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Smart Assistance for Visually Challenged People

Praveena. M[1], Priyanka. G.P[2], Preeti. N[3], Kaushika. S[4], *Dr. S. Deepa M.E.,*
[5]*Ph.D.,* [1, 2, 3, 4]*Department of Electronics and Communication Engineering, Panimalar Engineering College, Chennai, India.*

Abstract: ***Vision plays a most significant role in observing and interpreting the environment. Due to their impairment the visually challenged people finds difficulties in doing their daily chores[10]. Several new techniques and devices have been developed in recent times for them to do their day to day activities independently. Li-fi smart shoe is one of those technologies which gives gait assistance to visually impaired people. So that they can travel around independently without any human abetment. The mechanism of the smart shoe is controlled by Arduino Nano. It operates apparently with the use of ultrasonic sensor which detects the obstacle and notify the user. Water sensor is also used in this device to detect the presence of water in the pathway. Li-fi communication mechanism is used to notify the user about the location through the visible light communication system. These detections are notified to the user in form voice signal.***
Index Terms: Li-fi (light fidelity),obstacle detection, speech signal, gait assistance.

I. INTRODUCTION

There are many guidance systems for visually impaired travellers to navigate quickly and safely against obstacles and other hazards faced. Generally, a blind user carries a white cane or a guidance dog as their mobility aid. With the advances of modern technologies many different types of devices are available to support the mobility of blind. These mobility aids are generally known as Electronic Travel Aids (ETAs).

There is an artificial navigating system[1] with adjustable sensitivity with the help of ultrasonic proximity sensor to assist these blind persons to walk fearlessly and independently in both indoor and outdoor environment. It consists of different sensors that are set to the chest ,knee and toe of the person. These different sensors are used to detect the obstacles at the different levels and the levels of obstacles can be known to them with the help of buzzer with different sounds. This system can detect any type of upcoming obstacles and potholes using the reflection properties of ultrasound. Attachment of the system to the clothes, shoe, body area and as well as to the walking stick make its utilization more versatile and reliable. This system has some limitations such as it is unable to identify the condition of the surface. The change in the environment affects the sensor accuracy.

There are also crutches[2] consists of a ultrasonic sensor which is used to locate the obstacles present in their way, and the sensor in the bracelet fixed to hand of the person would vibrate when the obstacles are detected to prompt the user about the upcoming obstacles . When the distance of obstacle is less than one meter, the vibration will be significantly increased, then the blind can change the walking direction to avoid obstacles. This system can be developed further by adding the Sensors on the bracelet that can detect a blind man's fall by the different sensors attached and if the blind can't stand up in time, the bracelet would automatically make a voice to passers-by for help.

There are also electronic walking stick[3] consists of two ultrasonic sensors. Vibrating sensors along with a buzzer is used and vibration is produced if stick is about to hit with any obstacles. Two Infrared sensors are also implemented on the lower side of stick in order to avoid small obstacles ranging from2-10cms. IR sensor is also used in this device for ground analysis. In an unknown environment, the nature of surface and its properties are important in order to interpret IR sensor output as a distance measurement. This system aims to avoid minor collision and provides a clear path indication. But 1m width is required for proper management of stick. Also, the IR sensor used in this system sometimes provides nonlinear response.

There are also hand mounted devices[4] which performs as a navigator to help visually impaired peoples. This is an electronic system which consists of two ultrasonic sensors, two vibrating motors and a microcontroller in which it uses two measuring channels for two different distances. one sensor is used for near objects and one for distant objects. In order to inform the blind user about the distance, two motors in the proposed system configuration receive specific signals from the microcontroller and produce specific vibrations as human interacting interface. Use of 2 motors provides greater accuracy, because human brain does not distinguish the vibration’s intensity correctly.

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The system proposed in this paper provides an effective obstacle detection. The presence of obstacle will be notified to the wearer in the form of voice signal through the speaker. These voice signals are control LED by DF mini player. This system also detects the presence of water with help of water sensor. This detection also notified to the wearer through the speaker. The solar panel used in this system provides power back-up to the battery. The solar panel gets light energy from the sun while the person is walking and convert it into electrical energy. Thus this system does not depend on external power supply.

LI-FI communication[7] is used in this system .It consists of a Li-fi receiver and a transmitter , The Li-fi transmitter consists of LEDs, and the Li-fi receiver consists of the photodiode . With help of LED the data bits are transmitted and these bits are received by the photodiode. This transmission and reception mechanism (LI-FI) helps the user to find their location . The transmitter and receiver block are explained in section II, the design flow is explained in section III and the overall experimental results are explained in section IV.

II. SYSTEM DESCRIPTION

The steps involved in detection mechanism are as follow:

A. Obstacle Detection

Two ultrasonic sensors are attached to the shoe .The one sensor detects the obstacle in forward direction and the other senses obstacle in its side.

B. Water Detection

A water sensor is attached to the shoe and when it comes in contact with the water, due to its conducting property the resistance of water sensor will change. Thus, the presence of water is notified to the wearer via the voice signals are produced.

C. Li-fi Communication

This project also consists of a Li-fi transceiver. The Li-fi transmitter (LED) transmits the information about the location of the wearer and it is obtained by the receiver (photodiode) attached to the shoe of the wearer.

This system consists of Li-fi receiver which is used to obtain the data bits that have been transmitted from the Li-fi transmitter. The transmitter session shown in fig.1 consists of the LCD Display which is used to indicate the name of the corresponding places .The Li-fi transmitter consists of the LED(s) which are the source for transmitting the data to the receiver. The keypad used in this project is used switch the data transmitted by the LEDs. In the transmitter block, all actions are controlled by Arduino Uno.

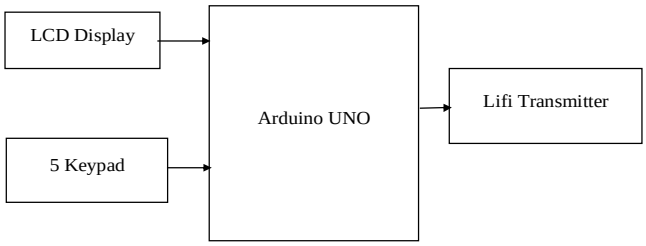

Fig 1. Block diagram of transmitter

In this system Arduino microcontroller[8] is used in guiding the visually challenged people for walking. It receives various data as input from the different types of sensors. The receiver side shown in fig.2consists of the ultrasonic sensor which is used to locate the obstacles in the path by sending the ultrasonic signals and an echo is provoked and the signals strikes in the object. Thus the distance between the person and the obstacle is measured[5]. The water level sensor detects the presence and the depth of the water and the corresponding input is given to the microcontroller. The 12 volt/1a battery which provides power source to the product. The solar panel fixed to the battery provides power to it. The DF Mini Player is used to give the corresponding voices as output with respect to the input data given by the sensor, The SD card is the memory which consist of all the pre-recorded voice signals. The output of the df mini player is given to the speaker, this speaker amplifies the voice messages from the SD card.

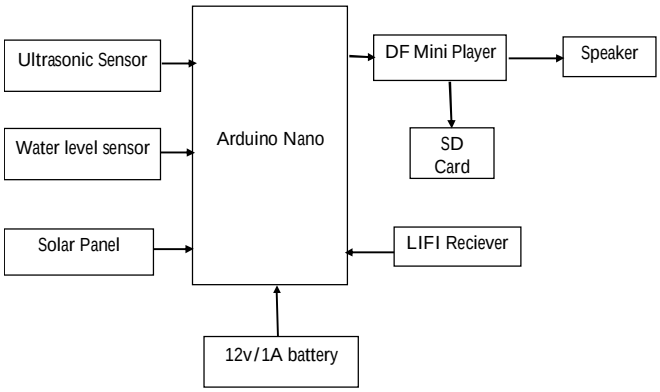

Fig 2. Block diagram of receiver

III. FUNCTIONAL DESCRIPTION

Fig.3 shows operations based on the input obtained from various sensors and receivers attached to the system.

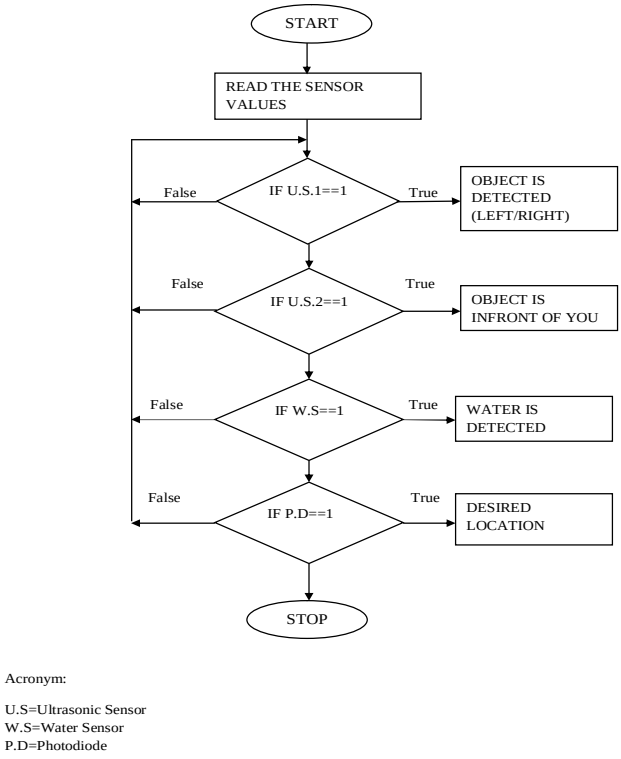

Fig 3. Design flow

The Arduino Nano at receiver circuit controls all the actions accordingly. This system can be attached to the shoe of the visually challenged people. Whenever the wearer walks, the ultrasonic sensor(U.S) attached to the front side of the shoe sends the sound waves and the presence of obstacle is detected based on the echo signal received by the sensor. Similarly, the ultrasonic sensor(U.S) attached to either left or right side of the shoe detects the presence of obstacle by similar mechanism. The water sensor(W.S) attached to this system detects the presence of obstacle based on decrease in resistance due to conducting property of water. The photo diode(P.D) attached to Li-fi receiver receives the information about the location of wearer based on the light signal sent by Li-fi transmitter. All these detections are notified to the wearer through voice signals from speaker, controlled by DF mini player. Thus, the wearer can be more safe when walking in unknown environment. The necessary power supply is provided with help of solar panel attached to the shoe.

The various sensors and receivers used in this system are explained below.

A. Ultrasonic sensor

Ultrasonic sensor is type of acoustic sensor. It consists of transmitter and receiver section. The transmitter section obtain the electrical signal and convert it into ultrasound[9]. This ultrasound is transmitted as trigger. When there is any obstacle in front of this sensor, the echo of the ultrasound is received by the receiver. The receiver again converts the received ultrasound into electrical signal. This mechanism is similar to radar and sonar as shown in fig 4.

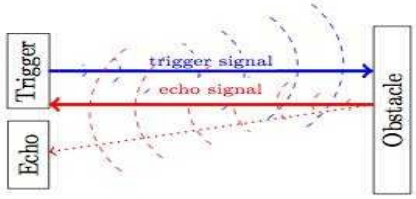

Fig 4. Obstacle detection using ultrasonic sensor

B. Water Sensor

The water sensor is used in this system to detect the presence of water in the path. Whenever the shoe of the wearer comes in contact with water, it will be notified by speech signal via speaker. The water sensor detects the water by the decrease in resistance of stripes present in it. This happens due to conducting property of water.

C. Li-fi Transceiver

The Li-fi communication is a visible light communication[6]. In this paper, the Li-fi communication mechanism is used for notifying the user about their current location. In this a keypad module is used to control the desired optical signal to be transmitted by LEDs. Accordingly the location is displayed in the LCD display at transmitter side. At receiver side a photodiode is being used to receive the optical signal. Then the photodiode converts the optical signal into the electrical signal. Based on this, the DF mini player control the speech signal to be transmitted via the speaker. Fig.5 shows the mechanism of transmitting and receiving of information using li-fi.

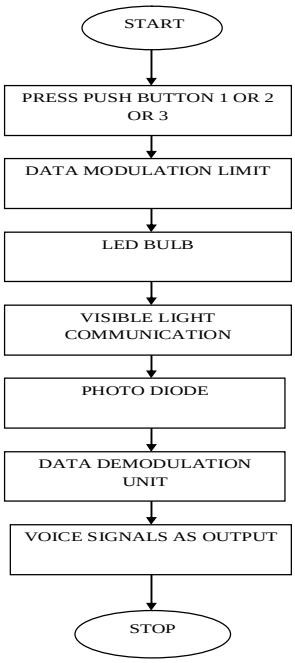

Fig 5. Li-fi communication

IV. RESULT AND DISCUSSION

This system shown in fig 6 detects the presence of obstacle and water, then it alerts the user. The user gets alerted by the appropriate voice signal from the speaker. Hence this system operates satisfactorily and thus it is very easy to use. This ensures a better gait assistance to the visually impaired people**.** This system also uses Li-fi communication for locations finding.

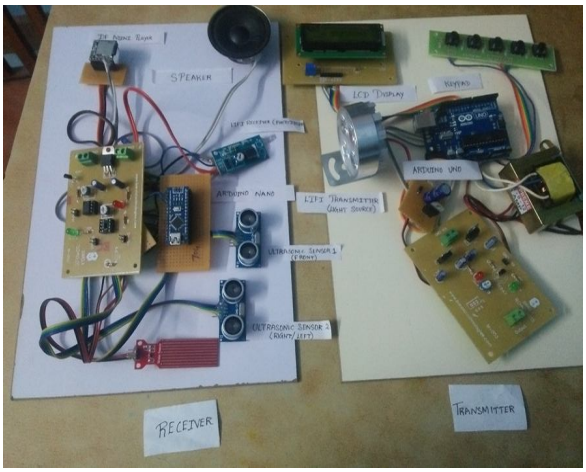

Fig 6. Output

The transmitter transmits different location controlled by the keypad. For example, the test1 done for location ‘coffee shop’ is transmitted by the light source and it is displayed in the LCD as shown in fig 7.

Fig 7. results for test 1

The test2 for location ‘medical shop’ is transmitted by the light source and it is displayed in the LCD as shown in fig8.

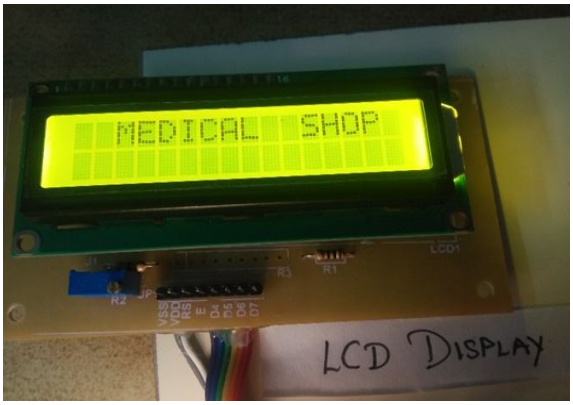

Fig 8. Results for test 2

V. CONCLUSION

Li-fi smart shoe is one of the technologies which gives gait assistance to visually impaired people. . Microwave radiations hazards due to wi-fi can be overcome with the help of light fidelity. The major disadvantage of this technology is its limited range as it is in the development phase. But in future li-fi technology will play a major role in communication unit. This system can also enhanced by adding GPS module, so that the wearer can get accurate location details.

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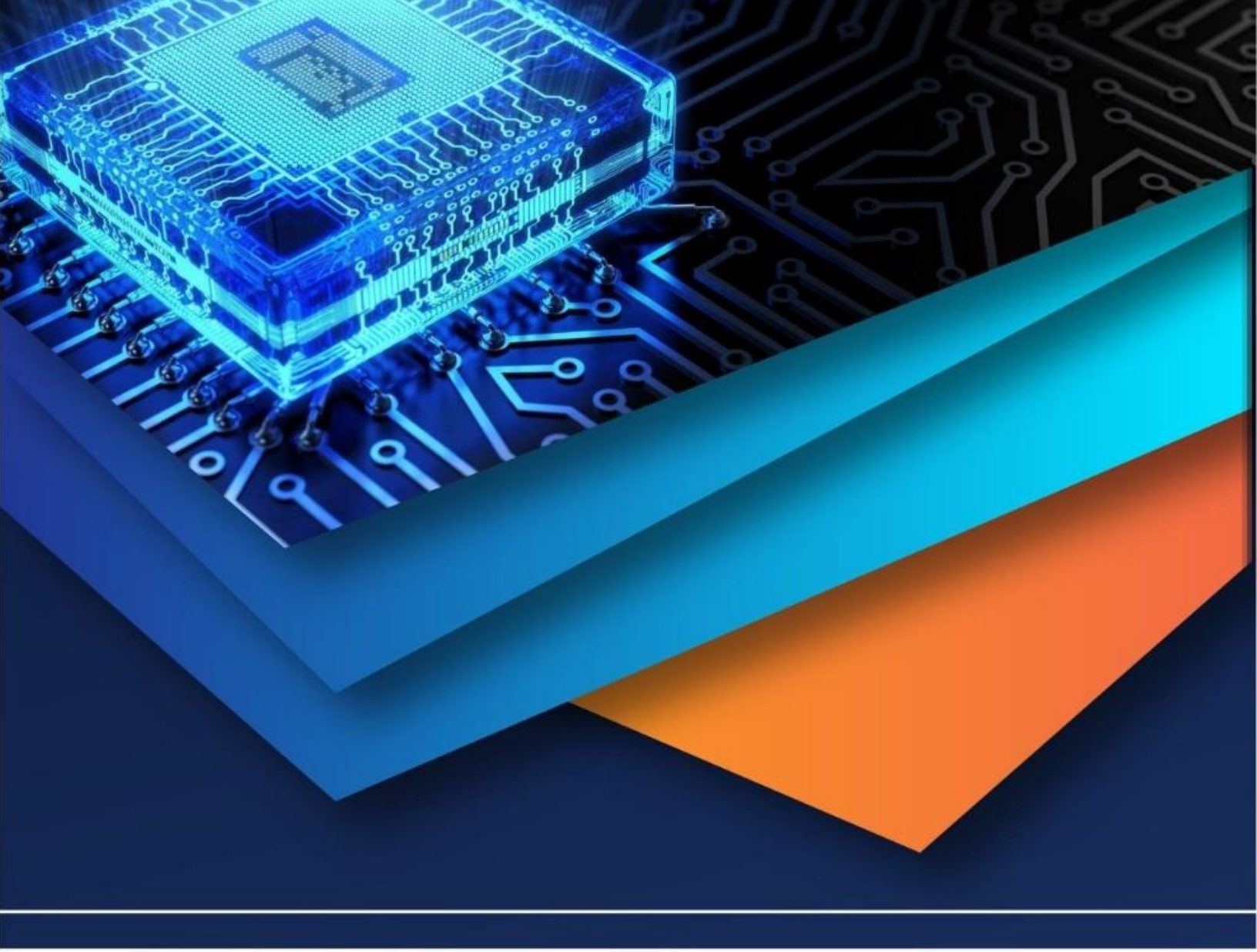

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