

Assistive Device For Visually Impaired People By Using Ultrasonic Sensors

Hninn Nandar Aye, Aye Thin Naing, Hla Myo Tun

Abstract: The visually impaired people need some aid to walk and move safely in their surroundings. The ordinary people cannot know how hard it is to live and move in daily life for the blindness, the visually impaired people and the old person who has poor vision. Although the sighted people cannot help the blindness to regain the eyesight, the visually impaired one can try to make easier the daily routine by using the assistive device that can detect the obstacles near the blindness and the visually impaired people, and warn the alert to the users before accident. This assistive device like walking stick contains ultrasonic sensors, PIC microcontroller (Peripheral Interface Controller), LDR, vibrator, servo motor, buzzer and LED. Ultrasonic sensors are used for sensing and detecting the obstacles near the user to avoid the dangerous condition. Vibrator and buzzer are used for providing the alert to know that the obstacle is near. Servo motor is used for turning the wheel easily without effort. LDR and LED is used for lighting in low light room and at night to know the ordinary or sighted people where the walking stick is, so, this assistive device will be safe from the other people's hit.

Key Words: Assistive device, detection system, avoidance system, ultrasonic sensors, vibrator, servo motor, buzzer, LDR.

I. INTRODUCTION

Vision is a precious and beautiful gift to human beings by GOD. Vision allows people to see or perceive and understand the surrounding of the world. But the visually impaired people or the blind people struggle a lot to live in the miserable life. That makes the blindness to lose the destination or hope to live in the competing society. There are seven billion people in the world in 2014. Global estimate of the number of the visually impaired people according to World Health Organization survey made in 2014 is 258 million people are visually impaired worldwide. Among them, 39 million are blind and 246 million have low vision. In our country, Myanmar, there are 58,377,000 people in 2013. Among them, 350,262 are totally blind people and 1,167,540 are partially blind people by the evaluation of the current eye care status in Myanmar, which was carried out between 3rd June and 11th June 2013. Many of blind persons in our country use the white cane which is the most successful and widely used travel aid for the blindness. The ordinary walking stick or white cane is unable to detect obstacles in its path except by direct contact with the obstacle. A few people use the guide dogs, but those guide dogs require extensive training and the fully trained guide dogs are so expensive, and then the visually impaired people cannot fully believe those dogs to avoid the obstacles. Both the ordinary sticks or the white canes and the guide dogs cannot detect the obstacles from all directions such as left, right and front side of the users in not only familiar environment but also unfamiliar surroundings. In this system, this assistive device will sense the obstacles from the left, right and front side of the user and it will alert to the user through vibration and buzzer. That's why, the visually impaired people or the blind people are requiring the advanced technology or assistive device to walk and move safely and quickly in the surrounding. So, the modern technology should help to improve the quality of the blind people's life with an assistive device.

II. SYSTEM COMPONENTS

For this assistive device, three ultrasonic sensors, servo motor, LDR, buzzer, vibrator, LED, PIC16F887 and rechargeable battery are used to sense or detect, avoid and alert to the user if there is an obstacle in the path of the user.

A. Ultrasonic Sensor

It generates high frequency sound waves and evaluates the echo which is received back by the sensor. It calculates the time interval between sending the signal and receiving the echo to determine the distance to an object. Ultrasonic is like an infrared where it will reflect on a surface in any shape. However, ultrasonic has a better range detection compared to infrared. Then, comparing with other sensors, the ultrasonic sensor is more accurate. HC-SR04 ultrasonic sensor is used for this system. It can measure the distance from 2cm (minimum) to 400cm (maximum) with an accuracy of about 3mm and measuring angle is 15 degree. This HC-SR04 module includes ultrasonic transmitter, ultrasonic receiver and its control circuit. It is used for sensing the obstacles.



Fig. 1 Ultrasonic sensor (HC-SR04)

B. Servo Motor

Servos are small mechanical devices whose sole purpose is to rotate a tiny shaft extending from the top of the servo housing. Tower Pro SG-5010 servo motor is used to turn the wheels easily to the left direction or right direction depending on the ultrasonic sensors.

C. Light Dependent Resistor (LDR)

It is a light-controlled variable resistor. It has high resistance in low light conditions or darkness and low resistance in well light or daylight situations. So, its resistance depends on the light intensity falling on its surface. This LDR is used for lightening the LED at night or in the low light room.

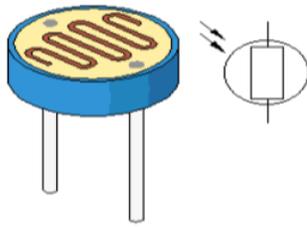


Fig. 2 LDR

D. Buzzer and Vibrator

Buzzer is an audio signaling device. The typical usage of buzzer includes alarm device, timer and confirmation of the user input. Vibrator is used in mobile phones. Both buzzer and vibrator are used for alerting or warning the alert to the user to avoid the obstacles before accident.

E. PIC16F887 Microcontroller

PIC means Peripheral Interface Controller. This microcontroller is a single chip that contains the processor (CPU), non-volatile memory for the program (ROM or flash), volatile memory for input and output (RAM), a clock and an I/O control unit and timer. It is a 40-pin device with five ports (A, B, C, D, and E). It uses as a main control unit to control the whole system such as detection system, avoiding system, alerting system and lightening system.

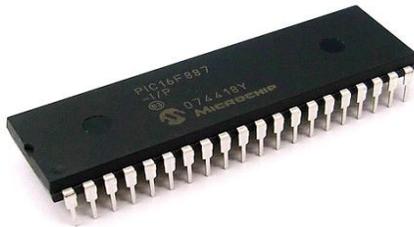


Fig. 3 PIC16F887 Microcontroller

III. SYSTEM DESIGN

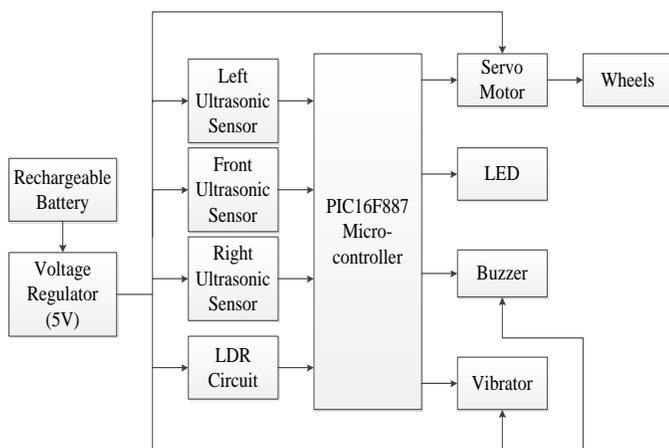


Fig. 4 System Block Diagram

In this system, three ultrasonic sensors are used for detection system. Servo motor is used for avoiding system. Buzzer and

vibrator are used for alarming system. LDR and LED are used for low light room and at night.

A. Detection System

Three ultrasonic sensors are placed at front side, left side and right side. The front ultrasonic sensor senses the obstacle in front of the user. The left ultrasonic sensor and the right one also sense the obstacles at left and right of the user. These sensors will detect the obstacles during 120cm for the users. If an obstacle is near the user or less than 120cm, the alarm system and avoiding system will operate or provide immediately to the users.

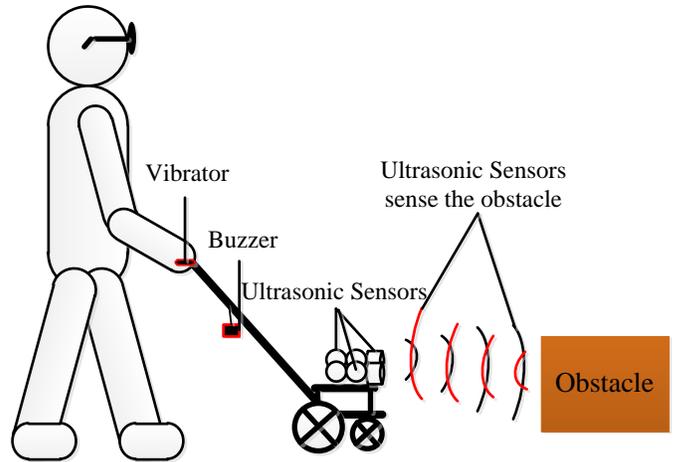


Fig. 5 Detection System for Visually Impaired People

B. Avoidance System

The servo motor is used to turn the wheels easily, if there is an obstacle near the user. And then, that servo motor will turn the wheels before accidents for the visually impaired people. If the obstacles are at front side and left side, the servo motor will turn the wheels to the right side to avoid those obstacles.

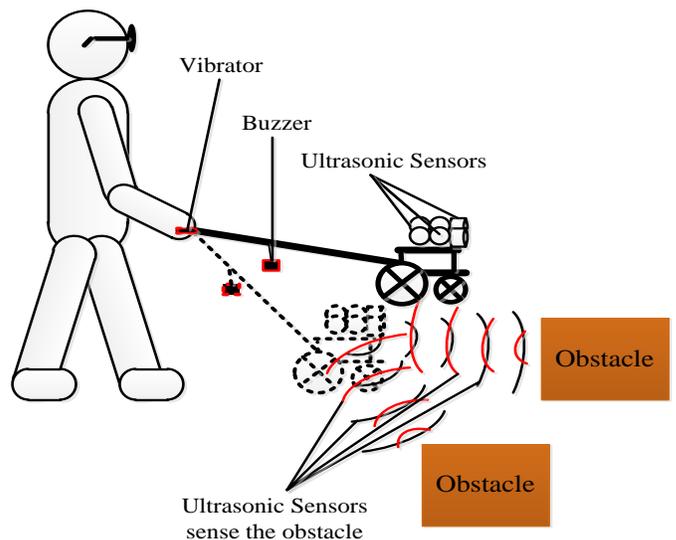


Fig. 6 Avoidance System for Visually Impaired People

C. Alarming System

If there is an obstacle near the user, not only the vibrator but also the buzzer will alarm to the user to know the obstacles which exist in the path of the user. LDR and LED are used for low light room and at night. If the blind people or visually impaired people walk in the low light room or at night, the ordinary people or sighted people will know where the blind people's stick exists. Then only, the sighted people can avoid those stick and the user before they hit. So, the visually impaired people and their stick will save and can walk with confidence at night.

IV. OPERATION AND CIRCUIT DIAGRAM

The complete circuit schematic is shown in figure 7. In this system, front ultrasonic sensor, left ultrasonic sensor, right ultrasonic sensor and LDR are input. A 20x4LCD, servo motor, buzzer, LEDs and vibrator are output for this system. The three ultrasonic sensors sense the obstacles between 0cm and 120cm for the users to be secure in their path. If there is an obstacle in front of the user, the servo motor will turn the wheels to right and the buzzer and vibrator will alert to the user immediately. If there is an obstacle at right side or left side of the user, the vibrator will vibrate but the buzzer will not give alert to the user. If the front side and left side have the obstacles, the servo motor will turn the wheels to right side and both the vibrator and the buzzer will give alert to secure the user. If the three sides have the obstacles, the wheels will not turn any side, and the vibrator and buzzer will provide alert to the user continuously. Although the light condition cannot effect to the visually impaired people or the blindness, the ordinary person or the sighted people need the light to know where the blind people's stick is in the dark or low light condition and at night. If there is no LED or light at the blind stick, the sighted people can hit the visually impaired people and their stick unexpectedly. Then, the blind stick can destroy unfortunately and the visually impaired people can get an unwanted situation by hitting them. That's why; LDR and LEDs are very useful for low light or dark room and at night for the users.

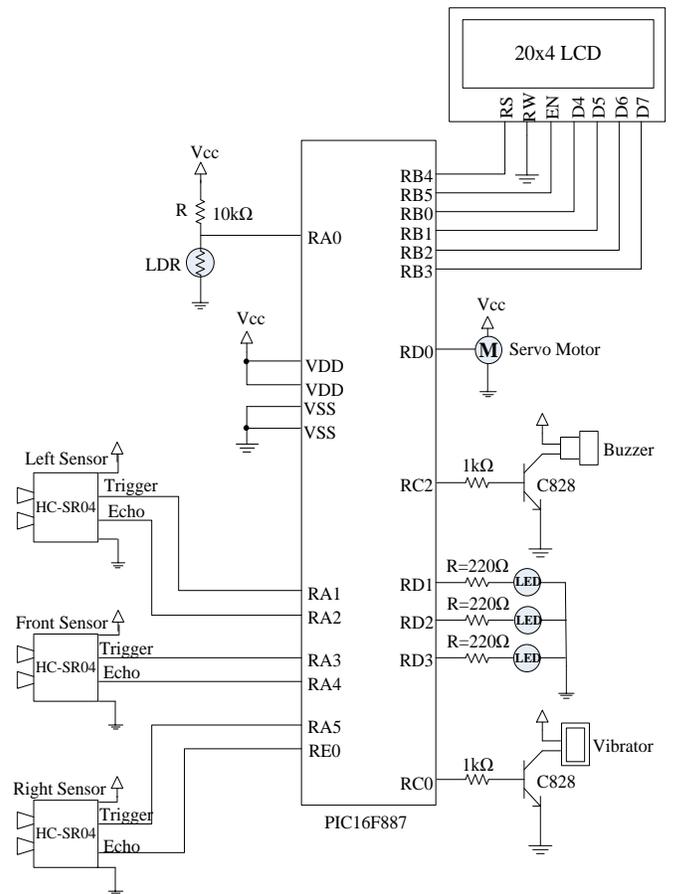


Fig. 7 Overall Circuit Diagram

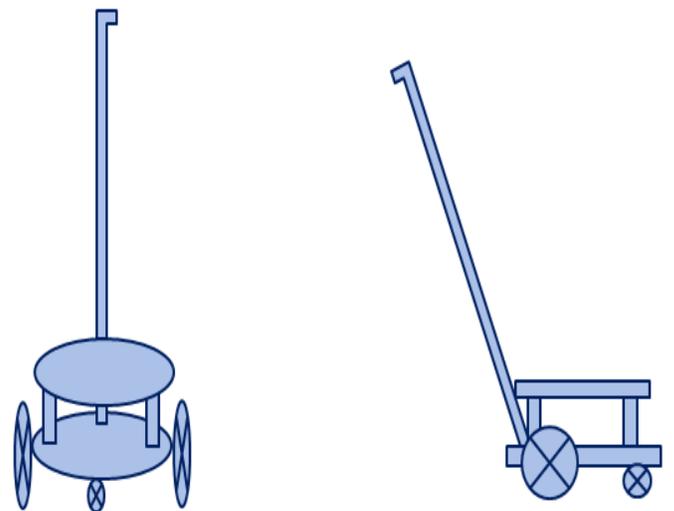


Fig. 8 Schematic stick for the assistive device or blind stick for visually impaired people

In that stick, the three ultrasonic sensors and the main controller circuit board will be placed on the upper layer, and, the rechargeable battery will be fitted at the lower layer. Then the vibrator will be equipped at the handle of the assistive stick to know the vibration alert. And then, LEDs will be fitted on the upper layer and along the stick.

V. RESULTS

This research is implemented with software and hardware. The results are following.

A. Simulation Results

The Proteus Software is used to simulate the system. The ultrasonic sensor (HC-SR04) module and vibrator are not available in Proteus. So, three push buttons and three pulse generators are used instead of the three HC-SR04 modules, and LEDs are used for vibrator and buzzer to be noticeable easily by watching the following figures. The following results are software simulation.

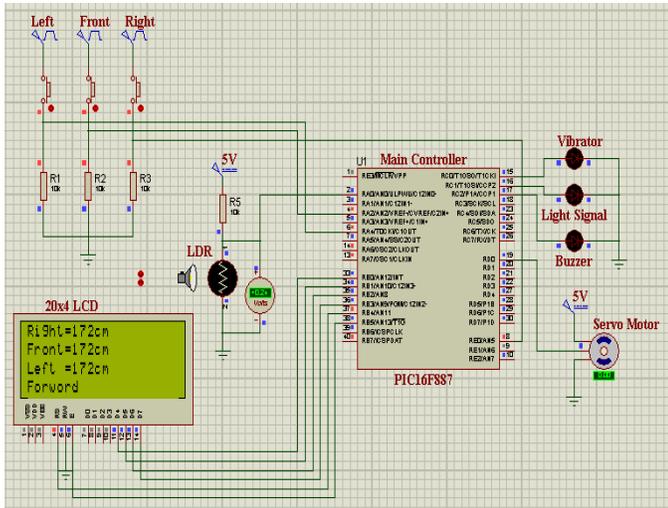


Fig. 9 Simulation test for no obstacle and day condition

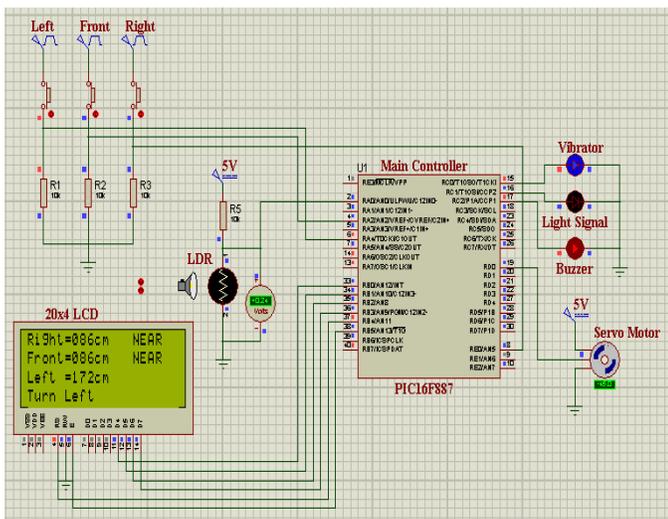


Fig. 10 Simulation test for "Turn Left" and day condition

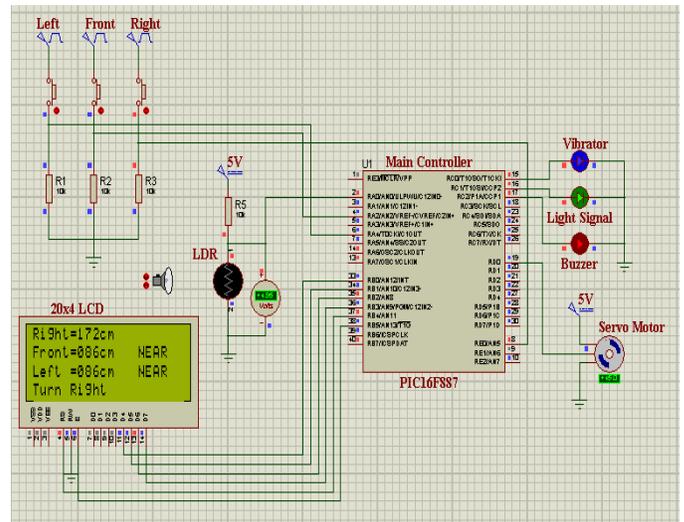


Fig. 11 Simulation test for "Turn Right" and night condition

In figure 9, the three ultrasonic sensors are greater than 120cm, so the system means that there is no obstacle near the user. Therefore, the vibrator and buzzer are OFF and the servo motor is at default condition. And, it means day light condition or well light condition, so the light signal is also OFF. In figure 10, the front and right ultrasonic sensors show 86cm and "NEAR" because those two sensors are less than 120cm. Therefore, the servo motor turns to left (45 degree) and the LCD shows "Turn Left", and then the vibrator and buzzer are ON. It is also well light condition, so the LED for the light signal is OFF too. In figure 11, the front sensor and the left one show 86cm and "NEAR" on LCD because those two ones are less than 120cm and then there is no light on LDR, it means low light condition or at night, therefore, the LED for light signal is ON. The servo motor turns to right (45 degree), and the vibrator is ON, and then the buzzer is also ON.

B. Test Result



Fig. 12.1 Test result for left obstacle detection system



Fig. 12.2 Test result for distance measurement of left obstacle with LCD display



Fig. 14.1 Test result for low light condition



Fig. 13.1 Test result for front and left obstacle detection

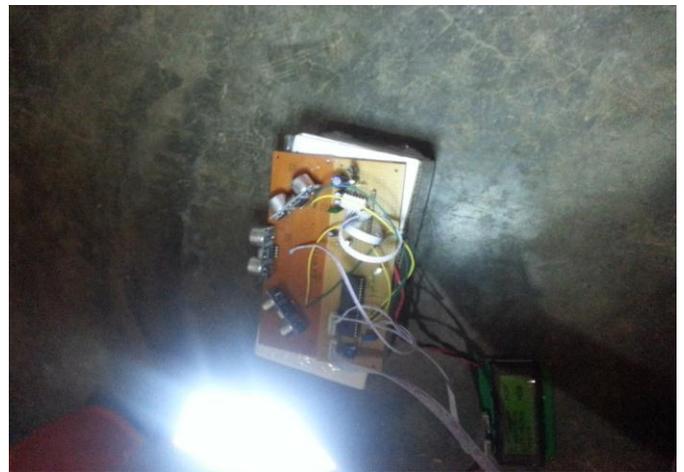


Fig. 14.2 Test result for day or well light condition



Fig. 13.2 Test result for distance measurement of front and left obstacles with LCD display

In the experimental test, the vibrator and the buzzer cannot be known or seen when it is captured that the vibrator vibrates and the buzzer provides with alert. In this system, the three ultrasonic sensors sense the obstacles between 120cm from the stick and the LCD display shows the distance measurement and then it also shows where the obstacle is. If any obstacle exists near the user or the distance of the obstacle is less than 120cm, the buzzer and vibrator will operate to give alert to the user to avoid the obstacles. LDR senses the light condition. If the user goes or walks in the low light room or at night, the LED will be ON to know the ordinary or sighted people where the blind people's stick locates. Then only, the sighted people can avoid that stick before accident or hit.

VI. CONCLUSION

This assistive device or walking stick allows the visually impaired people and the blindness to avoid the obstacles by warning system through the buzzer and the vibrator. This walking stick by using ultrasonic sensors is an effective solution for both totally and partially blind people. It is able to sense or detect the obstacles at front, left and right side of the users. Then the wheels can turn easily left and right direction with according to the sensors. And then, this walking stick will be safe even in a low light room and at night from the others'

hit to it by using LDR and LED. This assistive device will help the blind people to walk and move safely and easily from one place to another or an unfamiliar environment and it will improve the confidence. That's why this system will be useful and can motivate the blind people's suffering that they are not cursed or inferior to our society.

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