable resistor.

2.3 Object Detection

The ultrasonic sensors detects obstacles with the help of sound waves. Each transceivers consists of transmitter and receiver for sending sonic burst and receiving echo. The time interval between sending pulse and receiving echo is measured and the value is used to find the distance of obstacle using the equation (1).

$$D=(t*v)/2 \quad (1)$$

As sound velocity varies with temperature according to the equation (2),

$$v= 331.5 \text{ m/s } +0.6*(T-273) \quad (2)$$

so temperature has some effect on distance measurement. Figure 3 shows the functional block diagram of ultrasonic sensors.

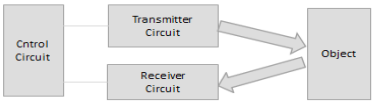

Fig.3: functional block diagram of ultrasonic sensors.

3. IMPLEMENTATION

All sensors and Bluetooth module are interfaced with Arduino Mega 2560, which receives the output from ultrasonic transducers and water sensor and feeds the android application via Bluetooth. Figure 4 shows the circuit diagram for the system.

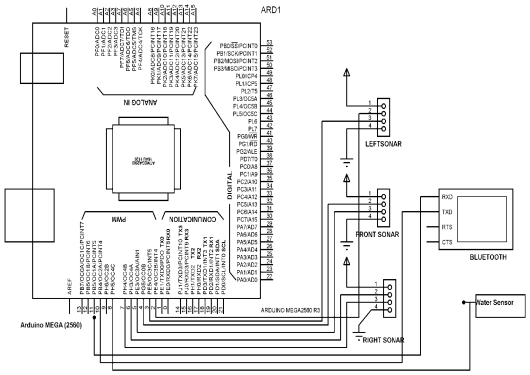

Fig. 4: Circuit diagram of walking assistance system

3.1Hardware Implementation

The whole circuit is mounted on a walking cane. The ultrasonic sensors are placed at an angle of 60® and the water sensor board is placed on the lower level of cane. A 9 volt battery is used for providing power to the system. Cane is used in this system as blind people are normally comfortable with a cane while walking. Figure 4 shows the implemented system.

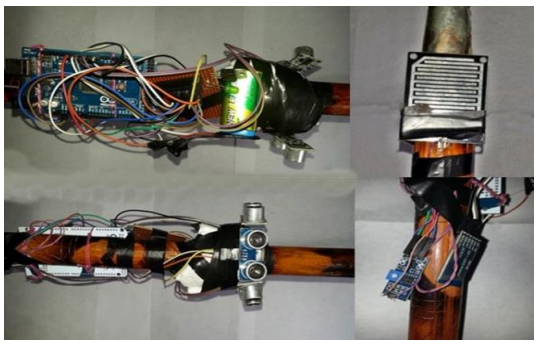

Fig.4: Hardware Implementation

3.2 Software Implementation

An android application is developed using eclipse apk maker. Figure 5 shows the interface of the android application. The application has two buttons. First of all user have to pair and connect the android device with the Bluetooth module. 'CONNECT' button is used in this purpose. 'START' button has to be pressed to start using the system.

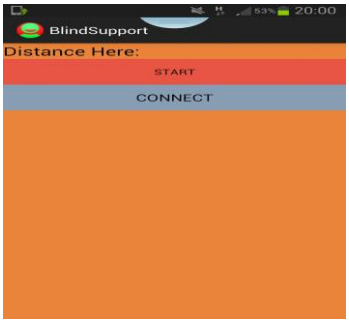

Fig.5: Android app interface

The user can get the audio output either in earphone or speaker of the android device according to his choice.

4. RESULTS AND DISCUSSION

The assistance system worked without any disturbance. The range of ultrasonic sensor is fixed to 200 cm and the system can be able to detect any obstacles within its range and be able to alert the user through android application. The sensitivity of the water sensor can be changed using potentiometer and it perfectly works. Trials are performed to determine the measurement accuracy of the system. Table 1 below shows the measurement accuracy of the system.

Table 1: Measurement Accuracy

Sensor	Actual Distance cm	Measured Distance cm	Accuracy %
Front	7	7	100
Front	66.8	67	99.70
Left	87.1	87	99.88
Left	46	46	100
Right	33.2	33	99.40
Right	54.7	55	99.45

The user is able to walk among obstacles with ease using the system. Detection of dynamic obstacles for the system needs to be improved. It is difficult to respond accordingly in case of speedy obstacles. The actual range of the system may be lower than the theoretical value. The device is light weighted and fully portable. Power consumption is low and the whole operation is easy and user friendly.

5. CONCLUSION

The main goal of this assistance system is to help blind people walk through obstacle with ease and in less time. Using the android application along with the system is easy and users can learn the process with a little practice. Multiple sensors with a narrow field of view can be used to make the system more precise. The system is made as cost effective as possible. We hope that the assistance system will be an effective device for the visually impaired people who are deprived of seeing.

7. REFERENCES

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8. NOMENCLATURE

Symbol	Meaning	Unit
D	Distance	(m)
v	Sound Velocity	(m/s)
t	Time	(s)
T	Temperature	(K)