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AN INITIAL STEP TO DESIGN IN AIDING EQUIPMENT FOR BLIND USING ULTRASONIC SYSTEM

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ABSTRACT

Nowadays, blind people getting to grow in our daily life quietly. Even though they are small amount and maybe people do not have the alert that blind people are around us in our daily life, but they still there and technologies should help them for getting better in physically and mentally. By developing more and more technologies, many of the problems in our daily life can be solve or reduce. One of the problems is how the blind people can be walk alone everywhere without produce problem to them. This project proposes a blind walking stand for the blind people to let them walk around alone and make blindness away from their daily life mentally. In this project, a blind walking stand is developed by using Proteus 8 Professional to design the circuit and Arduino UNO to control the microcontroller chip. By connecting the microcontroller chip with the ultrasonic sensors, the system is built. It uses buzzer and vibrating motor to alert the user to avoid the obstacle in a limited range so that they can walk away from getting injure or fall.

1.0 INTRODUCTION

Biomedical engineering is an engineering principles and design concepts to medicine for healthcare purpose and biology (Ashok, V. and Kumar, N., 2013). It's combining the design and problem-solving techniques with the main focuses on the advances that improve human health and health care at all levels (Ashok et al;2011). Biomedical instrumentation is the application of creating such instruments that help us to measure, record and transmit data from any of human body part (Mohamed et al; 2020). It is a high tech and costly instrumentation used in conduct cutting edge research in biological sciences and it focuses on the use of multiple sensors to monitor physiological characteristics of a human (Ashok et al;2010). Role of engineer in the scopes of instrumentation is mainly target on the instrumentation basically from a small sensor and microprocessor to the extent of the large machine and device (Akila et al; 2020). Engineers of instrumentation are also responsible for designing, developing, installing, managing, and maintaining equipment which is used to monitor and control engineering systems, machinery and processes (Sivaranjani et al; 2018). Engineers are to expect to keep the machine or device working effectively and efficiently and always safe to use (Teizer et al 2010). As the title that we choose is blind aid equipment, there are a lot of applications nowadays that is assistive and mainstream technology has helped and improved the quality of the lives of those of us with visual impairments. All the systems, services, devices, and appliances that are used by disabled people to aid in their daily lives, make their activities simple and provide a safe mobility are included under one term that is assistive technology. This assistive technology became available for the blind people through electronic devices which provide the users with detection and localization of the objects in order to offer those people with sense of the external environment using functions of sensors (Ashok et al;2010). As stated in the article, loads of innovation is being created to help blind impairment people to make their daily life sail smoothly. For example, blind walking stand that using ultrasonic sensor to sense object in front and can be avoid. Next example is blitab, software that can be used in all smart devices such as tab and smart phone. Bunch of examples for the blind aid device that being affordable, easy to purchase and easy to use. Most important point that the device could be use while indoor or outdoor to make sure user avoid any accident happened. This paper will go into detail on how the blind waking stand is created.

2.0 METHODOLOGY

Ultrasonic sensor is a transducer which can measure the distances using ultrasonic waves. It consists of transmitter and receiver which emits the ultrasonic waves and detects the reflecting signal form the object respectively. Ultrasonic sensor uses the speed of sound to work as its principle. The formula used to calculate the distance is:

Distance = (duration/29)/2

The system is designed by using Proteus 8 Professional and controlled using Arduino UNO. Proteus 8 Professional is a software tool used for electronic design automation and let the engineers and technicians to create schematics and electronic prints for the circuit. Arduino UNO is a microcontroller chip which contain everything to support microcontroller while connect to a computer with their own cable. Ultrasonic sensors are used in the circuit design to send the signal immediately from the transmitter when the switch is on at the top of the stand. The signal is reflected back to the sensor's receiver when it impacts the level surface. When Arduino received the reflected signal, it will send a pulse signal to the actuators which are buzzer and vibrating motor in this system to alert the user. Figure 1 shows the block diagram of the system.

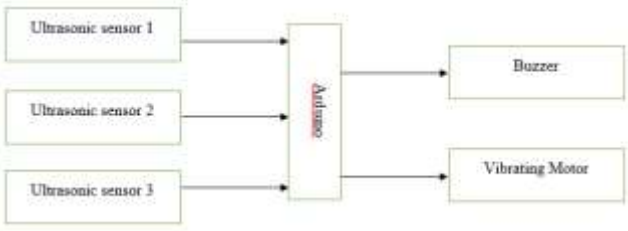

Figure 1: Block diagram of the system for Blind Walking Stand.

In the design system using Proteus 8 Professional, potentiometer is used to create a distance to trigger the sensor. The level of the potentiometer is divided into 10 level and the distance of the detection of each level is 40cm. Besides, the buzzer is replaced by speaker and the vibrating motor is replaced by the LED. This create a simple and direct action to the reflection of the sensor while there is a blocking in front of the user within the limit distance.

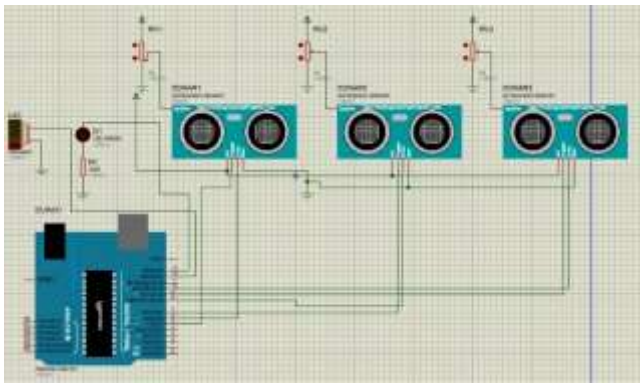

Figure 2: Circuit diagram of the system for Blind Walking Stand.

The distance of the obstacle in this system from the user is calculated in a straight line from the user. If the obstacle is in front of the user within the active range of the sensor, both buzzer and vibrating motor will be alert at the same time. The flowchart shown in Figure 2 shows how the system work.

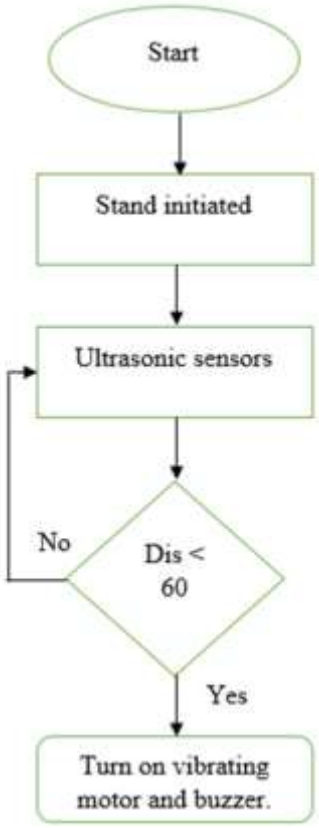

Figure 3: Flow chart of the system designed for Blind Walking Stand.

3.0 RESULTS AND DISCUSSION

The circuit shown in previous part is the system that designed specifically for blind user which named it as Blind Walking Stand. The circuit is used to do a simulation by using the software Proteus 8 Professional and the simulation result has successfully proved the functionality of the Blind Walking Stand. Firstly, the potentiometer in the circuit can be adjusted and the adjustment is divided into 10 parts where we can increase or decrease the value of the resistance. The adjustment of resistance is assumed to be the distance of object detection from the ultrasonic sensors. As assumptions, the theoretical range of distance that can be detected by ultrasonic sensor is from 2cm to maximum 400cm. Hence, the potentiometer in the circuit is assumed to have a range of 0cm to 400cm for the adjustment where the lowest part of potentiometer represents 0cm and the highest part is 400cm. The assumption for value of distance is as shown as below and the level of potentiometer is according to the adjustment of increasing and decreasing button of potentiometer in circuit:

Table 1: Assumption on level of potentiometer to the distance of detection for ultrasonic sensor.

Level of Potentiometer	Distance of detection (cm)
10	400

9	360
8	320
7	280
6	240
5	200
4	160
3	120
2	80
1	40

The Arduino Uno has been programmed with the function to detect the object within 60cm and it will automatically trigger the buzzer and vibrating motor to alert the blind user that there are some obstacles ahead. The results below show the simulation result of the designed circuit.

Result 1:

The first ultrasonic sensor has been adjusted to the lowest level which indicated the distance of object detection between 0 to 40cm and the buzzer and LED has been successfully triggered by the ultrasonic wave that transfer by the Echo Pin.

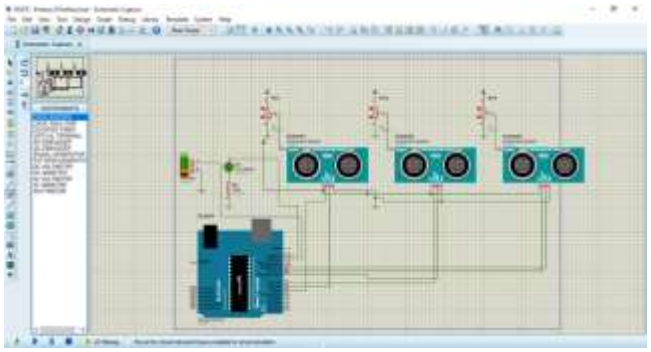

Figure 4:The result of first ultrasonic sensor with the distance of 0 to 40cm object detection.

Result 2:

The second ultrasonic sensor has been adjusted to the lowest level which indicated the distance of object detection between 0 to 40cm and the buzzer and LED has been successfully triggered by the ultrasonic wave that transfer by the Echo Pin.

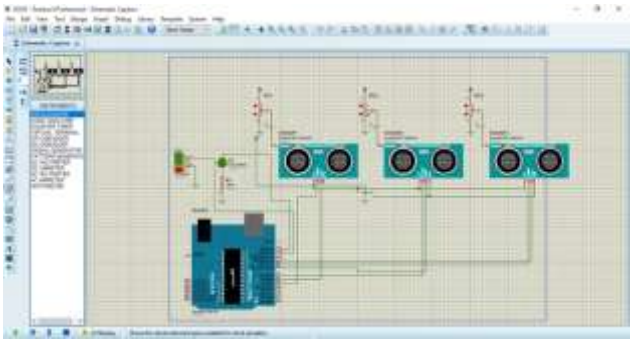

Figure 5: The result of second ultrasonic sensor with the distance of 0 to 40cm object detection.

Result 3:

The third ultrasonic sensor has been adjusted to the lowest level which indicated the distance of object detection between 0 to 40cm and the buzzer and LED has been successfully triggered by the ultrasonic wave that transfer by the Echo Pin.

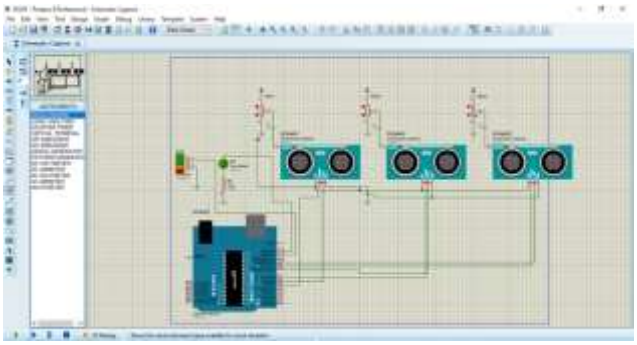

Figure 6:The result of third ultrasonic sensor with the distance of 0 to 40cm object detection.

Result 4:

All the potentiometers of all three ultrasonic sensors have been adjusted to the lowest level which indicated the distance of object detection between 0 to 40cm and the buzzers and LED has been successfully triggered by the ultrasonic wave that transfer by the Echo Pin.

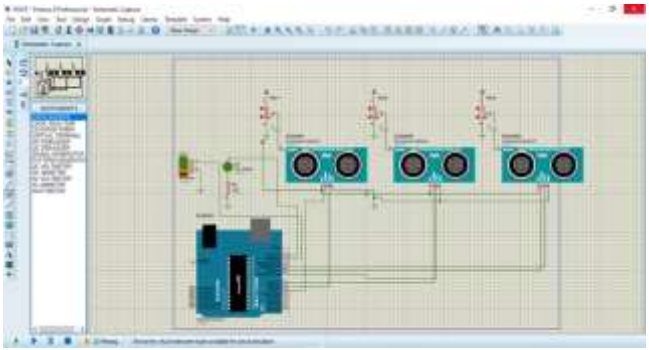

Figure 7: The result of all the ultrasonic sensors with the distance of 0 to 40cm object detection.

Result 5:

All the potentiometers of the ultrasonic sensors have been adjusted to at least second level or above which indicated the distance of object detection between 41cm to 400cm and the buzzer and LED are not triggered by the ultrasonic wave that transfer by the Echo Pin. This is because the second level of potentiometer indicates the distance between 41cm to 80cm where 80cm is exceed the limitation that has been programmed into the Arduino Uno. Therefore, the buzzer and LED which represented the vibrating motor are not triggered to alert the blind user because there are possibilities for the distance that exceed 60cm. However, this possibility is only effective for simulation result because there is limitation for adjustment of potentiometer in simulation process but in fact the distance of each distance can be tested or calculated with a prototype.

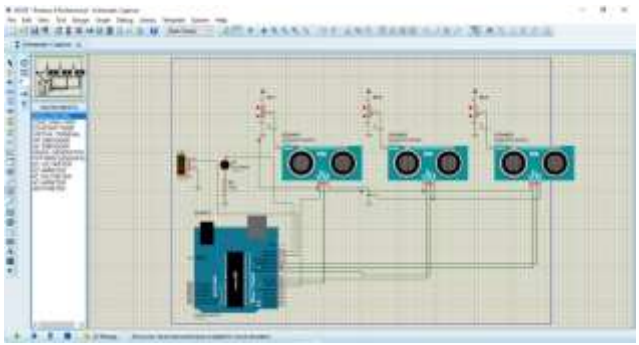

Figure 8: The result of all ultrasonic sensors with the distance of 41cm to 400cm object detection.

The results of simulation above that proved the blind walking stand can used to detect obstacles within 60cm from the ultrasonic sensor is summarized in the table below:

Table 2: Summary of the simulation result.

Level of Potentiometer	Distance of detection (cm)	Alert from buzzer and vibrating motor
10	361 - 400	No
9	321 - 360	No
8	281 - 320	No
7	241 - 280	No
6	221 - 240	No
5	201 - 200	No
4	121 - 160	No
3	81 - 120	No
2	41 - 80	No
1	0 - 40	Yes

From Table 2, the results shown proved that a blind walking stand utilized the ultrasonic sensor to perform its functionality accurately in order to act as a vital blind aid equipment in medical field. The limitation is set within 60cm is to alert the blind user and at the same time it is within the range of detection for an ultrasonic sensor. Moreover, 60cm of object detection is a suitable range to protect and alert the user as well as a prevention to produce sound pollution if the distance increases to higher level because the buzzer will keep ringing if there is any obstacle surround of 100cm. This is because 100cm is considered as a safety distance for walking between people hence if the ultrasonic sensor is programmed to detect obstacles within 100cm around the buzzer will be keep beeping because there is high possibility to have people walking around the blind user.

4.0 CONCLUSION

As a summary, the main biotechnology in the circuit is we are using the ultrasonic sensor to detect the object in front of the blind people to help them avoid any dangerous accident happen. The smart blind stick is a valid solution for helping the sightless to navigate in unknown scenarios. The circuit is easy to understand, and the blind walking stand is really affordable and will help a lot of blind people undergo their live easily.

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