



Project Report

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Aim: The aim of this project is to design and develop a Smart Parking Gate System that automatically opens and closes the gate using an ultrasonic sensor, servo motor, and Arduino Nano. The system detects the presence of a vehicle at the entrance and triggers the servo motor to open the gate, then automatically closes it once the vehicle passes. This project enhances parking automation, convenience, and security through a simple and efficient IoT-based solution.

Objectives:

1. To automatically detect the presence of a vehicle using an ultrasonic sensor.
2. To control the parking gate operation (open/close) using a servo motor and Arduino Nano.
3. To enhance parking convenience through a fully automated gate system.
4. To improve safety and reduce manual effort in parking management.

Components Required:

Sno	Name of Component	Qty.
1.	Arduino Nano	1
2.	Ultrasonic Sensor(HC-SR04)	1
3.	Jumper Wires	1
4.	Servo Motor	1
5.	Breadboard	1

Details of Components:

1. Arduino Nano:

The Arduino Nano is a small and powerful microcontroller that acts as the brain of the project. It reads data from the RFID module, processes it, and controls other components like the OLED display and servo motor. Its compact size makes it ideal for small embedded systems.

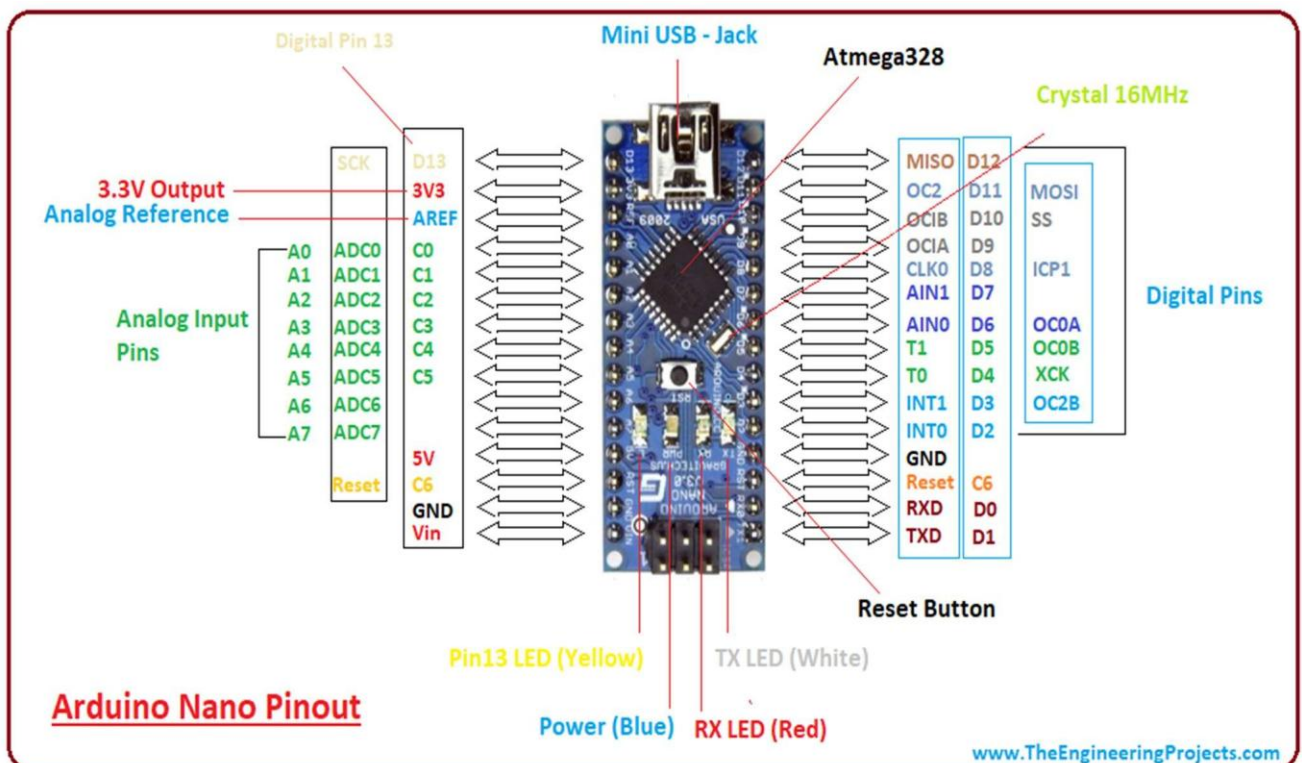


Figure 1 Arduino Nano Pin Diagram

2. Servo Motor:

The servo motor is responsible for opening and closing the door automatically after verification. It rotates to a specific angle when triggered by the Arduino, ensuring precise and controlled movement.

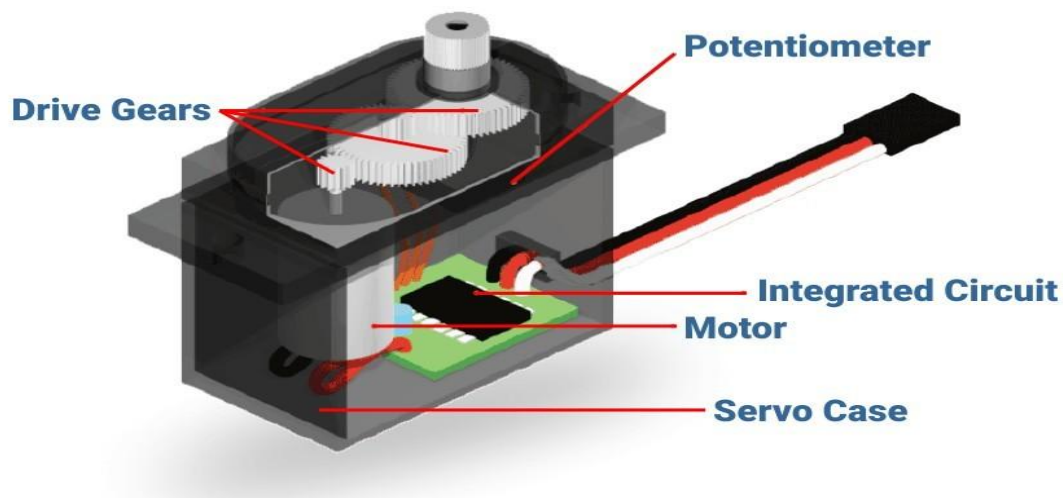
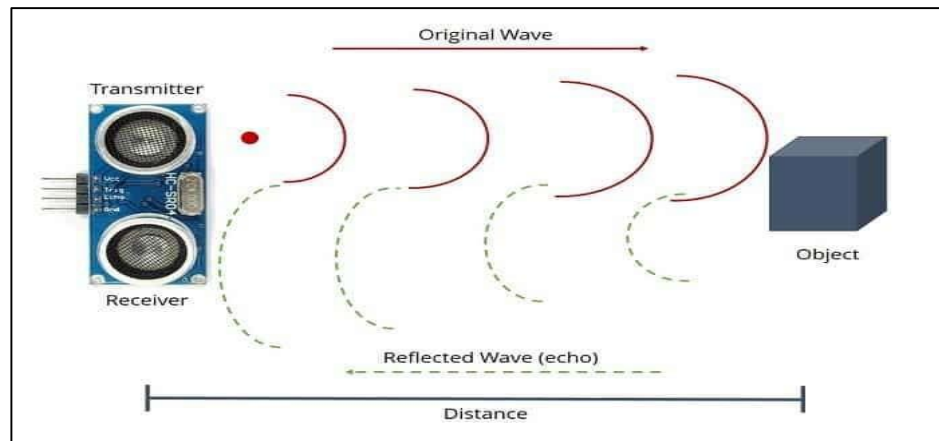


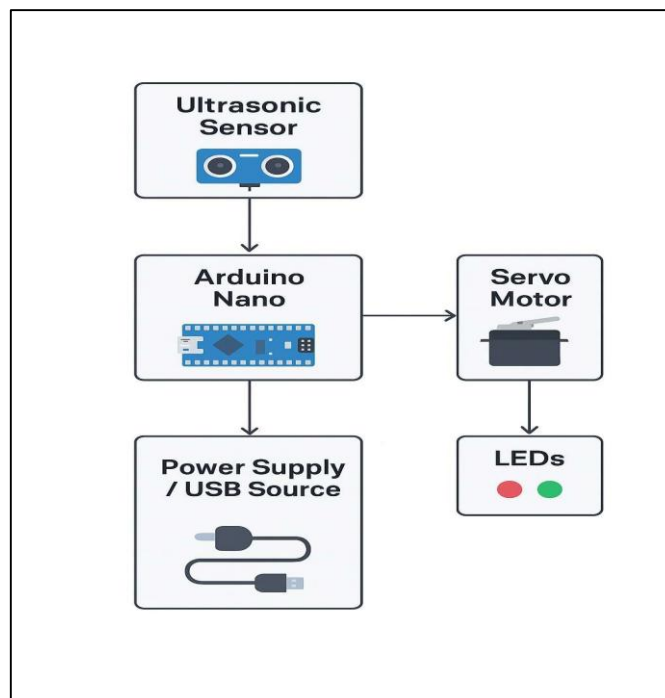
Figure 2 Servo Moto Diagram

3. Ultrasonic Sensor(HC-SR04):

The ultrasonic sensor is used to detect the presence of a vehicle by measuring the distance between the sensor and the object in front of it. It emits ultrasonic waves and calculates the time taken for the echo to return after hitting an object. Based on this distance data, the Arduino determines whether a vehicle is present and triggers the servo motor to open or close the parking gate automatically. This ensures accurate and contactless vehicle detection for smooth gate operation.



Block Diagram of Designed Model:



Working of Designed Model:

- **Idl Waiting:**

The Arduino Nano powers up and initializes the ultrasonic sensor and servo motor. The system continuously monitors the distance from the sensor to detect any approaching vehicle.

- **Vehicle Detection:**

When a vehicle comes near the sensor (e.g., within 20–30 cm), the ultrasonic sensor measures the distance and sends the data to the Arduino Nano.

- **Gate Open Signal:**

Upon detecting a vehicle within the set range, the Arduino sends a PWM signal to the servo motor. The servo rotates to a specific angle (e.g., 90°), lifting or opening the parking gate automatically.

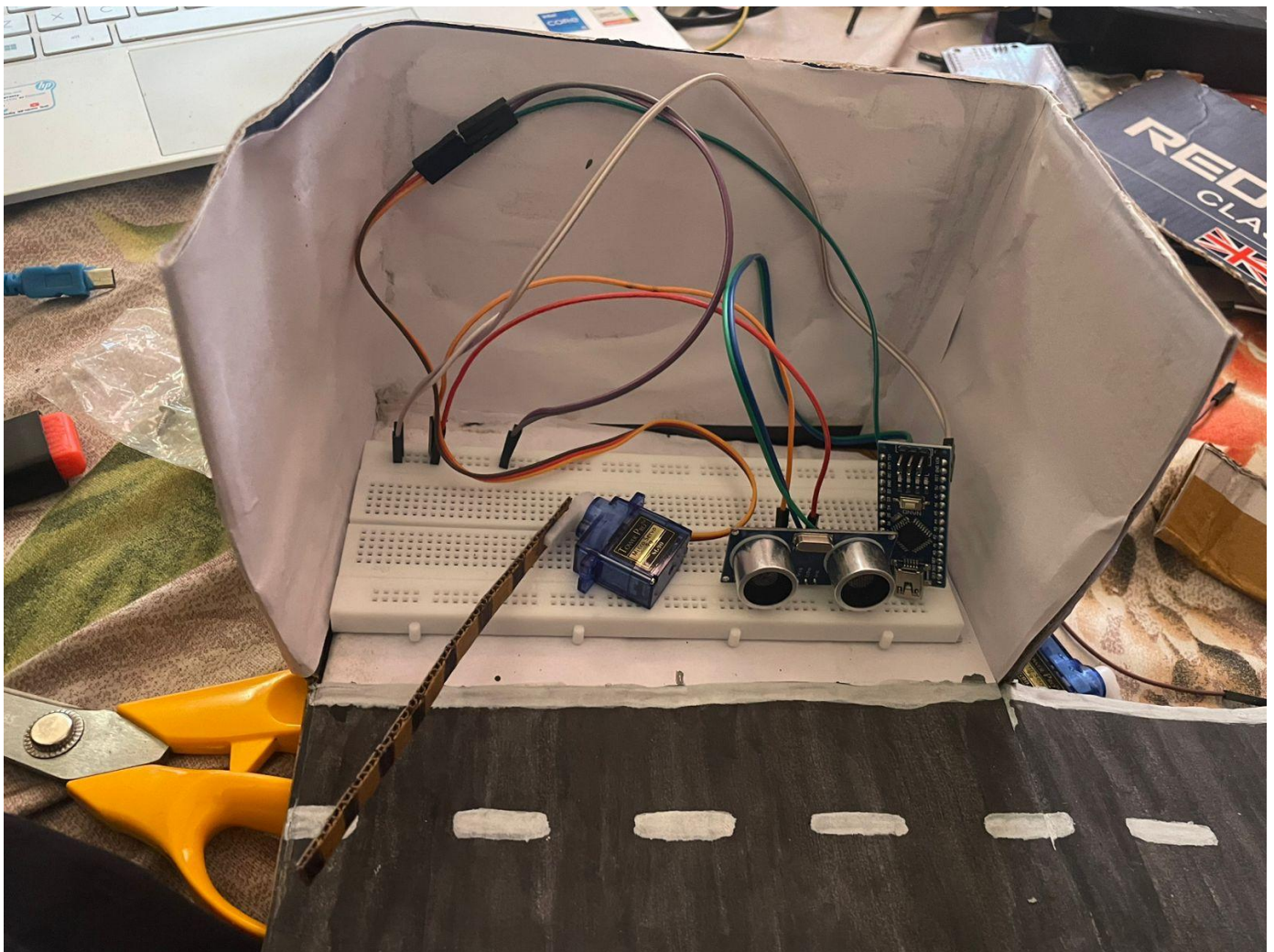
- **Vehicle Pass Confirmation:**

The ultrasonic sensor keeps monitoring the area. Once the vehicle passes and the distance increases beyond a threshold (e.g., >50 cm), the Arduino identifies that the vehicle has crossed the gate.

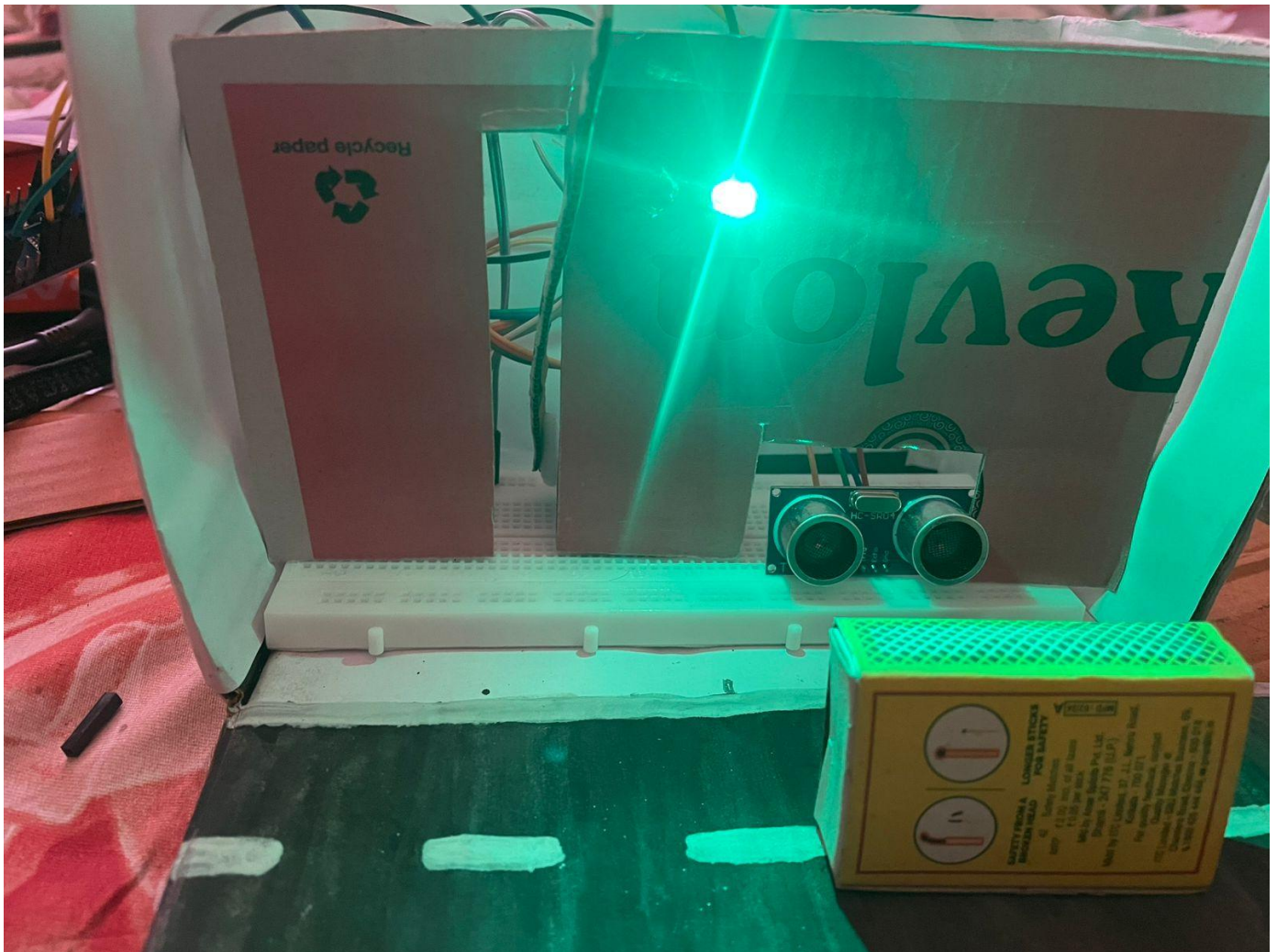
- **Gate Close & Reset:**

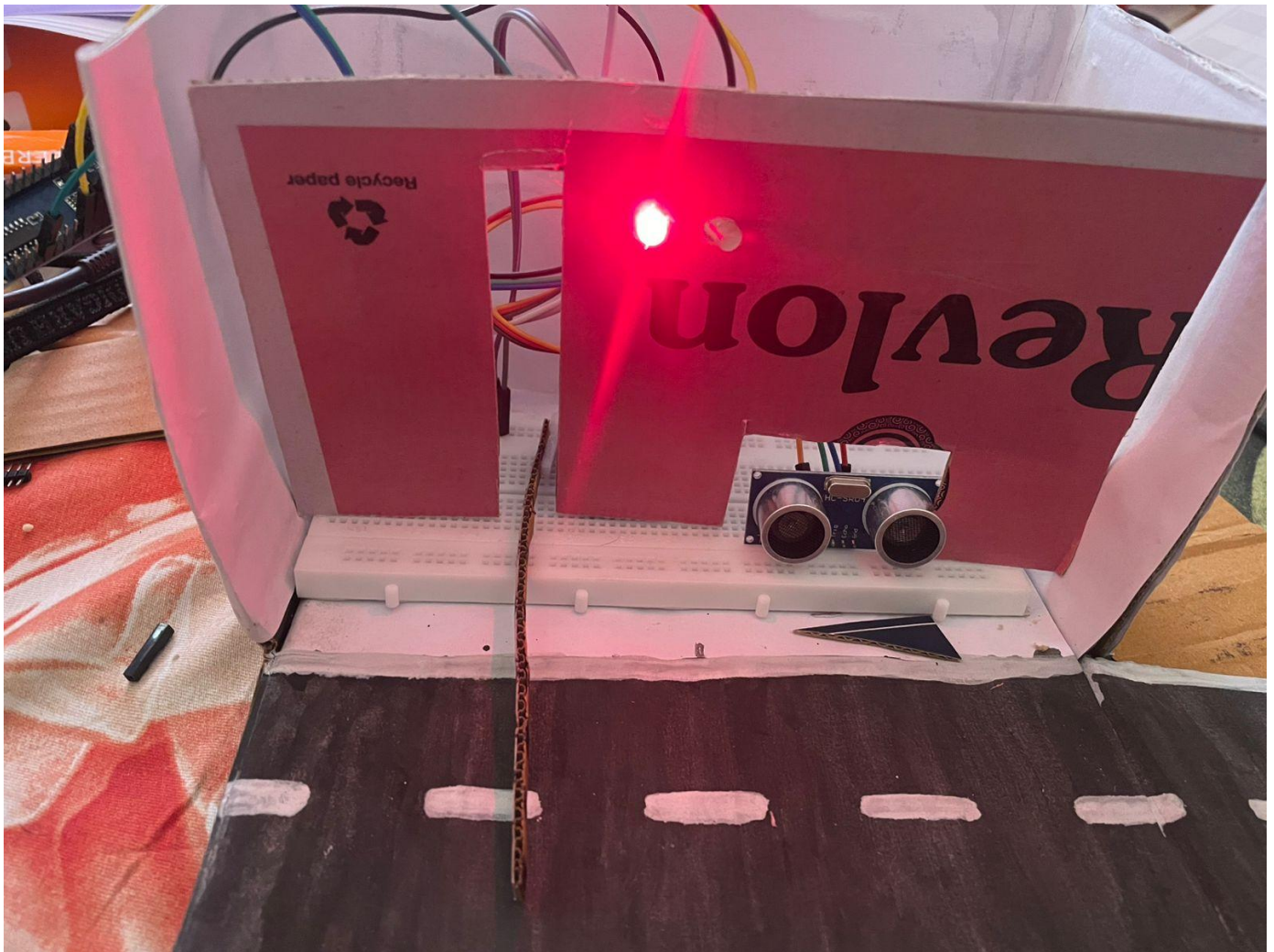
After a short delay, the Arduino commands the servo motor to return to its initial position (0°), closing the gate. The system then resets and returns to the idle state, ready for the next vehicle.

Pictures of Prototype:



Output of Deigned Model/Prototype :





Learning outcomes (What I have learnt):

- Gained practical knowledge of ultrasonic sensor technology and how it enables automatic detection of vehicles.



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- Learned to interface multiple components such as the ultrasonic sensor, servo motor, and LEDs with the Arduino Nano for an automated parking control system.
 - Developed skills in microcontroller programming using Arduino IDE for real-time sensing and gate control operations.
 - Understood the concept of automation and smart systems, and how IoT-based solutions can improve parking management and convenience.