Intelligent Walker with Obstacle Detection Technology for Visually Challenged People

S.Krishnakumar*, Banani Mridha, M.J Nancy Naves and K. Kowsalya
Department of Biomedical Engineering, School of Bio and Chemical Engineering, Sathyabama University, Chennai - 600119, Tamilnadu, India.
*Corresponding Author E-mail: drkrishnakumar_phd@yahoo.com

Abstract: - Visually challenged peoples are facing a lot of problems for mobility in their day-to-day life. To overcome their problems the present research is initiated to design and develop a blind walking stick in all the aspects and the accuracy and efficiency is also made high comparatively. The main aim of the proposed system is to design an intelligent stick that will guide the visually impaired person thereby improving their mobility. This intelligent walker comprises of array of both ultrasonic sensor and Passive Infrared sensor to detect the static as well as the dynamic obstacle in 180^{o}C range and 3m distance in three different directions (ie left, right and front). When the stick is misplaced, it can be found using the wireless remote that activates the buzzer to give signals and hence helps the person to determining the location of the stick if the stick is located within a radius of 3 meters.

Keyword: visually impaired person, ultrasonic sensor, Passive Infrared sensor, obstacle detection, Intelligent walker

I. INTRODUCTION

Visually impaired persons face many challenges when they move from one place to another that involves obstacle avoidance, path finding etc. Out of the 37 million blind people all over the globe more than 15 million people are in India. According to World Health Organization (WHO) in 2011 estimates that there are 285 billion people in world with visual impairment, 39 billion of people are blind and 246 billion are with low vision, and around 15 million people are blind in India. Commonly used assistive device by the visually impaired is the white cane. Mechanical canes provide information when an obstacle is sensed in front of it. There are different sensors used for the detection of obstacle. Electronic Travel Aids (ETAs) devices have been introduced to be a mobility aid for the blind people.

The main aim of the research is to design and develop a walking stick to improve the mobility and accuracy of visually impaired people. An array of ultrasonic sensor and PIR sensor is being interfaced with Mega Arduino (ATmega2560) in the development of the intelligent guide. The proposed smart walking stick can detect static as well as dynamic obstacle. Further to enhance the accuracy of the visually impaired person, the direction of the obstacle is also taken into account ie this stick can tell the exact direction in which the obstacle lies. Nada et al. [1] worked on the detection of staircase, its direction and other obstacle present in the user path within a range of 2m. Prasun Shrivastava et al.[2] presented his work the cane could be used for both indoor and outdoor purposes. Whenever a person is holding stick has high pulse rate or low blood pressure rate or any unfortunate condition, a message will be sent to the concerned person using a GPS attached to it. Smart walking stick developed using various sensors for obstacles, pot holes, and moisture detection Gayathri et al. [3]. The disadvantage of stick is, it is not able to detect dynamic obstacles not directly in the

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range of the ultrasonic sensor. Mohammad Hazzaz Mahmud et al. [4] mentioned system utilizes two pair of ultrasonic sensors that detect the obstacles below the stick and infront. To change the vibration pattern for different range of obstacles, these sensors also make use of Pulse Width Modulation. In this context the present study has been design and develops an intelligent walking stick to overcome the visually challenged people to lead their life smoothly.

II. MATERIALS AND METHODS

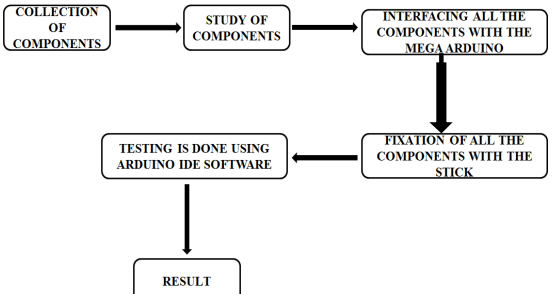

Fig.1: work flow of proposed system of smart walker

A. Block Diagram:

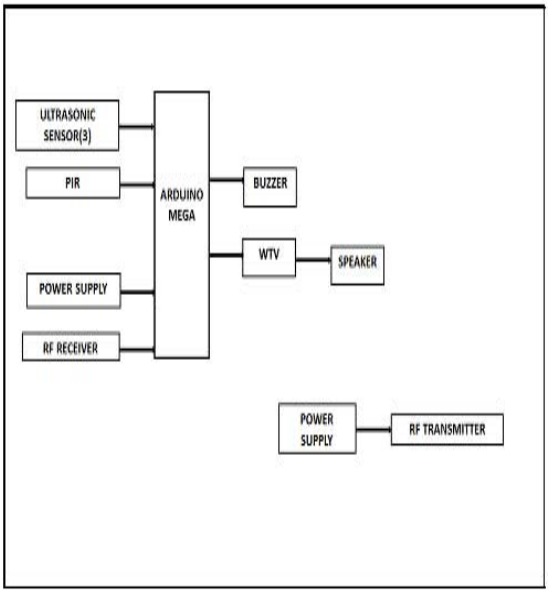

Fig.2: The block diagram of proposed device

III. HARDWARE REQUIREMENTS

A. Ultrasonic sensor

HC-SR04 ultrasonic sensors are used for the obstacle detection and distance measurement. This sensor modulus contains ultrasonic transmitter circuit, receiver and control circuit. This sensor has 0.3 resolutions with a ranging distance of 2 cm to 500cm. It drives from a 5V DC supply and the current is less than 2mA. The sensor is triggered by 10μs high level signal. The basic principle of ultrasonic sensor is, when the sensor is triggered, it sends eight 40 kHz pulse and waits for the echo pulse. If there is no obstacle present, no echo pulse is received. On the other hand, if there is any obstacle detected, then the echo pulse is received in the receiver circuit.

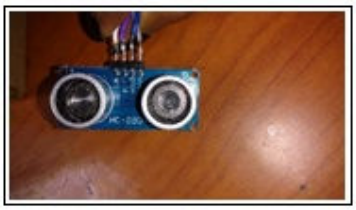

Fig. 3: HC-SR04 ultrasonic sensors

B. PIR sensor

A Passive Infrared Sensor (HC-SR501 Pyroelectric Infrared Module KG001) is an electronic sensor that measures the infrared light radiating from objects in its field of view. They are often referred to as “Pyroelectric” or “IR Motion” sensors. The PIR sensor, as the name suggests, works by identifying infrared radiation from objects in front of it.

Fig.4: PIR Sensor

C. Mega Arduino (ATmega2560)

The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 . It has 54 digital input/output pins, 16 analog inputs, 4 UARTs , a 16 MHz crystal oscillator, 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 computerwith a USB cable or power it with a AC-to-DC adapter or battery to get started. The Mega is compatible with most shields designed for the Arduino Duemilanove or Diecimila.

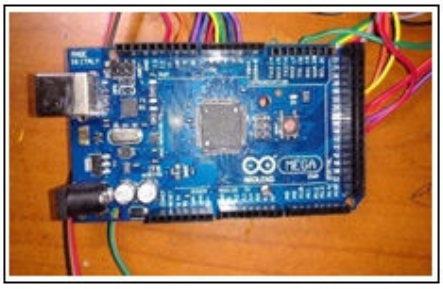

Fig. 5: ATmega2560Mega Arduino

D. RF TRANSMITTER (HT12E) AND RF RECEIVER (HT12D)

An RF module (radio frequency module) is a small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio frequency (RF) communication. Its Operating frequency is 433MHz

RF transmitter will be with the remote and receiver with the stick.

When a button 'A' in the remote is pressed, LED 'A' in the stick glows and the buzzer ins switched ON.

RF transmitter consists of encoder that converts parallel data to serial data. RF receiver consist of decoder that converts serial data to parallel data.

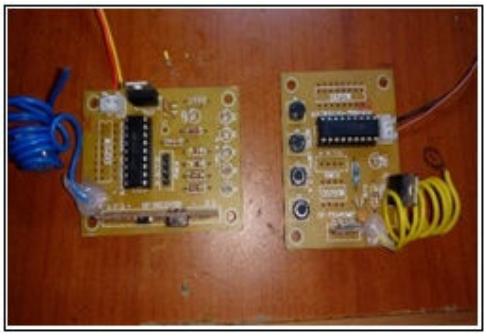

Fig. 6: HT12E RF transmitter AND HT12D RF receiver

E. WTV (APR33A3)

- Operating Voltage Range: 3V ~ 6.5V
- Single Chip, High Quality Audio/Voice Recording & Playback
- Solution Voice Recording Length APR33A3:- 680 sec
- Audio Processor:- Powerful 16-Bits Digital
- Memory :- Non-volatile Flash
- Built-in Audio-Recording Microphone Amplifier
- Resolution :- 16-bits
- Averagely 1, 2, 4 or 8 voice messages record & playback

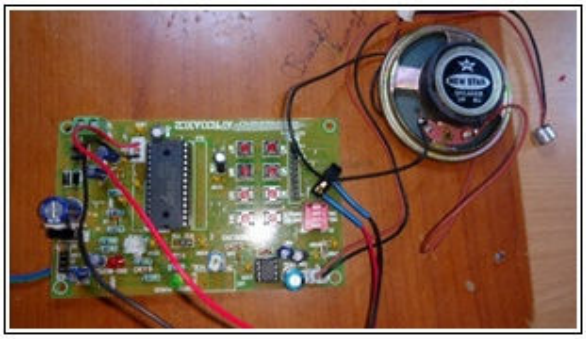

Fig. 7: APR33A3WTV

F. Software Requirements

Using Arduino IDE software, code is written and is uploaded to the Arduino board for testing. The software is easy to use. Once the coding is done, its being RUN to perform necessarily working of the proposed system.

G. Working Principle:

The main part in the system is the Mega Arduino that controls the other components in the system. When the ultrasonicsensors and PIR sensor detect any objects or obstacle in 180 ° path at a range within 3m, a voice warning message is given to the user regarding the direction in which the object lies.

IV. RESULTS AND DISCUSSION

Visually impaired peoples are facing lots of problems to lead their day to day activities. To over come their difficulties the researchers are designing a novel and new devices with new system for the betterment of the life. The proposed system is a simple, cheap, configurable, easy to handle electronic guidance system that provide constructive assistant and support for blind and visually impaired persons. This system is highly effective and unique in its capability in detecting the objects that may encounter the blind. It is able to scan areas left, right, and in front of the blind person. With the proposed architecture the blind will be able to move from one place to another without others help. Tests have been performed using different obstacle in order to get the detection of the obstacles. In the present research object detection has provided an accuracy of 3 meter. The detection range for various objects in cm are as listed in the below table:

Table: 1 Object detection of different obstacles

OBSTACLE	TEST 1	TEST 2
Chair	150 cm	260 cm
Human	220 cm	300 cm
cardboard box	170 cm	285 cm

In this present work, an array of ultrasonic sensor, PIR sensor is interfaced with the Mega Arduino has been used to construct a intelligent walker. The visually impaired person will get the information about the presence of human, static as well as dynamic obstacles in front of them using voice command. Buzzers are used as the feedback to the user. With this proposed model, the user may move from one place to another easily and independently. The model can be improved by increasing the range of the ultrasonic sensor and implementing a technology for determining the speed of approaching obstacles. A vibrator can be used for partially deaf people. Rupali Kale et al [5] has presented this project aims to make the blind person fully independent in all aspects. The proposed system is based on Global Positioning System (GPS) and Obstacle detection and object avoidance technologies. Sabarish.S et al [6] have described the development of a navigation aid in order to assist blind and visually impaired people to navigate easily, safely and to detect any obstacles. The system is based on a microcontroller with synthetic speech output. In addition, it consists of two vibrators, two ultrasonic sensors mounted on the user's shoulders and another one integrated into the cane. Rohit Sheth et al [7] presented the intensity of vibrations in his paper as assn indication of the closeness of an obstacle in the walking path of the user. Also four different voice messages were given for down-step, up-step, obstacle in front, and obstacle overhead. Mohammad Hazzaz Mahmud et al.[4] mentioned a non-contact distance measurement about the obstacle in about 2cm-3m.Obstacle and hole was determined easily by sensors reading. In addition wet or slippery terrain was detected by a pair of electrodes.

V. ACKNOWLEDGMENT

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VI. CONFLICT OF INTEREST

The authors declare no conflict of interest.

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