Vehicle Parking Management System

Project Report

Under the guidance of

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INDEX

1. ABSTRACT

In an increasingly urbanized world, the efficient management of parking spaces has become a pressing challenge. This mini-project introduces a Digital System Design solution for a Vehicle Parking Management System (CPMS) to tackle this issue. The CPMS is designed to revolutionize parking operations by leveraging digital logic components such as sensors, gates and other sequential components. These components work in tandem to detect vehicle presence, facilitate entry and exit, and dynamically allocate parking slots.

Through meticulous design and implementation, the CPMS offers real-time monitoring capabilities, optimizing resource allocation and enhancing user experience. Its intelligent control system allows for the seamless integration of parking management within existing infrastructure, providing a comprehensive solution to parking congestion. By automating processes and utilizing digital logic, the CPMS not only addresses the immediate challenges of parking management but also lays the groundwork for future smart city initiatives aimed at promoting urban mobility and sustainability.

In essence, this project presents a practical application of digital logic principles to solve real-world problems. By streamlining parking operations, the CPMS contributes to the creation of more efficient and livable urban environments, demonstrating the transformative potential of digital logic in addressing contemporary urban challenges.

2. MOTIVATION

The multi-floor parking management system is designed for efficient urban mobility. Equipped with floor-level sensors, users receive real time updates on parking availability. The system allows users to choose preferred floors, with automated door locking when a floor reaches full capacity. A user-friendly interface displays parked Vehicles, ensuring transparency and efficient space utilization. Overall, the project aims to contribute to improved urban mobility, efficient space management, and a more convenient and secure parking experience for users.

3. OBJECTIVES

1. Objective 1 : Display System

- Design a display system to show the number of available and occupied parking spaces.
- Implement a user-friendly interface to provide feedback to users.

2. Objective 2 : Entry/Exit Control

- Design logic for controlling entry and exit barriers based on available parking spaces.
- Implement a system to manage the opening and closing of barriers.

3. Objective 3 : Vehicle Counting

- Develop a mechanism to count the number of vehicles entering and leaving the parking lot.
- Implement logic to update the display and manage parking space availability.

3. Objective 4 : Sensor Interface

- Interface digital sensors to detect the presence or absence of vehicles in parking spaces.
- Implement a mechanism to handle sensor signals and convert them into digital inputs

4. LITERATURE REVIEW

1. Paper by Sunggu Lee- The project entitled "THE SMART PARKING SYSTEM" presents an IOT based smart parking system which provides an optimal solution for the parking problem in metropolitan cities. Due to rapid increase in vehicle density especially during the peak hours of the day it is difficult task for the users to find the parking space to park their vehicles. This study proposes a smart parking system based on Arduino components and mobile application. The proposed smart parking system consists of an onsite deployment of a slot module that is used to monitor and signalize the state of availability of each single parking space. A mobile application is also provided that allows an end user to check the availability of parking space and book a parking slot accordingly. Smart parking can increase the economy by reducing fuel consumption and pollution in urban cities.

2. A Review of Smart Parking System and its Technology, paper by Leng Y.Y, and Zaidi Razak says parking allocation has become a major problem in modern cities for which numerous smart parking systems (SPS) have been developed. This paper aims to provide comprehensive study, comparison and extensive analysis of SPSs in terms of technological approach, sensors utilized, networking technologies, user interface, computational approaches, and service provided. Moreover, the paper fills up the research gap by providing a clear insight into the suitability of SPSs in various environmental conditions and highlights their advantages/disadvantages. The extensive comparison among multiple aspects of SPSs would enable researchers, designers, and policymakers to identify the best suited SPS and understand the current trends in this sector.

5. METHODOLOGY

Components Required:

- D flip flops(IC7474)
- OR gates (IC7432)
- AND gates (IC7408)
- Up-Down Decade Counter(IC7490)
- Hex Display (10 No.s)
- 4:16 Demux (IC 74154)
- LEDs

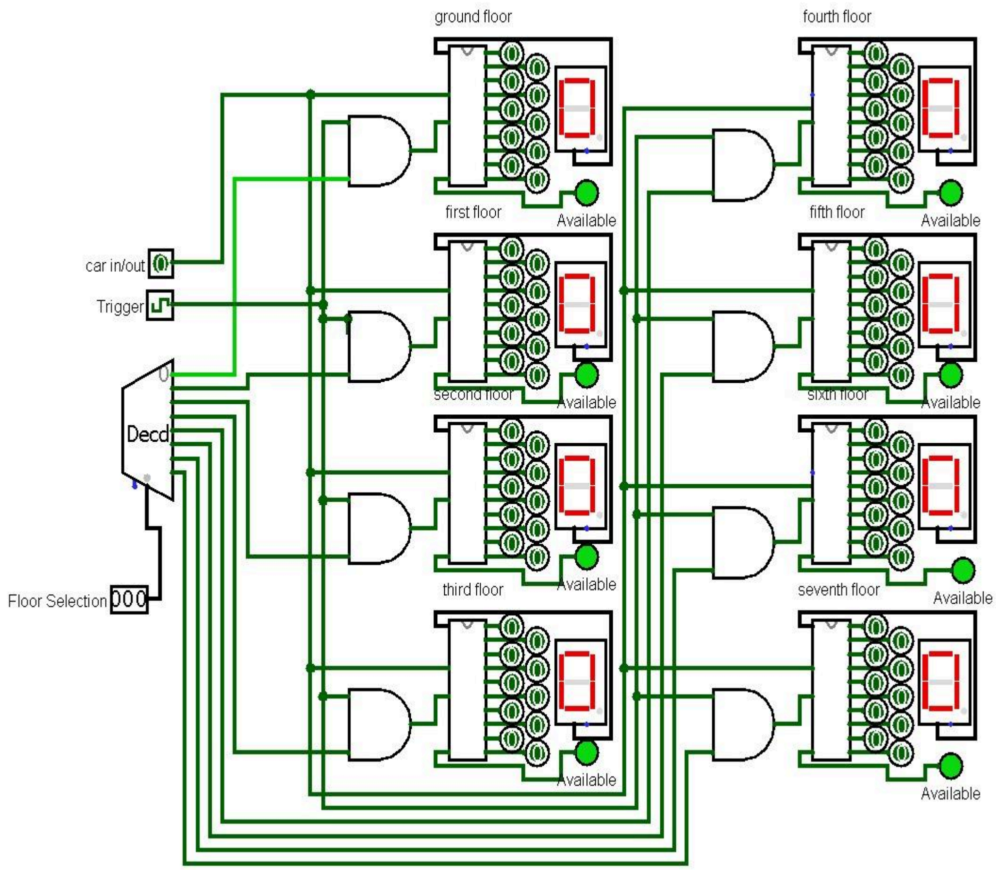

Fig. 5.1, Circuit diagram with the ICs

Working of the circuit:

Fig.5.1 is the full interface of the working circuit that we simulated in logisim. As mentioned in the labels, the bottom most input is used to select the floor, the top most input to decide whether the vehicle is entering or exiting, and just below that, we have the trigger (clock pulse)

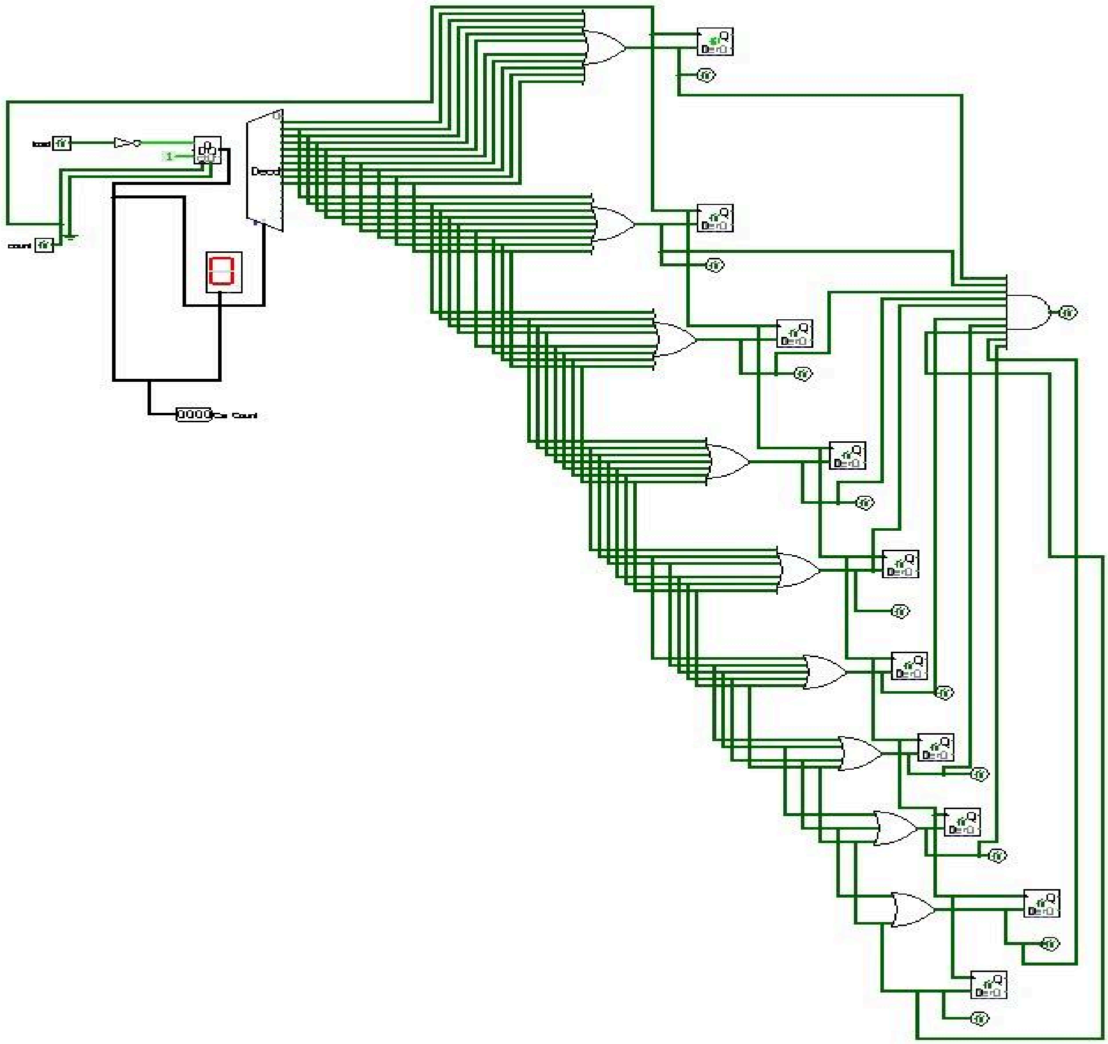

Fig 5.2, Internal structure of the IC

Working of the circuit:

Fig. 5.2 explains the internal functionality of the integrated circuit (IC), comprising a decade up-down counter responsible for monitoring vehicle entries and exits. The count from this counter serves as input for a 4:16 decoder. Through a network of OR gates, the decoder's outputs indicate slot availability. D flip-flops are incorporated to retain the previous availability state in the event of power interruptions. The circuit terminates with an LED signaling the full occupancy of the entire floor.

6. WORK DONE AND PROGRESS MADE\

1. **Ideation Stage**

The project began by conceptualizing a circuit that could effectively come up with such a parking system using digital system design, aiming to streamline vehicle parking operations, optimize space utilization, and enhance user experience in the parking plaza.

After conceptualizing the circuit, the next step involved simulating it on Logisim to ensure its functionality. The simulation confirmed that the circuit operated as intended. Subsequently, the project outlines future endeavors and potential enhancements for further development as mentioned ahead.

We aim to utilize ultrasonic sensors to detect vehicle arrivals and

departures .

2. **Software Simulation**

After the successful completion of the simulation phase for our vehicle parking management system project, we proceeded with the software implementation using Logisim Simulation. This transition marks a significant milestone in our project journey, as we move from conceptualization to

practical application. By leveraging Logisim Simulation, we translated our simulated model into a functional software system, ready to address the problem statement of parking management.
This phase involved translating the design and logic of our simulation into executable design, ensuring that the software behaves as intended and meets the requirements outlined during the ideation phase.

3. Hardware Implementation Stage

Following the successful software implementation phase using Logisim Simulation for our vehicle parking management system project, we transitioned to the hardware implementation stage.

I. Implementation of the circuit on the trainer kit:

Following software simulation, we moved to circuit implementation of the designed software simulation on a trainers' kit , translating virtual design into physical circuit. We meticulously assembled components according to simulation specs, ensuring accuracy and functionality. This phase brought us closer to integrating hardware and software for our vehicle parking management system.

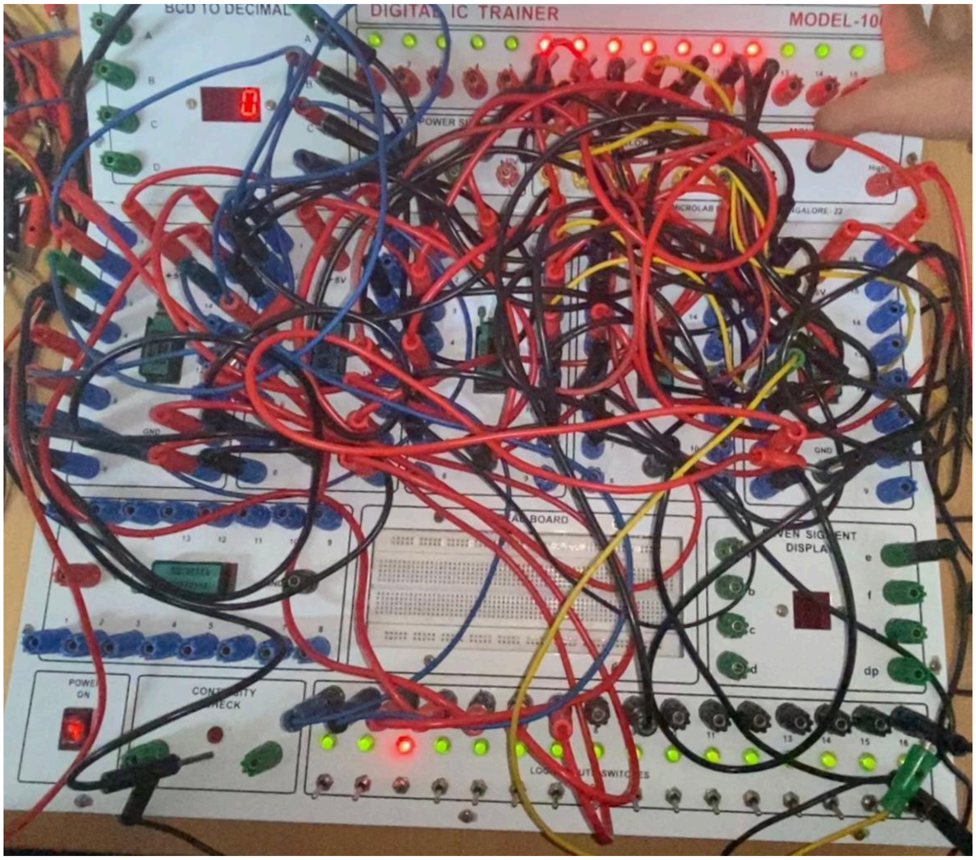

Fig 6.3.1, Hardware Circuit before Arduino interfacing

II. Programming the Arduino to use the ultrasonic sensor:

Following the circuit implementation phase, we proceeded to program the Arduino Uno. This step involved writing and uploading code to the Arduino to control its behavior based on the circuit designs and specifications. By programming the Arduino, we aimed to enable it to interact with the sensor, process data, and execute the necessary logic for our Vehicle parking management system.

Code:

```
const int clockPin = 8;
const int trigPin = 9;
const int echoPin = 10;
const int ledPin = 13;
float duration, distance;

void setup() {
  pinMode(clockPin, OUTPUT);
  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(ledPin, OUTPUT);
  Serial.begin(9600);
}

void loop() {
  distance = (ultrasonic()*.0343)/2;
  if(distance<=10 && distance>=1){
    Serial.println("A vehicle has been detected within " + (String)(distance));
    generateClockPulse();
    delay(500);
  }
  delay(150);

}

int ultrasonic()
{
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  return duration;
}

void generateClockPulse()
{
  digitalWrite(ledPin, HIGH);
  delay(500);
  digitalWrite(ledPin, LOW);
  // Serial.println(digitalRead(clockPin));
```

```
  digitalWrite(clockPin, HIGH);
  // Serial.println(digitalRead(clockPin));
  delay(500);
  digitalWrite(clockPin, LOW);
  // Serial.println(digitalRead(clockPin));
}
```

Output:

```
in\gdb.exe  --interpreter=mi
A vehicle has been detected within 4.09 cm
A vehicle has been detected within 4.48 cm
A vehicle has been detected within 6.54 cm
PS G:\>
```

The sensor was programmed to give the output of the distance of the object detected if it was within 10 cms from the sensor.

III. Interfacing the Arduino and Trainer Kit

After programming the Arduino, we proceeded to interface them with the trainer kit. This involved connecting the Arduino to the trainer kit's components and interfaces, ensuring seamless communication and integration between the hardware and software elements of our vehicle parking management system.

When the sensor detects a vehicle, it generates a clock impulse signal, prompting an increase or decrease in the vehicle count.

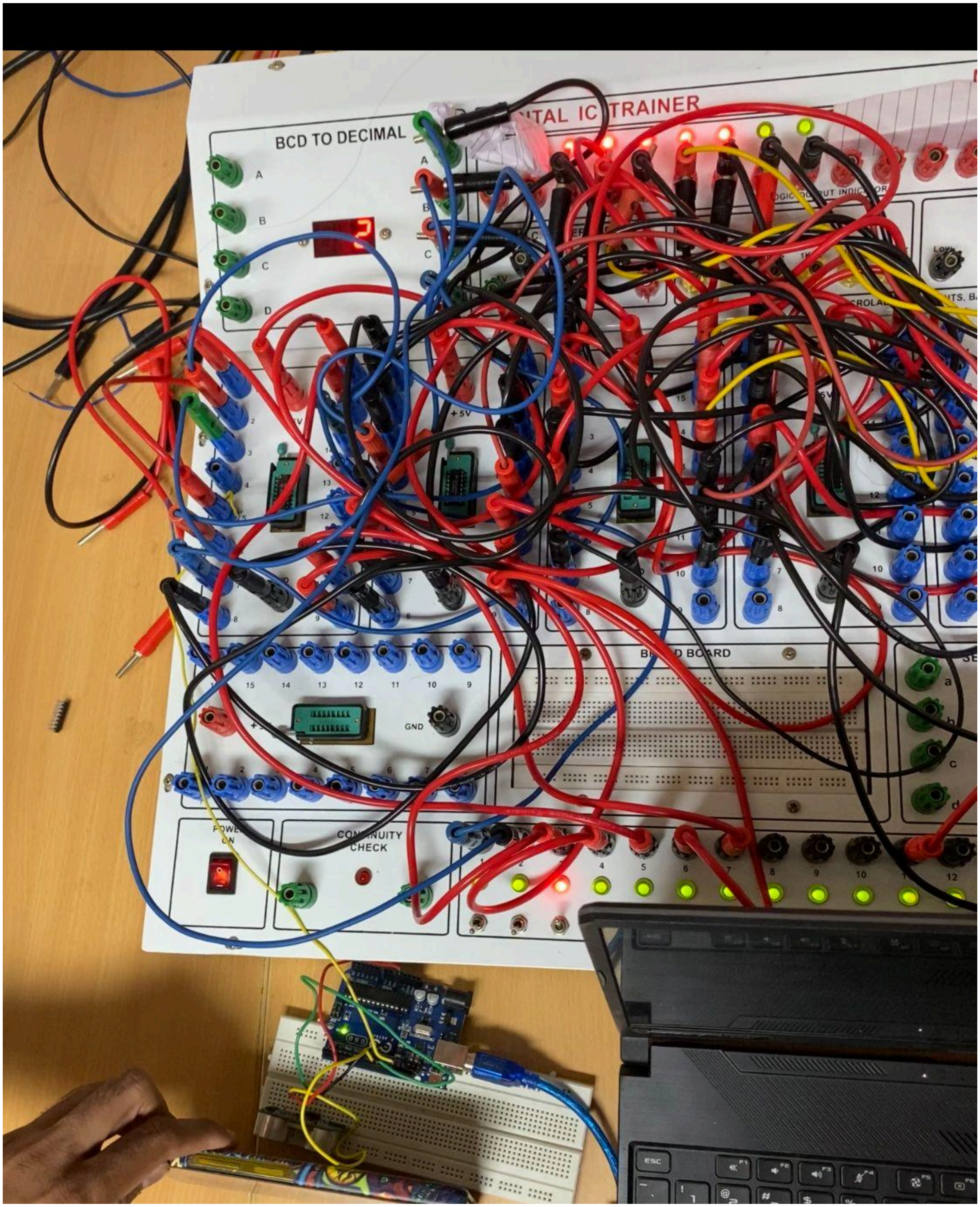

Fig 7.3.2, Hardware circuit interfaced with Arduino

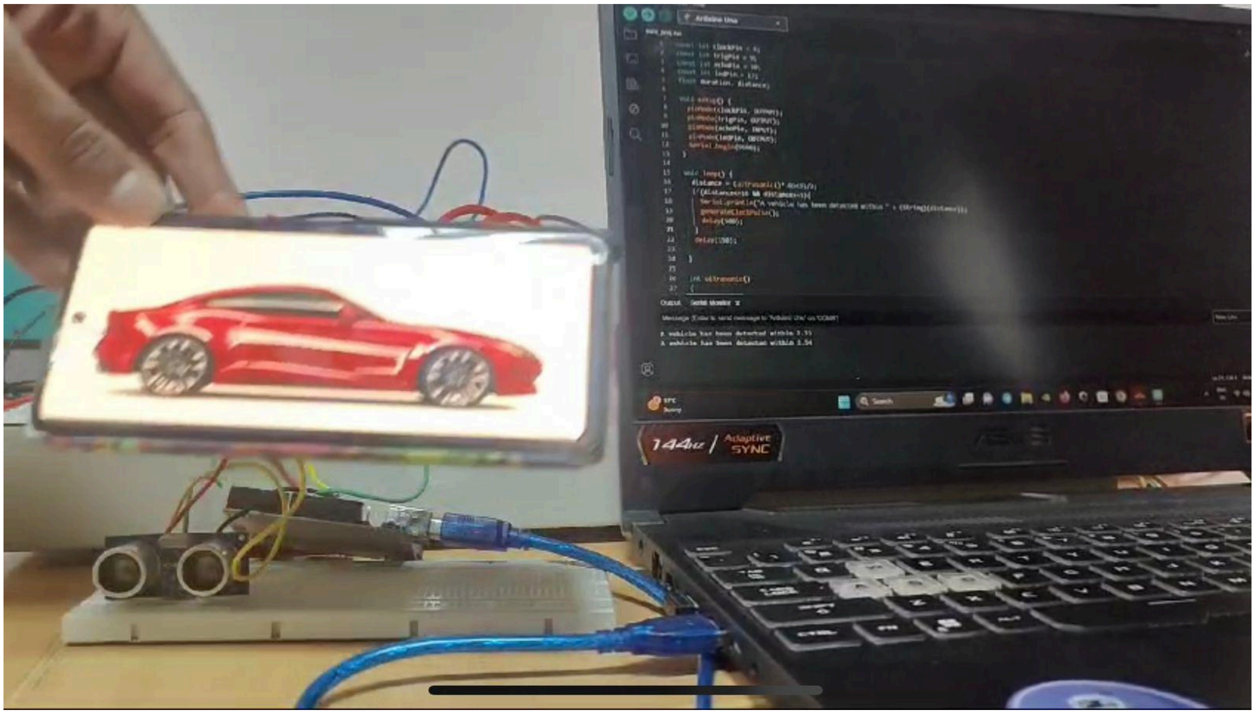

Fig 7.3.3, Front view of the circuit with an obstacle in front of the sensor

7. CONCLUSION

With the successful implementation of our multi-floor parking management system, we have not only achieved our goals of improving urban mobility and space management but also integrated advanced digital system design logic to enhance its functionality.

Through meticulous application of digital system design principles, we engineered a robust system architecture that efficiently processes sensor data, manages floor-level access, and ensures seamless communication between components. Leveraging concepts such as finite state machines, synchronous and asynchronous logic, and efficient data handling techniques, we optimized the performance and reliability of our system.

Furthermore, by employing digital system design logic, we were able to develop a scalable and modular architecture, allowing for easy expansion and integration of additional features in the future. This approach ensures that our parking management system remains adaptable to evolving needs and technological advancements in urban mobility.

In conclusion, the successful implementation of our project not only demonstrates our commitment to improving urban mobility but also showcases our proficiency in leveraging digital system design logics to create innovative solutions that address real-world challenges effectively.

8. REFERENCES

1. H. Muneer, 2018, Vehicle Parking Controller, Copyright (c) 2018-present

2. M. Y .I. Idris, Y.Y. Leng, Z.Razak, 2009, Vehicle Park System: A Review of Smart Parking System and its Technology

3. M. D. Hegde, M. S. Arshitha, 2019, Review Paper on Smart Parking System