

Design of Blind Spot Alert System Using Open-source Electronics Software and Hardware

Dzaryf Dzulkarnain¹ and Herman Wahid^{2*}

¹School of Electrical Engineering, Universiti Teknologi Malaysia, 81310 UTM Skudai, Johor, Malaysia.

*Corresponding author: herman@fke.utm.my, Tel: 607-5535247, Fax: 607-5566262

Abstract: The main goal of this study is to examine the feasibility of blind spot detection systems by using ultrasonic sensors. The blind spot detection systems will be used to identify obstacles inside the blind spot area. Hence, cautioning or alarming the driver consequently will secure the driver completely and prevent the driver from failure in identifying obstacles inside the blind spot region. The system mainly consists of the circuit connection of the Arduino UNO as the microcontroller and its software program. The usage of three ultrasonic sensors will be used for the system on each side of the vehicle with a 30-degree angle and in front of the vehicle to detect the incoming obstacle. To summarize the study, the constructed system is cheap, however, it is capable to help guiding the drivers from any lethal injuries from the blind spot region while on driving, especially when changing lanes on the road.

Keywords: Arduino UNO, Blind spot, Liquid Crystal Display, Light Emitting Diode, Ultrasonic Sensor

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1. INTRODUCTION

Society mainly relies on their vehicles to travel to do their work, run errands, meet up with people, etc. The usage of transportation is widely used and advancing in their different brands, designs, and types of transportation due to the improvement of technology in the world. The increase in the production of vehicles will indicate the increment of vehicle usage. The advantage of this is that the improvement of technology can be acknowledged but the disadvantage is that it will unexpectedly increase road accidents that may cause injuries or even death [1]. One of the main reasons is due to the blind spot area that is unable to detect by the driver within the vehicle that he or she is driving [2].

The field of view of a human is around 0 to 120-degree which above the range that will unable to be detected by the human eyes. The area that is unable to detect is called the blind spot area [3]. In a vehicle, the blind spot area also exists which differ from different type of vehicles [4]. Blind spot area is important towards the driver because, within the mirrors that provided in the vehicle, there is still an area is in danger that will cause unexpected event [5]. Hence, most drivers are having difficulties in handling this problem [6]. The following project is based on the design that applies for an average passenger car such as Proton X50, Toyota Altis, Suzuki Swift, etc.

2. RESEARCH METHODOLOGY

2.1 Project Overview

For the research methodology, the topic was researched

thoroughly to understand the full concept of the topic. This strategy of understanding. The literature review is to achieve important research and knowledge from the past researchers on the topic

After the research was made, the list of items to be purchased was made before purchasing them to eliminate any items that may have been left out. Arduino IDE was used to utilize the programming of the project and the system was tested and debugged to prevent any error in the programming of the system. The programming was configured to the Arduino UNO and the construction circuit to the Arduino UNO was applied [7]. A casing was made to support the whole circuit and the Arduino UNO

During the programming part of the system, the system was able to be tested out by using Tinkercad as the simulation to be able to eliminate any errors that may occur, and by doing this, the project was able to run based on desired completely without any problem.

2.2 Design

The complete system workflow can be identified in Figure 1 while the construction of the circuit from each component pin to the Arduino UNO pin can be referred to in Table 1. As depicted in Figure 1, three ultrasonic sensors are installed at the two car sides and at the front side of the vehicle. These sensors are connected to Arduino UNO as the microcontroller to make the required decision of the blind spot region detection. The alert system for the driver is represented by the buzzer as an alarm system and the LEDs as blind spot detection indicator.

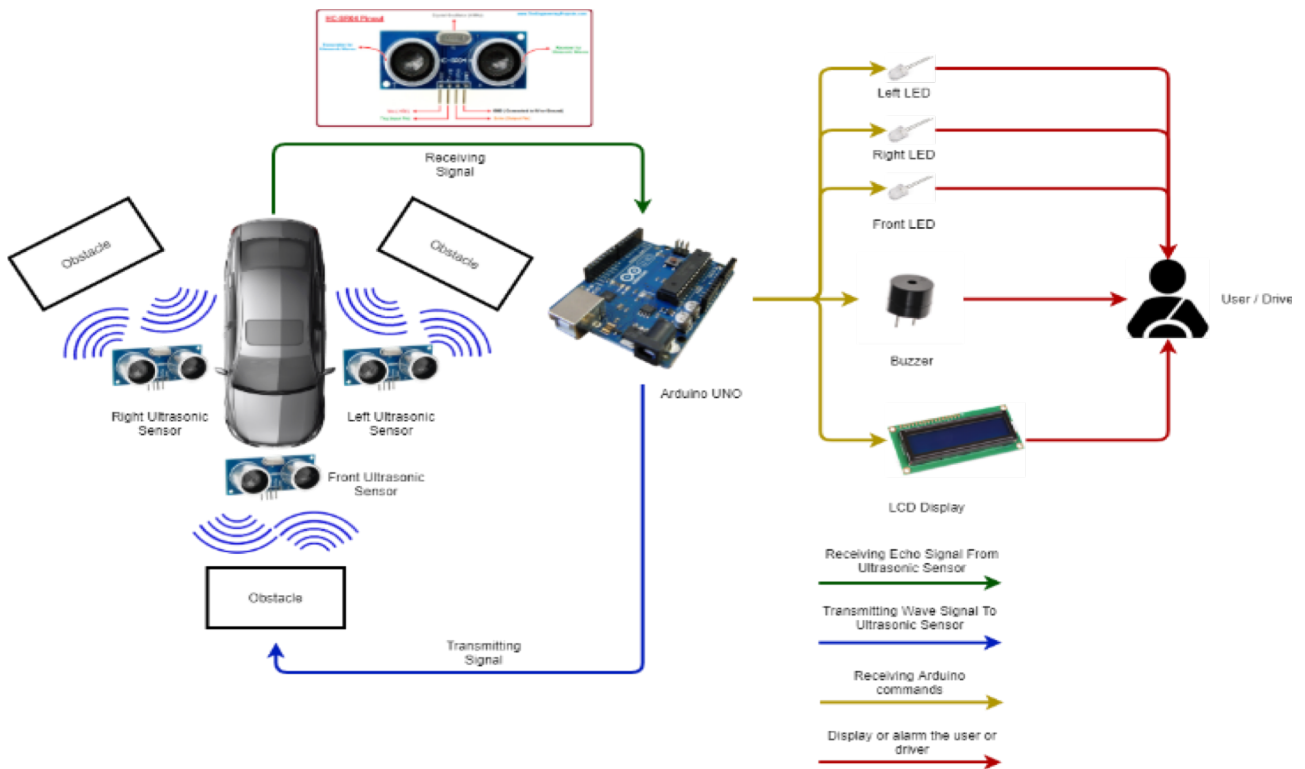


Figure 1. System Workflow

Table 1. Arduino UNO Pin Connection

Arduino UNO	The Connection of The Component to Arduino UNO
5 Volt	<ul style="list-style-type: none"> VCC (Liquid Crystal Display) +VE LED (Liquid Crystal Display) Power (All Ultrasonic Sensors)
Ground	<ul style="list-style-type: none"> VD, RW & -VE LED (Liquid Crystal Display) Buzzer Ultrasonic Sensors Cathode of LEDs
13	<ul style="list-style-type: none"> Trigger Front Ultrasonic Sensor
12	<ul style="list-style-type: none"> Echo Front Ultrasonic Sensor
11	<ul style="list-style-type: none"> Trigger Left Ultrasonic Sensor
10	<ul style="list-style-type: none"> Echo Left Ultrasonic Sensor
9	<ul style="list-style-type: none"> Trigger Right Ultrasonic Sensor
8	<ul style="list-style-type: none"> Echo Right Ultrasonic Sensor
7	<ul style="list-style-type: none"> RS (Liquid Crystal Display)
6	<ul style="list-style-type: none"> Enable (Liquid Crystal Display)
5	<ul style="list-style-type: none"> Data Pin 4 (Liquid Crystal Display)
4	<ul style="list-style-type: none"> Data Pin 5 (Liquid Crystal Display)
3	<ul style="list-style-type: none"> Data Pin 6 (Liquid Crystal Display)
2	<ul style="list-style-type: none"> Data Pin 7 (Liquid Crystal Display)
A2	<ul style="list-style-type: none"> Anode (Front LED)
A3	<ul style="list-style-type: none"> Positive (Buzzer)
A4	<ul style="list-style-type: none"> Anode (Left LED)
A5	<ul style="list-style-type: none"> Anode (Right LED)

2.3 Software and Hardware

2.3.1 Software

The Arduino UNO microcontroller was configured and programmed by using Arduino IDE depending on the connection of the system. For the casing to mount the hardware, Solidworks was used to design the case.

2.3.2 Hardware

The main hardware that was used for the project will be implemented with the programming that is based on the desired condition so that it will be able to make the project be executed completely. The list of hardware that was used for the system can be referred to in Figure 2. Ultrasonic sensor is one of the main components that was used to send out a sound wave where the capability of human hearing is unable to detect it. It will be used to estimate the distance that is detected from the echo signal received from the sound wave reflection based on their time-lapse, where it will decide the remove to a target by measuring time slips between the sending and getting of the ultrasonic pulse [8]. The main microcontroller board used is Arduino UNO. By referring to Figure 2, the components are connected to the Arduino Uno, then the program was designed to execute desired tasks.

Some other components also used for the system which are Liquid Crystal Display (LCD), buzzer and also Light Emitting Diode (LED [8]). LCD, it can display on the screen based on a 16x2 display depending on the programming of the system. Buzzer which will produce sound when it receives high output (1) while no sound during a low output (0). LED, will light up when there is high output applied to it and will not light up when there is

low output which depends on the programming of the system [9].



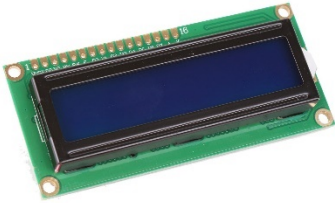


Hardware	Picture
Ultrasonic Sensor	
Arduino UNO	
Liquid Crystallized Display	
Buzzer	
LED	

Figure 2. List of Hardware

3. RESULTS AND DISCUSSION

3.1 The Software Flow

By referring to Figure 3, the software flowchart shows the complete program of the system of each component that will be executed by the programming of Arduino UNO [7]. Firstly, the ultrasonic sensors will produce a sound wave signal that will be reflected on a surface which acts as an obstacle and will be reflected as an echo signal. The echo signal will be received by the ultrasonic sensor and will indicate that there is an obstacle within the range that the ultrasonic sensor detects [10].

Based on the software condition, the detection of obstacles below 40 cm will produce sound on the buzzer

due to the high output and the LEDs will light up depending on their condition and location. The LCD will show a text of ‘Careful’ on the screen indicating there is an obstacle on the sides. If the obstacle is above 40 cm, the buzzer will not produce sound due to low output. The LEDs will not light up depending on their condition and location. The LCD will show the range of the obstacle and the ultrasonic sensor so that the user can be alert.

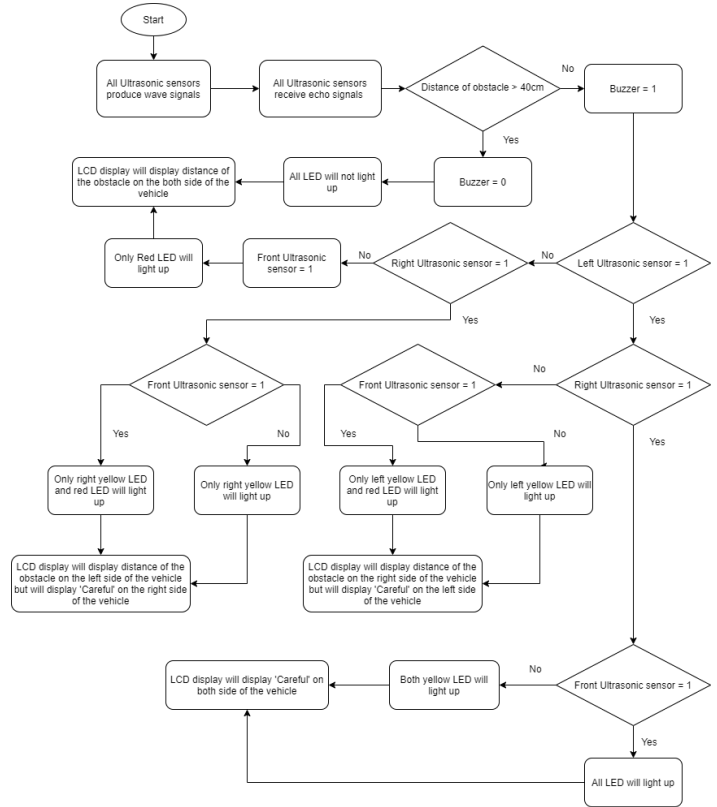


Figure 3. Software flow chart

3.2 Simulation Experiments

The programming was made based on the software condition that enables the system to achieve up to eight different conditions and will undergo repeatedly. The programming was able to be tested out based on the simulation that was made on a web-based software called Tinkercad. Before undergoing the simulation process, the system was able to be completely constructed based on the wiring diagram between the Arduino Uno and the other components as shown in Figure 4.

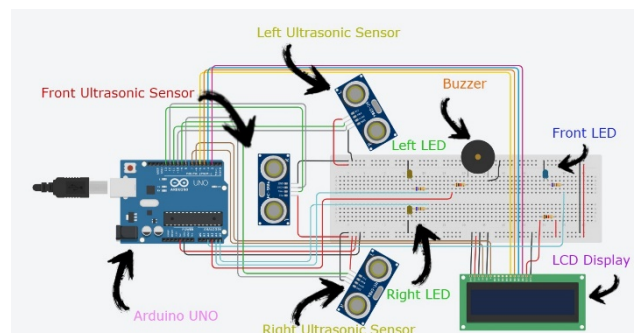


Figure 4. The Wiring Diagram

3.2.1 First Simulation

In Figure 5, the first simulation shows that there is the detection of obstacles on both sides of the circuit. The obstacle that had been detected will give data to the sensor and transfer to the Arduino and will execute the programming of other components. Both of the yellow-colored LEDs from the side will emit light and the buzzer will produce sound. The screen of the LCD will show that both sides need to be 'Careful' due to the detection range below 40cm. The red LED will not light up due to no obstacle detect on the ultrasonic sensor on the front.

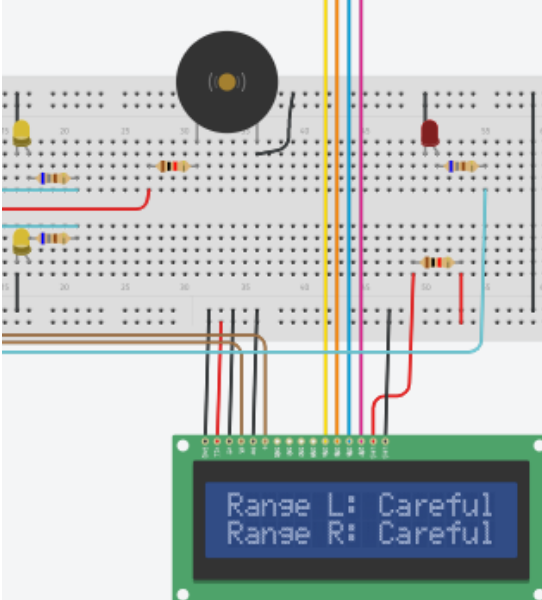


Figure 5. First Simulation

3.2.2 Second Simulation

In Figure 6, the second simulation shows that there is a detection of obstacle on the left side of the circuit. The obstacle that had been detected will give data to the sensor and transfer to the Arduino and will execute the programming of other components. The yellow-colored LED from the left will emit light and the buzzer will produce sound. The screen of the LCD will show that only the left side needs to be 'Careful' due to the detection range below 40cm. On the right side, the distance of any obstacle that passes through the right sensor can be measured from the LCD due to above 40cm. The red LED will not light up due to no obstacle detect on the ultrasonic sensor on the front.

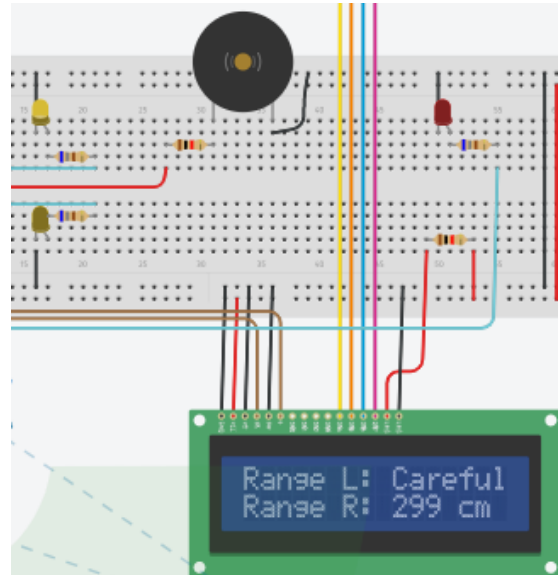


Figure 6. Second Simulation

3.2.3 Third Simulation

In Figure 7, the third simulation shows that there is a detection of obstacle on the right side of the circuit. The obstacle that had been detected will give data to the sensor and transfer to the Arduino and will execute the programming of other components. The yellow-colored LED from the right will emit light and the buzzer will produce sound. The screen of the LCD will show that only the right side needs to be 'Careful' due to the detection range below 40cm. On the left side, the distance of any obstacle that passes through the left sensor can be measured from the LCD due to above 40cm. The red LED will not light up due to no obstacle detect on the ultrasonic sensor on the front side.

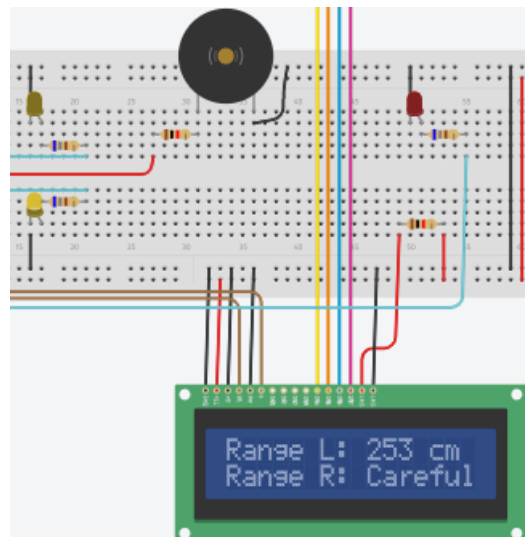


Figure 7. Third Simulation

3.2.4 Fourth Simulation

In Figure 8, the fourth simulation shows that there are detection of obstacles on both sides of the circuit but the distance is more than 40 cm. The obstacle that had been detected will give data to the sensor and transfer to the

Arduino and will execute the programming of other components. All of the LEDs will not emit light and the buzzer will not produce sound due to low output. The screen of the LCD will show the distance of any obstacle that passes through on both sides of the sensor due to above 40cm. The red LED will not light up due to no obstacle detect on the ultrasonic sensor on the front.

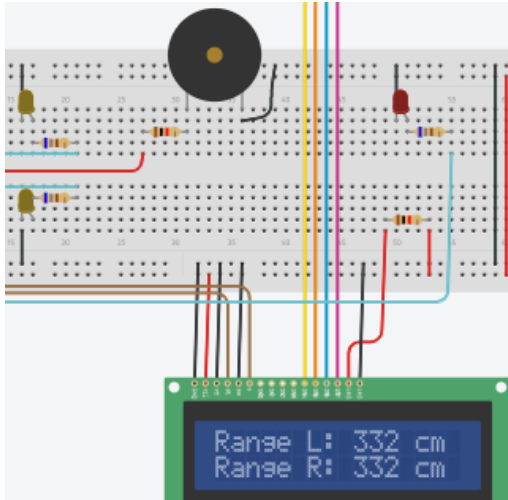


Figure 8. Fourth Simulation

3.2.5 Fifth Simulation

In Figure 9, the fifth simulation shows that there is detection of obstacles on both sides of the circuit. The obstacle that had been detected will give data to the sensor and transfer to the Arduino and will execute the programming of other components. All of the LEDs will emit light and the buzzer will produce sound due to the detection of obstacles on the sides and front. The screen of the LCD will show that both sides need to be 'Careful' due to the detection range below 40cm.

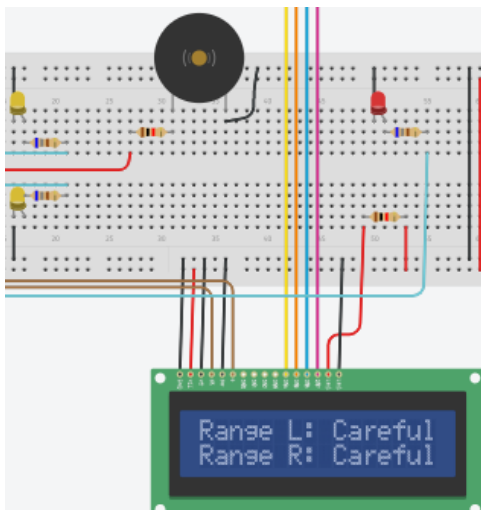


Figure 9. Fifth Simulation

3.2.6 Sixth Simulation

In Figure 10, the sixth simulation shows that there is detection of obstacles on both sides of the circuit but the

distance is more than 40 cm. The obstacle that had been detected will give data to the sensor and transfer to the Arduino and will execute the programming of other components. Both yellow-colored LEDs will not emit light due to low output. The screen of the LCD will show the distance of any obstacle that passes through on both sides of the sensor due to above 40cm. The red LED will light up due to obstacle detection on the ultrasonic sensor on the front and the buzzer will produce high output.

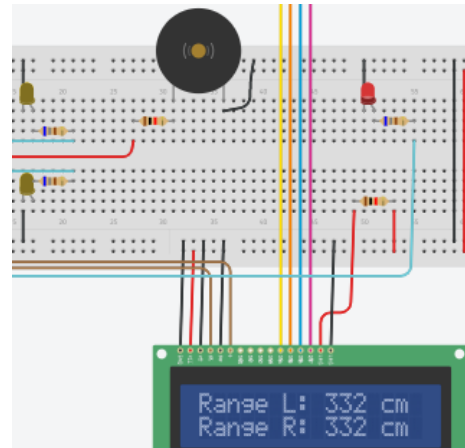


Figure 10. Sixth Simulation

4. CONCLUSION

From this study, the pros and cons of different types of sensors must be acknowledged depending on their usage capability. There are a couple of sensors that are suitable to be used for the project depending on their reliability and their range of detection where the ultrasonic sensor is one of them. The system was able to function without any flaw based on the desired condition where it can help user to be able to detect obstacle within blind spot area

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APPENDIX

A.1. Ultrasonic Sensor Datasheet



2.3. Module pin definitions

Types	Pin Symbol	Pin Function Description
HC-SR04	VCC	5V power supply
	Trig	Trigger pin
	Echo	Receive pin
	GND	Power ground

2.4. Electrical parameters

Electrical Parameters	HC-SR04 Ultrasonic Module
Operating Voltage	DC-5V
Operating Current	15mA
Operating Frequency	40KHZ
Farthest Range	4m
Nearest Range	2cm
Measuring Angle	15 Degree
Input Trigger Signal	10us TTL pulse
Output Echo Signal	Output TTL level signal, proportional with range
Dimensions	45*20*15mm