PARKING SENSOR

CMPE 331 SOFTWARE ENGINEERING CONCEPTS
FINAL REPORT

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1 The Aim Of Parking Sensor

As the number of vehicles on the road grows, so does the parking problem in major cities. Parking is becoming increasingly scarce, with nearly all major cities experiencing a shortage of public and residential parking spaces. Even if you find a spot, parking will be difficult. Another reason for the growing parking problem is that cars are becoming wider and taller than ever before.[1] Parking sensors, also known as "parking assist," are made up primarily of ultrasonic sensors, controllers, and displays. It assists the driver in "seeing" invisible objects in the rearview mirror and alerts the driver to obstacles in the driver's path, either through sound or a more intuitive display. The parking sensor assists the driver in eliminating blind spots and blurred vision defects caused by the driver's visits to the front, rear, left, and right while parking, reversing, and starting the vehicle. The parking sensor also has blind spots, such as obstacles and ridges.[2].

What is the Parking Sensor?

Parking sensors are the proximity sensor which is used to help the vehicle driver in identifying near vehicles while parking. Usually, an automobile company places these sensors at the back bumper of the vehicle. Consequently, this system is also called a driver assistance system. Day by day, the popularity of these sensors has been increased because of increasing automobile dimensions as well as decreasing the parking area.

2 The Importance of The Parking Sensor

Many cars are equipped with built-in speakers that increase speed and frequency as the vehicle approaches the obstacle. Still, sound waves (in ultrasonic sensors) can miss environmental objects or smaller objects. Electromagnetic sensors have a wider detection scope than ultrasonic and detect the obstacle when the vehicle starts to move. In addition, ultrasonic parking sensors can detect obstacles even when the vehicle is stationary. Moving the car forward is not as difficult as

going backwards. Reverse parking sensors are a must-have feature for drivers who have problems with rear parking due to distance assessment issues or errors. These sensors are activated when you start parking the car. Rear parking sensors warn drivers of the distance of the obstacle behind the vehicle and protect them from accidents or any kind of damage [3].

The most obvious advantage provided by parking sensors is convenience. Parking sensors take the stress out of parallel parking in a tight spot while also making it easier to maneuver in traffic. because they They not only warn the driver of objects that cannot be seen in the mirror, but they also provide safety benefits. Parking sensors allow you to park in even the most congested areas. They are also very useful in a dark parking lot, allowing for smooth parking. Sensors are analogous to having an extra pair of eyes in the back.

Ultrasonic parking sensors Detect and calculate the distance between the car and other objects using sound echo. These sensors are mounted on the car's bumper to ensure that the acoustic waves travel uninterrupted. They warn the driver by beeping an alarm; as the car approaches the obstacle, the frequency of the beeping increases.

Electromagnetic parking sensor Systems create an electromagnetic field around the car's bumper. When an obstacle within this field is detected, the driver is notified. Electromagnetic sensors can be easily installed inside the car's bumper. They also have a wider detection field.

2.1 Preventing Accidents with Parking Sensors

Over 300,000 reversing-related accidents are reported each year. These kinds of mishaps might have been avoided if the car had parking sensors. Over 25 percent of accidents, according to national insurance claims, take place in reverse. Additionally, they assert that the use of vehicle parking sensors could have avoided 70 percent of these collisions. According to statistics, practically every driver will have a backing-up mishap at some point. It has been suggested by numerous insurance firms that you install rear parking sensors in your car to avoid becoming another statistic. Not only will it help reduce car accidents, but it might also make parking in awkward places easier.

All drivers—experienced and novice alike—young and old will benefit from these sensors, as well as people who have trouble looking behind them because of neck injuries or other incapacitating conditions. According to a study by the Insurance Institute for Highway Safety (IIHS), using parking sensors, a reversing camera, and a rear automatic braking system reduces accidents by 78 percent; using parking sensors and a reversing camera alone reduces accidents by 42 percent; and using parking sensors alone reduces accidents by 28 percent. Rearview cameras and parking sensors together decreased the frequency of rear-end collisions by 42 percent. Over and above the impact of cameras and sensors, rear autobrake decreased backing crash rates by 62 percent. In comparison to vehicles without any of the systems, vehicles equipped with all three systems had a back collision rate that was 78 percent lower overall. Accidents that result in death can also happen to vehicles without parking sensors. Annual mortality from backing up exceed 400. Usually, kids are involved in these deaths. As seen in all the statistics mentioned above, the presence of parking sensors alone saves a lot of unpleasant situations, from minor abrasions to child deaths. In this sense, a parking sensor that can be easily placed on the bumper of the vehicle provides a very useful and simple solution to get rid of these situations to a large extent.

3 Requirement List

Table of components is detailed below.

Table 1: Table of Components

Component	Function
Arduino UNO	Microcontroller board that allows the creation of the parking sensor (interact with buttons, LEDs, motors).
Ultrasonic Sensor (HC-SR04)	Ultrasonic Distance Sensor is a sensor used for detecting the distance to an object using sonar.
Breadboard	A thin plastic board used to hold electronic components (transistors, resistors, chips, etc.) that are wired together.
Male and Female Jumper Wires	Electric wire that connects remote electric circuits used for printed circuit boards.
Buzzer	A device that creates an audible tone under the influence of an applied external voltage.
Plastic Box	Plastic box used to complete the visual aesthetics.

3.1 Requirement Table

The requirement table is detailed below.

Table 2: System Requirements

ID	Priority	Requirement
Requirement1	5	The system warns the driver when the vehicle approaches an obstacle more than a certain distance.
Requirement2	3	Identification and determination of the critical distance through coding phases.
Requirement3	5	When the critical distance for the vehicle is reached, the LED in the system flashes and the buzzer beeps.
Requirement4	2	The parking sensor is designed in such a way that it can be easily placed in the vehicle's bumper.
Requirement5	1	Ensuring the parking sensor design is simple and convenient.

4 Timeline

In the timeline that will be created in such a way that computer engineers and electrical electronics students will work in a properly coordinated manner, they will come together at certain intervals and on certain days of the week, and the distribution of tasks in accordance with the timeline, the distribution of tasks that each individual will undertake, has been put into the construction phase in accordance with the weekly schedule below and will be included in the weekly schedule. The activities followed during the construction of the circuit and the project will be established and implemented in order to increase the efficiency on the coding, shape, schematic design and coding of the circuit, with coding coding in the form of the parking system sensor detecting and sending to the main brain and interpreting the code sent by the system's brain to continue the action that the system will take. will be designed and the project phase will be completed successfully. For all these phases, the weekly chart given below has been produced in the most efficient way.

1.week : Deciding which project to do

2.week : Searching every details for doing the project

3.week : Issuing a budget plan

4.week : Learning and applying the role of materials in the project after receiving the materials in the project

5.week : Understanding and applying the code stages in the parking sensor project of ardunio codes

6.week : Application of the outlines of the circuit diagram in the parking sensor project to the project

7.week : To be able to understand and comprehend the effect of ardunion on these components and the code effect in the form of application of the materials in the circuit according to the scheme.

8.week : Circuit setup phase and connection phase

9.week : Writing code with ardunio

10.week : Coding the sensor perception with ardunio in a way to continue the operation of the project in the system vspace.5em

11.week : Repair time for malfunctions in the system (code error, interference malfunction, etc.)

12.week : The phase of removing the missing coding and component parts during the completion of the parking sensor project

13:week : Check the workability of the project

14:week : Project completion and presentation phase

5 Rolls in Group

As a group with four group members, we will all work together on the coding, circuit diagram creation and design parts of the project. However, since our group members consist of two different departments as Electrical-Electronics and Computer Engineering, our skills and competencies in coding, circuit creation and design will be different, and the task distribution and weight of the group members will be as follows;

1) Devin Elgün, Kıvanç Demirkıran (Department of Computer Engineering); Working on the necessary coding parts for the parking sensor to work properly depending on the desired procedure and conditions (C/C++).

2) Ayhan Emre Şermet, Aykın Sancaklı (Department of Electrical and Electronics Engineering); Working on the

creation of the parking sensor, the planning of the circuit schematic and the application of the circuit connections according to the desired result.

3) All group members; Performing the necessary tests on whether the parking sensor is working in accordance with the planned procedure and necessary conditions.

4) All group members; Study on the compatibility of the coding and circuit components of the parking sensor and the desired visual expectation.

6 Design

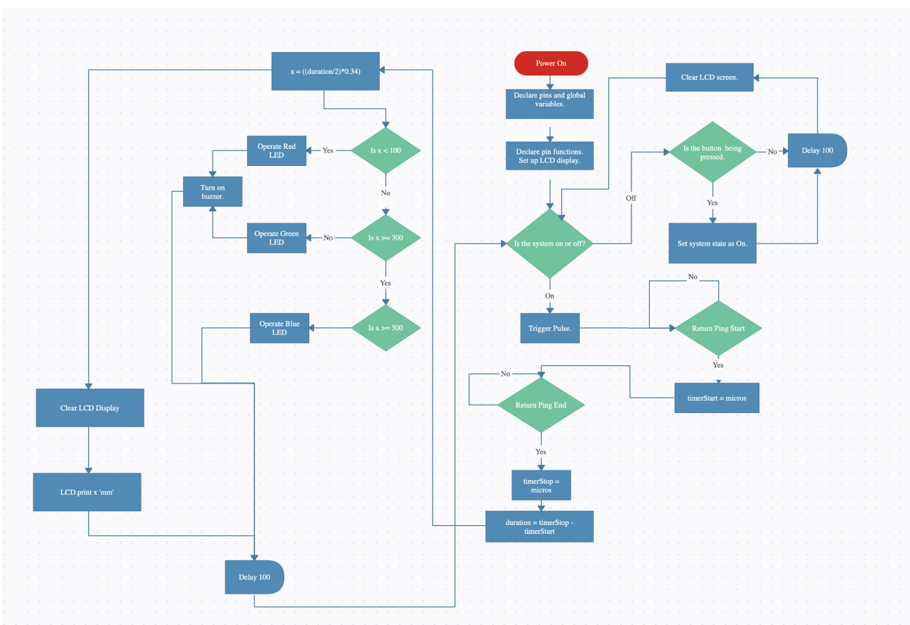
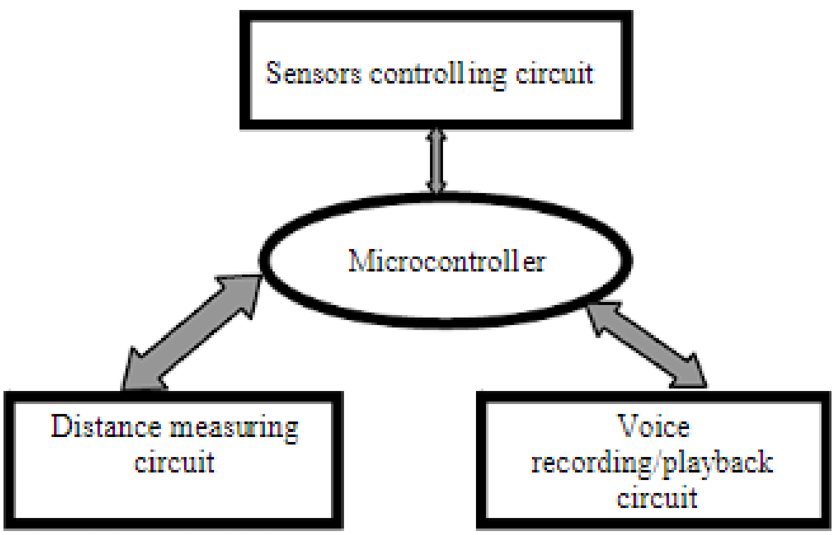
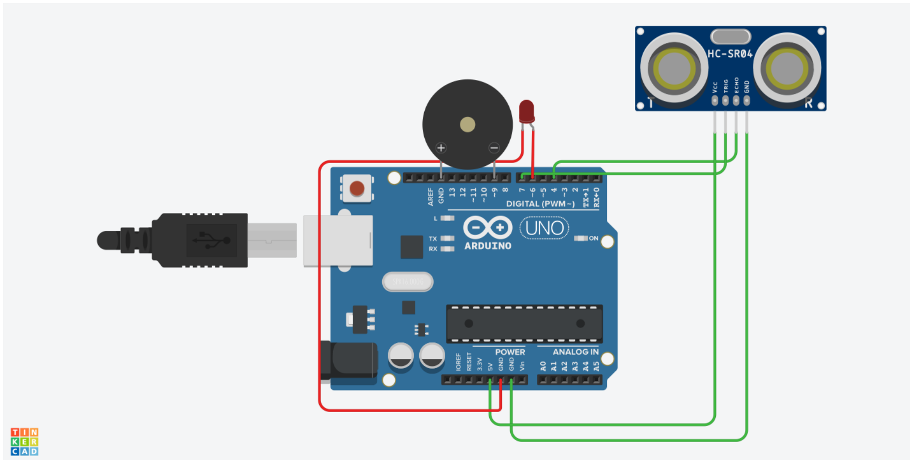


Figure 1

The main working principle of the project and the main working principle of the parking sensor, which is its main factor, is the reaction of the car in terms of warning the user when a part such as a wall, wooden object, etc. is approaching the object. The aim of the project is to prevent accidents and warn the user, and it is a very useful system. Together, the system will send a pulse signal to the brain designed with the ardunio. intermittent but long intervals are provided and it will warn the user. The distance adjustment and design depend on the coding to be designed with Arduino.





In parking a four-wheeled vehicle in the reverse position, the driver often has difficulty in knowing the presence of objects behind the vehicle. With the use of a microcontroller that controls a series of sensors, it can help find out information about the distance of objects, and reduce the risk of the object being hit. In this study, experimental research methods were used with a prototype based on a series of tools made. Applications in-vehicle circuits work by inputting a reverse signal and issuing object distance information that is detected by a series of tools. When the distance of an object is detected as having a risk of being hit, the circuit will give a warning. From the results of the study, it was found that the braking distance is influenced by the speed of the vehicle when braking. So that the results obtained are almost the same braking distance at all initial braking distances when the experiment is carried out. In conclusion, this device reduces the risk of being hit by objects behind the vehicle.

7 Test Cases

Test stages will be carried out as a group after each pre-specified step as follows;

1) Tests to be made after the circuit is built and connections are complete, and whether it is properly constructed.

2) Test stages on the coding to see if the parking sensor will respond according to the specified conditions.

3) The test stages to be carried out about whether the circuit and codes created as a whole can fulfill the required obligations.

7.1 Expected Results

The expected results of the system are given below.

Table 3: Expected Results of the System

System	Expected Results
Distance measurement indicator	The system will warn the user when the vehicle exceeds the critical distance with the help of ultrasonic sensor.
LED and Buzzer Controls	The system communicates with the user with LED and Buzzer when the threshold specified in the preset controls is exceeded.
Setttings for Alerts	The system will provide warnings to a certain extent according to the vehicle's distance to an obstacle with a preset code entry.

8 What has been done in the project so far?

The stages of creating the parking sensor, from the establishment of the circuit and the creation of the schematic, to the coding part are given below in order.

8.1 Gathering the necessary materials.

After removing a list of materials to collect the important components (sensor, transistor, buzzer, board, male and female jumper cables) in the circuit, by bringing together the circuit components, each separate task that will create between the components in the formation phase of the circuit is read with the necessary diagram to implement the parking sensor. It was aimed to get together and work.

8.2 Creation of the Circuit

In the creation of the circuit, after the ultrasonic sensor is first placed on the breadboard, the plus and minus poles of the terminals on the sensor are connected with the help of red and black jumper cables as follows; The red cable plus terminal is connected to the vcc pin of the sensor, the other end is attached to the 5v part on the arduino, and the gnd pin on the sensor is connected to the gnd pin on the arduino with the help of the black cable and the negative terminal is connected to the gnd pin on the arduino. Its pin is connected to the 7th pin on the arduino and the echo pin on the sensor is connected to the 6th pin on the arduino. In this way, the connection of the sensor is completed on the Arduino and the breadboard, that is, the connections of the + - terminals (signal sending and signal receiving ends) are completed. To complete the connection of the buzzer, a 330 ohm resistance is connected to the + terminal leg of the buzzer after the + pole terminal is attached to the sensor. And the other leg of the resistor is connected to an empty place on the other side of the breadboard, and the free leg of the resistor is connected to the 8th pin of the Arduino, which will trigger the buzzer, with the help of a jumper cable. and the idle terminal of the buzzer is connected to the gnd pin on the arduino from the leg of the terminal. The 330 ohm resistor put was put against the possibility of the buzzer burning. In this way, the resistance and energy connection that the circuit will show on the system, the terminals and the systematic connection on the circuit diagram are provided.

8.3 Encountered Problems

The problems encountered can be basically listed as follows;

1) Incorrect configuration while performing the sensor connection on the arduino and the breadboard. At this stage, with the wrong connection of the sensor terminals with the resistor, the resistance that the sensor will show to the circuit was made with the wrong connection, and as a result of the measurement with the multimeter, it was determined that the connection of the resistor with the sensor was incorrectly connected.

2) As a result of overloading the buzzer and risk of deterioration due to the 330 ohm resistor being corrupted, the buzzer, which is one of the main factors of the circuit and is responsible for warning the user, is expected to respond to the sound frequency, while the buzzer does not interact due to the reverse connection of the appropriate 330 ohm resistor, and as a result, the buzzer does not interact. It has been determined that the buzzer may light up as a result of overload.

8.4 Circuit Stage

How the problems were solved

1.)Breadbord problem : After the problems encountered, it was determined how each component works with the avometer and to capture the correct values in the device measurement, and as a result, it was determined that the resistance did not have an effect on the energy transfer on the sensor and did not give a result, according to the avometer. After detecting whether the resistor is defective or not, it was determined that the resistor was working properly, and then it was understood that it did not respond as a result of incorrect connection to the circuit.

2.)Deterioriated resistance :

As we mentioned above, due to the 330 ohm resistor in the second stage, as we mentioned above, as a result of the buzzer not responding due to the malfunction, firstly, an investigation was started to determine why the buzzer did not respond after the buzzer did not respond, then the reason for this was investigated with the multimeter, the resistors, which are only one component in the circuit. After thinking that this might cause this situation, it was determined that the resistor was broken after the 330 ohm resistor did not respond according to the device, and after connecting a new 330 ohm resistor, it was determined that the circuit was working with a new resistor.

9 Programming

This is the coding part of the project.

```
#define echoPin 6
#define trigPin 7
#define buzzerPin 8

int maximumRange = 50;
int minimumRange = 0;


void setup() {

pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
pinMode(buzzerPin, OUTPUT);

}

void loop() {

  int measurement = distance(maximumRange, minimumRange);

  digitalWrite(buzzerPin, HIGH);
  delay(measurement*10);
  digitalWrite(buzzerPin, LOW);
  delay(measurement*10);

}

int distance(int maxrange, int minrange)
{
  long duration, distance;

  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);

  duration = pulseIn(echoPin, HIGH);
  distance = duration / 58.2;
  delay(50);

  if(distance >= maxrange || distance <= minrange)
  return 0;
  return distance;
}
```

9.1 How does the coding work on the project of Parking Sensor?

The TRIG Pin should be high for a minimum of 10µS. After this, the Ultrasonic Sensor automatically sends 8 acoustic pulses of 40KHz frequency. The time between this and the reflected signal is calculated by reading the HIGH on the ECHO pin. Distance can be calculated as

Time (for which ECHO is HIGH) * Velocity of Sound (340m/s) / 2.

Using the same principle in the code, first the TRIG is made HIGH for 10µS using the following lines of code:

```
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
```

Then, the time is calculated for which the ECHO Pin is HIGH using the pulseIn function of Arduino. duration = pulseIn(echoPin, HIGH);

Finally, the distance in centimeters is calculated using :

distance = 0.034*(duration/2);

9.2 What kind of problems occurred?

If your parking sensors are covered in road dirt, dust or mud, they may not work as efficiently. The sensor may mistake dirt for a close object, therefore setting the sensors off incorrectly. So, it's important to keep your parking sensors clean to ensure they are working as they should be.

9.3 How does the process work?

Table of components is detailed below.

Table 4: To Do List

Substances	Actions To Be Taken
1	Discussing the project
2	Issues are resolved
3	The materials are gathered.
4	Code and Circuit are examined before construction.
5	It is incorporated into the code.
6	It is ready to build the Parking Sensor

References

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