

Design of the HC-SR04 Ultrasonic Sensor as a Sensor Arduino Based Car Parking

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Abstract

This design aims to find out how to make a prototype of a car parking sensor using an Ultrasonic HC-SR04 sensor based on Arduino Uno. In this design, there are stages in making a car parking sensor system, namely stages related to the design that must be prepared to support the work process, stages of starting the process of designing a car parking sensor system using an Ultrasonic HC-SR04 sensor and Arduino Uno, and stages of analyzing the success of the car parking sensor system design process.

Keywords: *Arduino Uno, Car Parking Sensor, HC-SR04, Ultrasonic Sensor.*

1. Introduction

In the automotive world, parking is often a problem in big cities that are crowded and have limited parking space and become a scourge for some drivers. Actually, currently there is a parking security system found in cars with certain series and types using ultrasonic sensors to assist in the vehicle parking process. Generally, this ultrasonic sensor is already present in the latest car releases. Meanwhile, in old cars, there must be quite a few cars that do not have a factory-made distance sensor which will make it difficult for drivers to park their cars. This car parking aid uses the HC-SR04 distance sensor based on Arduino Uno and will work when the vehicle is going to park, where the microcontroller will process data from the ultrasonic sensor so that a result is obtained which will later be sent to the serial monitor as a distance display, a buzzer as a warning indicator in the form of sound, and an LED as a warning indicator in the form of light.

Ultrasonic distance sensor can tell the distance of the parking barrier to the car, which can be used to help the driver when parking. Arduino UNO as one of the single-board microcontrollers that can be used as the main controller is able to maximize the function of Ultrasonic sensor. This can minimize the occurrence of car damage when used which is expected to help car users to be safe and secure in using the car as a means of transportation.

2. Literature Review

Arduino Uno is an open-source single-board microcomputer designed to facilitate the use of electronics in various fields. Arduino Uno is also open hardware intended to facilitate the creation of prototypes or interactive electronic devices. Arduino Uno consists of an ATmega328P microcontroller that has been equipped with a bootloader so that it can be programmed using the Arduino IDE programming language. Arduino Uno has several features that facilitate prototype development, such as digital and analog input-output, serial ports, USB ports, and ICSP headers.

Arduino IDE is a cross-platform application written in Java. It is designed to be easier to use and familiar with software development. Arduino IDE includes a code editor with features such as syntax highlighting, brace matching, and auto-indentation, Arduino is able to compile and upload programs with just one click. Arduino IDE provides a programming language based on the Wiring language which is based on the C/C++ programming language and also provides various functions and libraries that are ready to use to facilitate program development on the Arduino board. Ultrasonic Sensor HC-SR04 is a sensor that can detect objects by emitting ultrasonic waves with a frequency of 40 KHz and then detecting the reflection. This sensor consists of two main parts, namely the transmitter and the receiver. There are 4 pins used for power supply (5V), echo, trigger, and VCC. Ultrasonic Sensor HC-SR04 is widely used in distance measurement applications, including in safe distance measurement applications in car parking systems.

Buzzer is one type of transducer, which is an electronic component that can convert energy from one form to another and functions to convert electrical vibrations into sound vibrations. Buzzer consists of a membrane or coil that can vibrate when given an electric voltage. Buzzer is usually used as an indicator that a process has been completed or an error has occurred in a device (alarm).

Breadboard is a tool used to create prototypes of electronic circuits before they are permanently installed. Breadboard consists of a series of small holes arranged in rows and columns. The holes are connected in a certain pattern that allows electronic components such as resistors, capacitors, transistors, and others to be connected to each other and form electronic circuits.

LED (Light Emitting Diode) is an electronic component that can emit monochromatic light when given a forward voltage. LED is a family of diodes made of semiconductor materials consisting of a semiconductor chip such as silicon or germanium, which is doped with other elements so that it can emit light when an electric current flows through it. So far, LEDs have been widely used in electronic devices because of their small size, practical installation methods, and low electricity consumption.

3. Research Methods

The methods used in this design include literature studies, problem analysis, system implementation, system testing, evaluation and documentation.

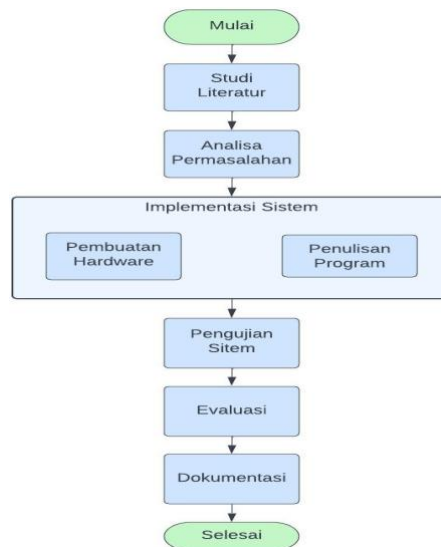


Fig. 1: Flowchart of design flow.

The subject of this study is a safe distance measuring device or parking system using an HC-SR04 ultrasonic sensor and Arduino Uno. To make the device, several components are needed, such as Arduino Uno, HC-SR04 ultrasonic sensor, buzzer, LED, and breadboard. The first step required is to design a circuit using Proteus, the author must learn about the parts, working principles and functions of each component to be used and what components are used and the reasons why these components should be used. After designing the circuit, the author began designing a parking sensor using the HC-SR04 ultrasonic sensor and Arduino Uno.

4. Result and Discussion

4.1 Wiring Process

Before designing the HC-SR04 ultrasonic sensor system to measure the safe distance of the car, the first step that needs to be done is to create a sketch that will be entered into the Arduino Uno. In the sketch that has been created, initialize the pins for all input and output components connected to the Arduino. The HC-SR04 sensor is connected to pin 6 as a trigger and pin 7 as an echo on the Arduino Uno. The buzzer is connected to pin 5 of the Arduino, while the LED is connected to pins 2, 3, and 4 of the Arduino. In the void loop section, the commands entered are the distance stages determined for the parking warning limit according to the safe distance to the closest distance or collision hazard distance, and then it will show a warning via buzzer and LED.

a. Configuring the HC-SR04 Ultrasonic sensor to Arduino

Connect the VCC pin of the HC-SR04 sensor to the 5V pin on the Arduino board. Connect the GND pin of the HC-SR04 sensor to the GND pin on the Arduino board. Connect the Trig pin of the HC-SR04 sensor to pin 6 on the Arduino board.

Connect the Echo sensor HC-SR04 pin to pin 7 on the Arduino board.

b. Red LED Configuration to Arduino

The plus (+) pin on the LED is connected to pin 2 on the Arduino board. The GND pin on the LED is connected to the GND pin on the Arduino board.

c. Yellow LED Configuration to Arduino

The plus (+) pin on the LED is connected to pin 3 on the Arduino board. The GND pin on the LED is connected to the GND pin on the Arduino board.

d. Green LED Configuration to Arduino

The plus (+) pin on the LED is connected to pin 4 on the Arduino board. The GND pin on the LED is connected to the GND pin on the Arduino board.

e. Buzzer configuration to Arduino

The plus (+) pin on the buzzer is connected to pin 5 on the Arduino board. The minus (-) pin on the buzzer is connected to the GND pin on the Arduino board.

Table. 1: Parking sensor test results.

No	Distance (cm)	LED Color	Warning Message	Buzzer Sound
1	< 8	Red	Stop	Keep on Beeping
2	> 8 and < 16	Yellow	Be careful	Fast Sounding
3	>= 16	Green	Safe	No Sound

4.2 Program Code

```
int trig = 6; int echo = 7;
long duration, distance; int red = 2;
int yellow = 3; int green = 4; int buzzer = 5;
void setup() {
// put your setup code here, to run once: pinMode(trig, OUTPUT); pinMode(echo, INPUT); pinMode(red, OUTPUT);
pinMode(yellow, OUTPUT); pinMode(green, OUTPUT); pinMode(buzzer, OUTPUT); Serial.begin(9600);
}
void loop() {
// put your main code here, to run repeatedly: digitalWrite(trig, LOW); delayMicroseconds(8);
digitalWrite(trig, HIGH); delayMicroseconds(8); digitalWrite(trig, LOW); delayMicroseconds(8);
duration = pulseIn(echo, HIGH); distance = (duration / 2) / 29.1; if(distance >= 16){ digitalWrite(green, HIGH);
digitalWrite(red, LOW); digitalWrite(yellow, LOW); digitalWrite(buzzer, LOW);
}else if((distance > 8) && (distance < 16)){ digitalWrite(green, LOW); digitalWrite(red, LOW); digitalWrite(yellow,
HIGH); digitalWrite(buzzer, LOW);
}else {
digitalWrite(green, LOW); digitalWrite(red, HIGH);
digitalWrite(yellow, LOW); digitalWrite(buzzer, HIGH);
}
Serial.print("Distance of Object : "); Serial.print(distance); Serial.println(" cm");
}
```

4.3 Working Mechanism

This car parking aid uses the HC-SR04 distance sensor based on Arduino Uno and will work when the vehicle is going to park, where the microcontroller will process data from the ultrasonic sensor so that a result is obtained which will later be sent to the serial monitor as a distance display, a buzzer as a warning indicator in the form of sound, and an LED as a warning indicator in the form of light.

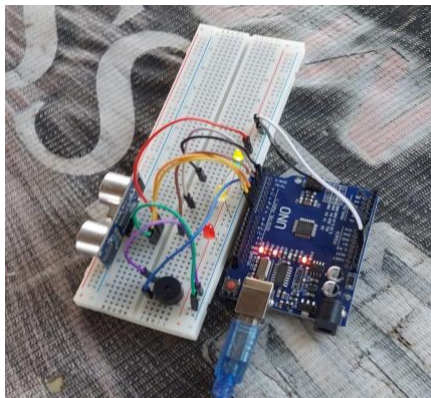


Fig. 2: Green LED lights up.

```

COM3
-----
Jarak Benda : 27 cm
Jarak Benda : 29 cm
Jarak Benda : 28 cm
Jarak Benda : 28 cm
Jarak Benda : 28 cm
Jarak Benda : 25 cm
Jarak Benda : 26 cm
Jarak Benda : 29 cm
Jarak Benda : 28 cm
Jarak Benda : 28 cm
Jarak Benda : 25 cm
Jarak Benda : 28 cm
Jarak Benda : 28 cm
Jarak Benda : 28 cm
Jarak Benda : 25 cm
Jarak Benda : 28 cm
Jarak Benda : 28 cm
Jarak Benda : 26 cm
Jarak Benda : 25 cm

```

Fig. 3: Serial Monitor distance more than 16 cm.

Usually the vehicle with a distance of more than 16, meaning the vehicle is far enough from that distance so that no more warning is needed. Therefore, the LED and buzzer will be turned off by the control unit because they are no longer needed. However, if the distance between vehicles is less than 16, the LED and buzzer will remain active and provide a warning to the driver to avoid unwanted collisions or damage.

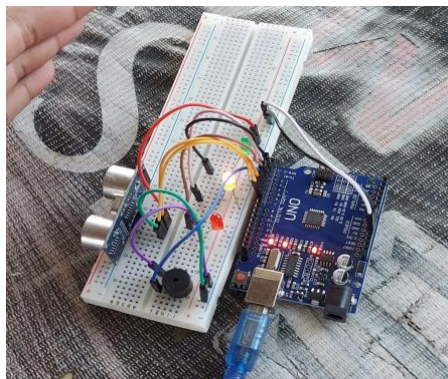


Fig. 4: Yellow LED lights up.

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COM3
-----
Jarak Benda : 11 cm
Jarak Benda : 10 cm
Jarak Benda : 11 cm
Jarak Benda : 9 cm
Jarak Benda : 9 cm
Jarak Benda : 9 cm
Jarak Benda : 9 cm
Jarak Benda : 9 cm
Jarak Benda : 11 cm
Jarak Benda : 11 cm
Jarak Benda : 9 cm
Jarak Benda : 9 cm
Jarak Benda : 9 cm
Jarak Benda : 9 cm
Jarak Benda : 9 cm
Jarak Benda : 9 cm
Jarak Benda : 10 cm
Jarak Benda : 10 cm
Jarak Benda : 10 cm
Jarak Benda : 10 cm

```

Fig. 5: Serial Monitor distance less than 16 cm.

When the parking sensor distance is more than 8 and less than 16 cm, the LED and buzzer will give different signals. The LED will turn off, indicating that the vehicle is very close to an object or wall. Meanwhile, the buzzer will turn on, indicating that the driver should stop immediately to avoid collision.

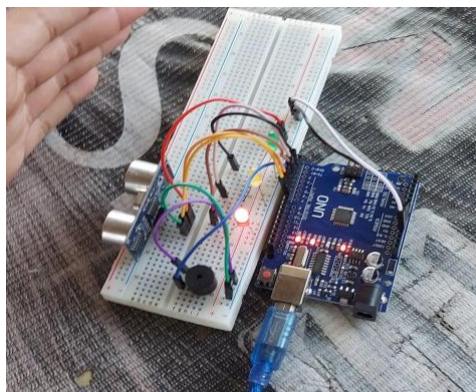
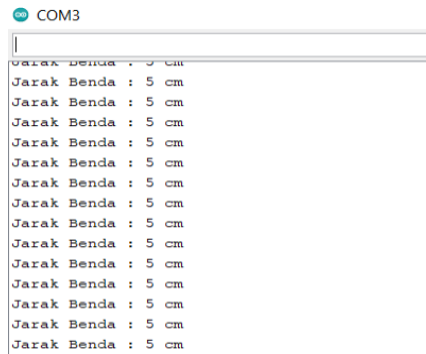


Fig. 6: The red LED is on.



```

COM3
Jarak Benda : 5 cm
Jarak Benda : 5 cm
Jarak Benda : 5 cm
Jarak Benda : 5 cm
Jarak Benda : 5 cm
Jarak Benda : 5 cm
Jarak Benda : 5 cm
Jarak Benda : 5 cm
Jarak Benda : 5 cm
Jarak Benda : 5 cm
Jarak Benda : 5 cm
Jarak Benda : 5 cm
Jarak Benda : 5 cm
Jarak Benda : 5 cm
Jarak Benda : 5 cm

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Fig. 7: Sensor distance is less than 8.

If the distance between the vehicle and the object detected by the parking sensor is less than 8, the LED and buzzer usually turn on. This is because a distance greater than 8 is considered safe and does not require warning to the driver. However, if the distance between the vehicle and the object detected by the parking sensor is less than 8, the LED lights and buzzer will turn on to warn the driver that the vehicle is approaching an object or obstacle. This aims to reduce the risk of collision when performing parking or reversing maneuvers. Detailed submission guidelines can be found on the journal web pages. All authors are responsible for understanding these guidelines before submitting their manuscript.

5 Conclusion

After designing a parking sensor device using Ultrasonic HC-SR04 based on Arduino Uno and testing the device. The following conclusions can be drawn:

1. The device that has been made can work well.
2. The tool can read and give voice commands according to the designer's wishes at a certain distance with various voice commands.
3. The Arduino Uno microcontroller is used as the main controller, and can run programs and commands as given.

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