Vehicle Parking Management System

EC281-Mini Project in Digital System Design

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INTRODUCTION

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 cars, 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.

Problem STATEMENT

A Parking plaza needs to automate its car parking functionality. The parking plaza has eight floors including basement, each having a capacity 10 cars. When a car comes in, the controller should tell the user about status of each floor i.e. “Space Available” or “Full”. To input the count of cars in each floor, a sensor should be used .User can choose a floor to park his car. If a floor is full, the controller will lock the entrance door of the floor and car cannot enter that floor. Also your system should display the cars parked on each floor.

LITERATURE REVIEW

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.

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.

Proposed OBJECTIVES

Designing a car parking management system encompasses the integration of digital sensors, entry/exit control logic, vehicle counting mechanisms, automated payment systems, and security features. This multifaceted project requires a comprehensive approach to digital logic design, ensuring seamless coordination between various components for efficient parking space management and user satisfaction.

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.

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.

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.

Objective 4: Sensor Interface

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

Project TIMELINE

Last Week of JAN 2024

- Confirmation of Project and zeroth presentation

Last Week of FEB 2024

- Come up with the circuit design
- Implement the circuit simulation and try to obtain output

First Week of MAR 2024

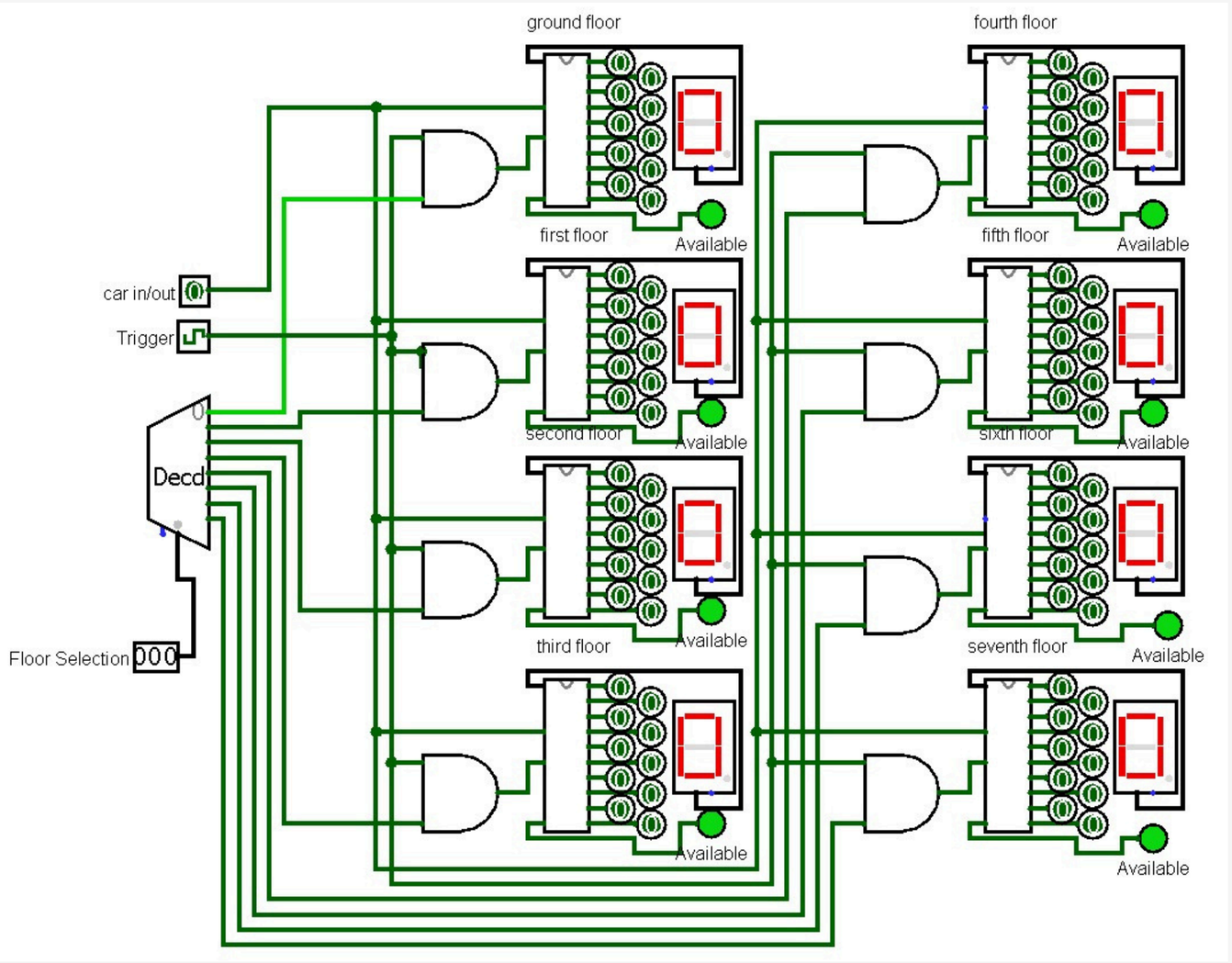
- Midsem evaluation and progress seminar

Second Week of MAR 2024

- Begin with the hardware implementation

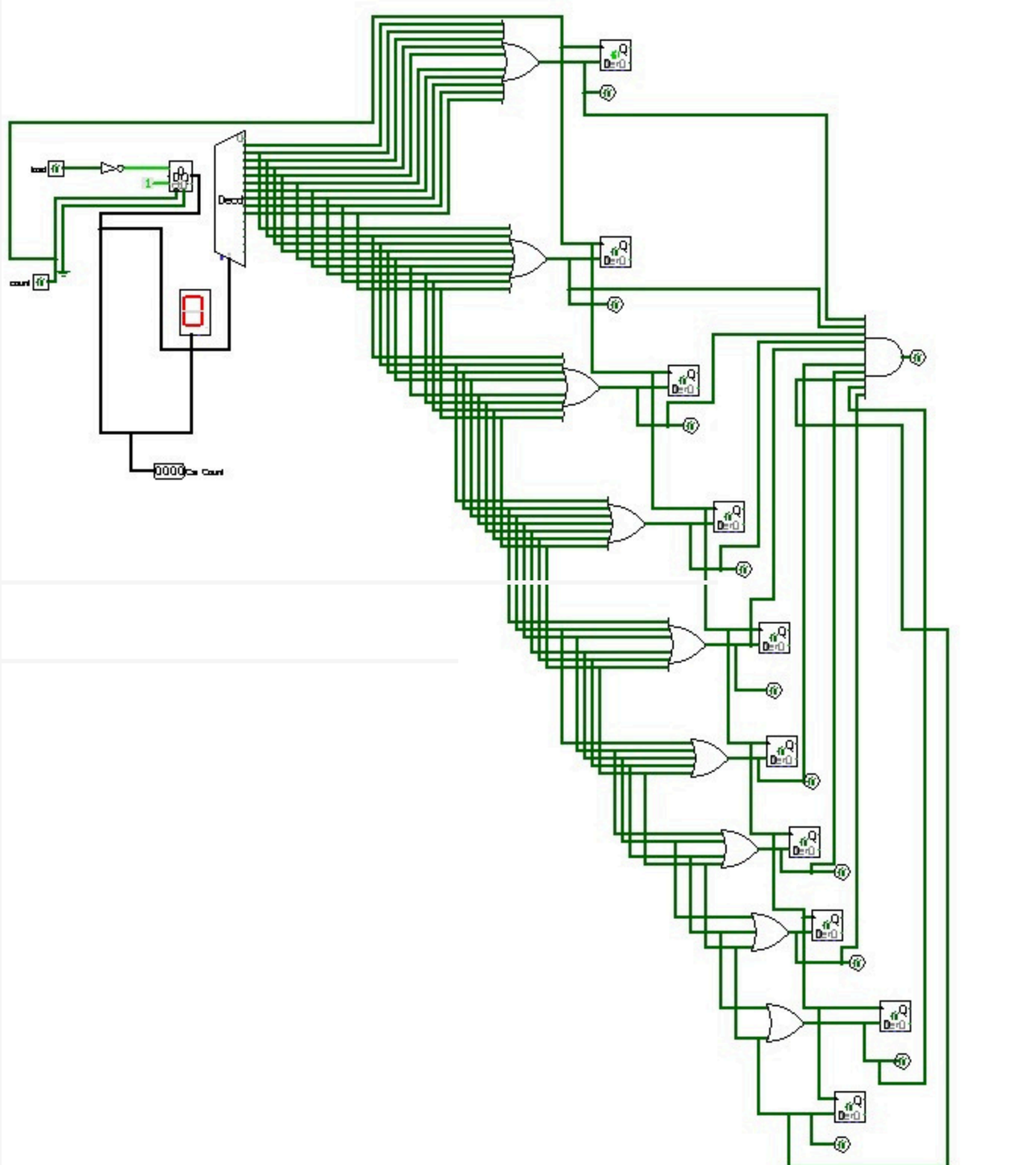
Final Week MAR/Second Week APR 2024

- Finish hardware implemenataion and come up with a working prototype.
- Mini project report submission
- Endsem evaluation and progress seminar



This 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 car is entering or exiting, and just below that, we have the trigger (clock pulse).

Inside the IC



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.

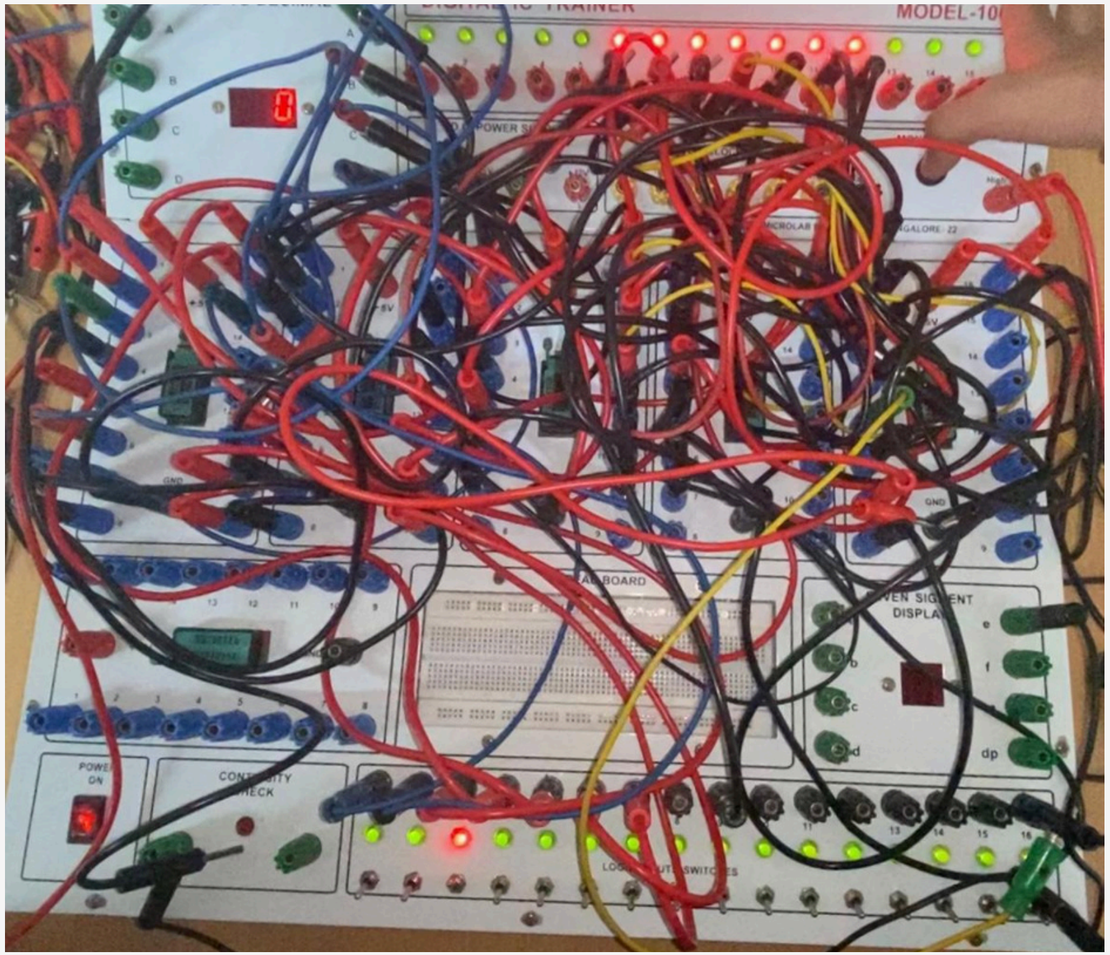
- The simulation confirmed that the circuit operated as intended. Subsequently, the project outlines future endeavors and potential enhancements for further development as mentioned ahead. We aim to utilize ultrasonic sensors to detect vehicle arrivals and departures .

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

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.

II.ARDUINO PROGRAMMING

```
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);
  digitalWrite(clockPin, HIGH);
  delay(500);
  digitalWrite(clockPin, LOW);
}
```

II.ARDUINO PROGRAMMING

Constants and Variables:

- clockPin, trigPin, echoPin, and ledPin are defined as constant integers to hold the respective pin numbers on the Arduino board.
- Duration and distance are defined as float variables to store the duration of the pulse and calculated distance respectively.

Setup Function:

- pinMode() is used to set the pins as either INPUT or OUTPUT. In this case, clockPin and ledPin are set as OUTPUT, while trigPin and echoPin are set as INPUT.
- Serial.begin(9600) initializes serial communication with a baud rate of 9600.

Loop Function:

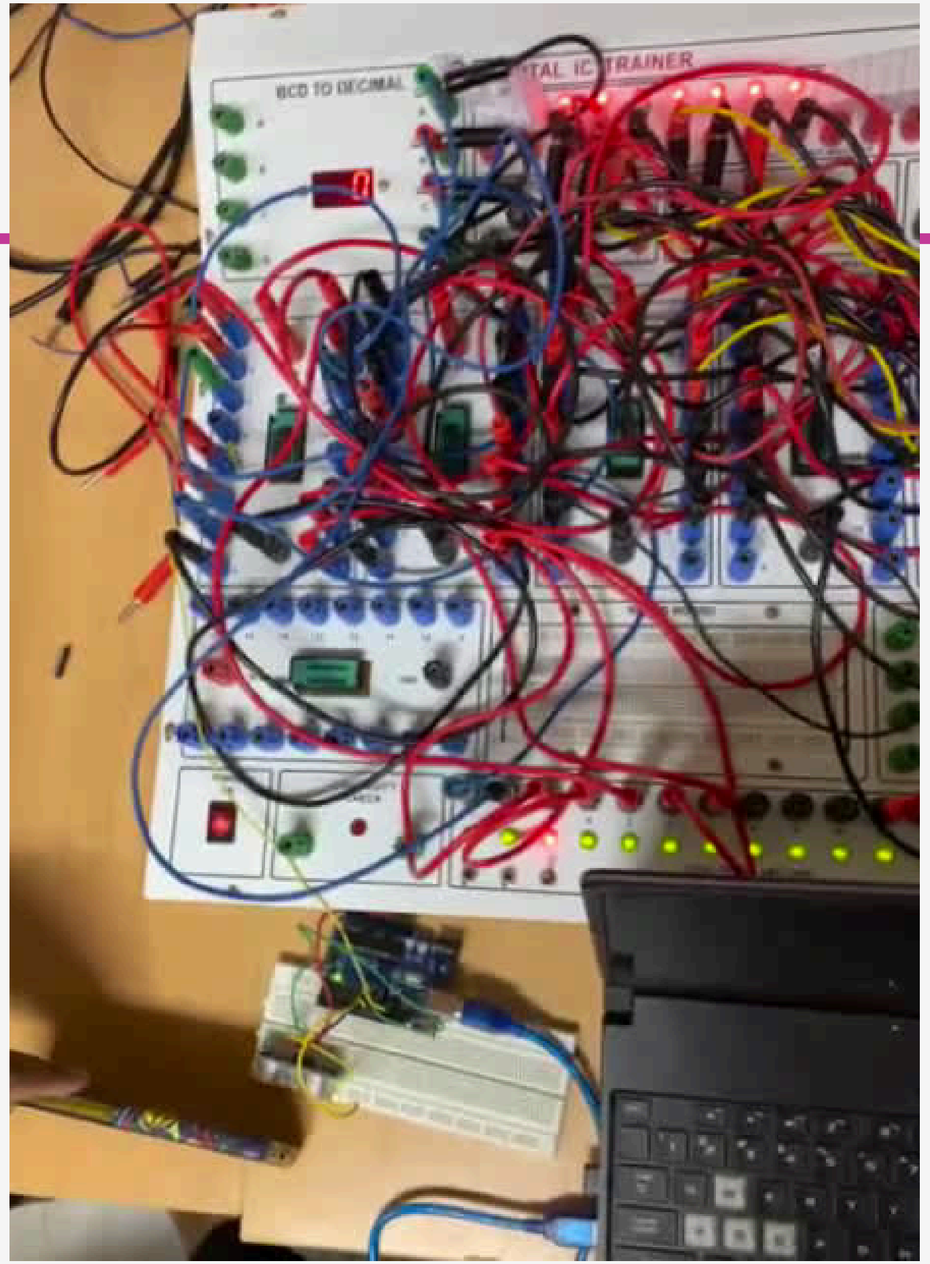
- The loop() function is where the main program logic resides.
- distance is calculated by calling the ultrasonic() function, which returns the duration of the pulse.
- If the distance is between 1 and 10 (inclusive), meaning a vehicle is detected within the specified range, it prints a message to the serial monitor indicating the distance.

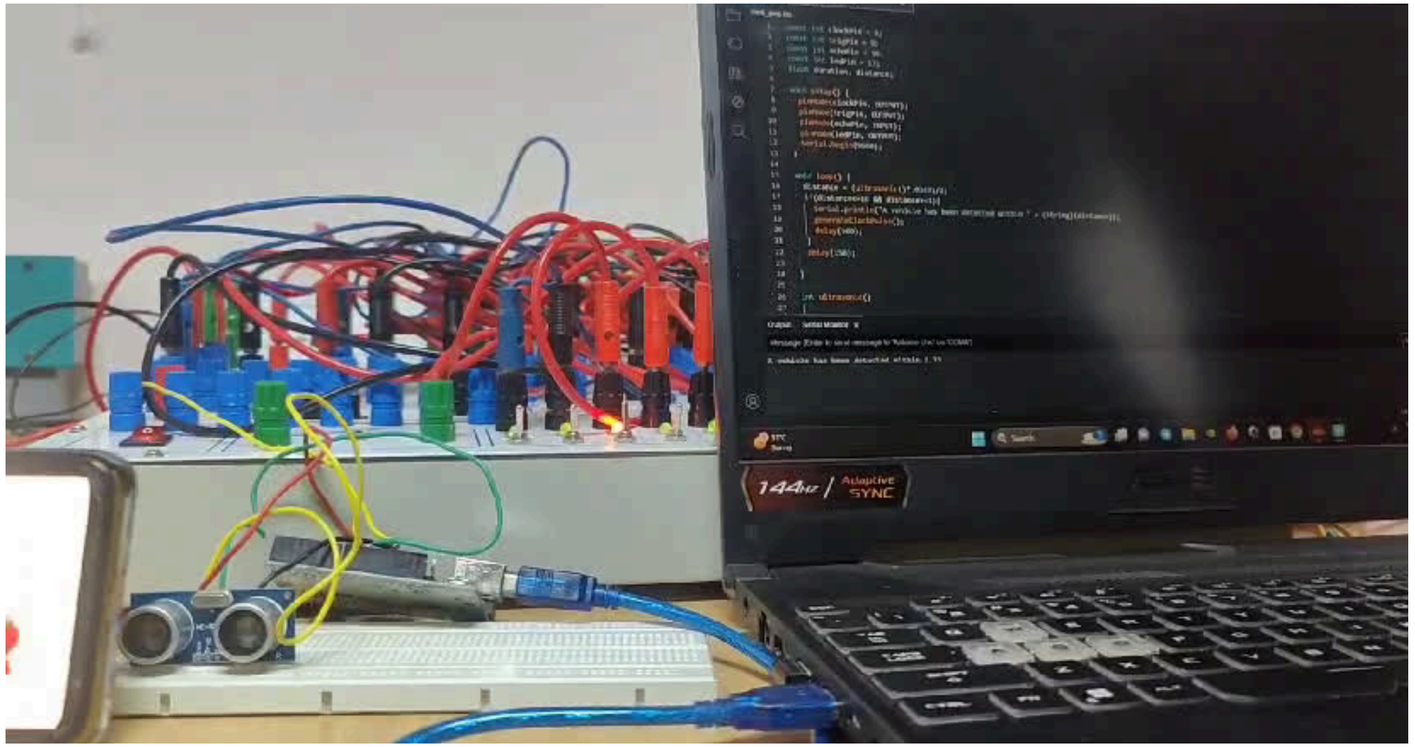
Ultrasonic Function:

- This function triggers the ultrasonic sensor to send out a pulse and measures the time it takes for the pulse to bounce back.
- It sets the trigPin LOW for 2 microseconds, then HIGH for 10 microseconds, and then LOW again to trigger the sensor.
- It uses pulseIn() to measure the duration for which the echoPin remains HIGH, which indicates the time taken for the pulse to return.
- It returns the duration of the pulse.

Generate Clock Pulse Function:

- This function is called when a vehicle is detected within the specified range.
- It toggles the ledPin HIGH and LOW with a delay of 500 milliseconds to visually indicate the generation of a clock pulse.
- It also toggles the clockPin HIGH and LOW to simulate the generation of a clock pulse.


BCD TO DECIMAL


144Hz | Adaptive SYNC

CONCLUSION

- Successful implementation of multi-floor parking management system integrating advanced digital system design principles, alongside ultrasonic sensors using Arduino.
- Optimizing performance with efficient data handling techniques, including concepts like finite state machines and synchronous/asynchronous logic.
- Ensures adaptability to urban mobility needs, showcasing proficiency in addressing real-world challenges effectively.
- Seamless communication between components enhances system reliability and functionality.
- Scalable and modular architecture allows for easy expansion and integration of additional features in the future.

REFERENCES

1. H. Muneer, 2018, Car Parking Controller, Copyright (c) 2018-present, harismuneer, Hassaan-Elahi
2. M. Y .I. Idris, Y.Y. Leng, Z.Razak, 2009, Car 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

THANK YOU