Project Report

Smart Car Parking System

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ABSTRACT

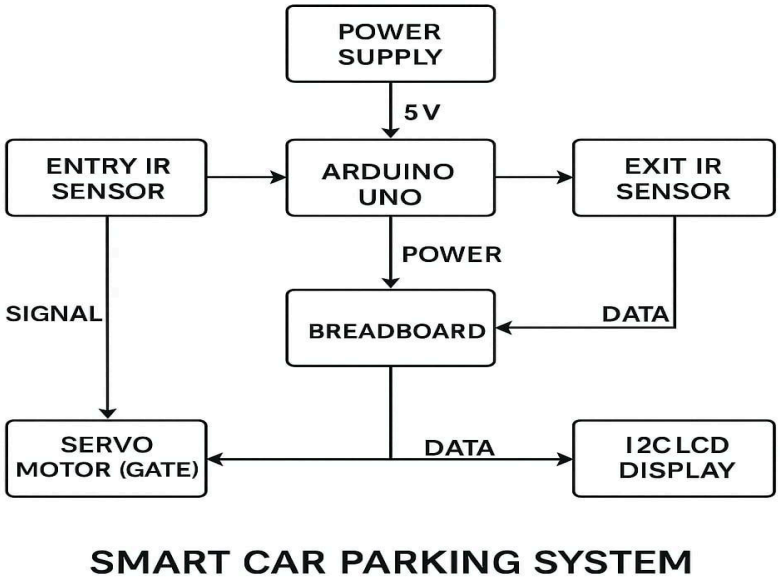
This project demonstrates a Smart Car Parking System designed using Arduino to automate vehicle entry and exit while monitoring slot availability. The core components used include IR sensors for car detection, a servo motor for gate control, and an I2C-based 16x2 LCD for real-time slot updates. The system works by detecting incoming or outgoing vehicles through IR sensors, updating occupancy status, and opening or closing the gate accordingly using a servo motor. Communication between devices is managed via digital pins and I2C interfacing. This system addresses real-world problems such as inefficient parking and congestion, especially in urban areas or commercial lots. With a clear display and automatic control, the setup minimizes human intervention and optimizes space utilization, making it a practical solution for modern parking management.

Introduction

In growing urban environments, efficient vehicle parking has become a major concern due to increased vehicle ownership and limited space. The Smart Car Parking System was developed to address this challenge by creating an automated and intelligent parking solution. We chose this project to explore real-world embedded system applications and improve our skills in sensor integration and actuator control. The primary objective is to manage parking occupancy and automate gate operations to reduce manual effort and improve system efficiency.

System Overview

Block Diagram:



SMART CAR PARKING SYSTEM

Architecture Explanation:

- IR Sensors detect vehicle presence at the entry and exit.
- Arduino Uno processes signals and controls logic.
- Servo Motor operates the gate.
- LCD (I2C) displays free and occupied slots.

Hardware Components

Component	Specification	Quantity	Purpose	Interfacing
Arduino Uno	ATmega328P, 5V logic	1	Central processing/ controller	Digital I/O
IR Sensor	Infrared, digital output	2	Detect vehicle at entry/exit	Digital IN
Servo Motor	SG90, 0-180°	1	Gate movement control	PWM
LCD Display	16x2, I2C module (0x27)	1	Show slot availability	I2C
Jumper Wires	Male-to-male/female	–	Circuit connections	–
Breadboard	–	1	Circuit prototyping	–

Software Details

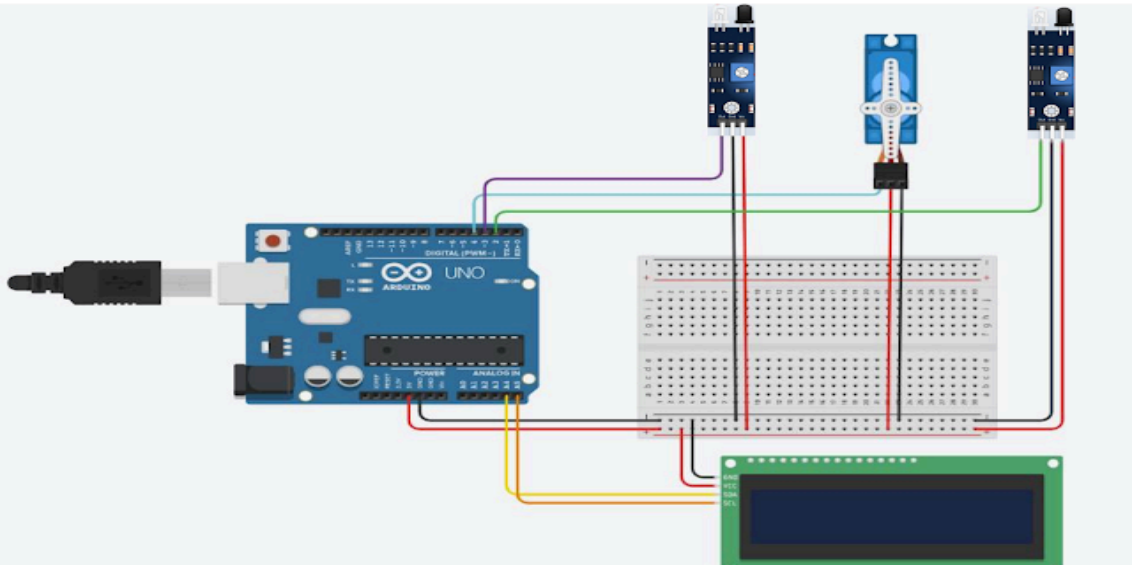
IDE Used: Arduino IDE
Libraries Included:

- Wire.h
- LiquidCrystal_I2C.h
- Servo.h

Core Logic Overview:

Entry IR sensor triggers check for free slots.
If available, gate opens (servo at 90°), car enters, counter increases.
LCD updates count of free and occupied slots.
Similar logic applies to the exit sensor, decrementing the counter.

Circuit Diagram



Label:

- IR sensors to pins 2 & 3
- Servo to pin 9
- LCD SDA & SCL to A4 & A5 respectively
- VCC and GND appropriately

Code Explanation

```
if (digitalRead(entrySensor) == LOW) {
 if (occupiedSlots < totalSlots) {
   openGate();
   occupiedSlots++;
   updateLCD();
   delay(2000);
```

```
    closeGate();
  }
}
```

Explanation:

This block checks if a vehicle is detected at the entry. If a slot is available, the gate opens, the slot count increases, the display updates, and the gate closes after a delay.

GitHub Link: https://github.com/monira1122/Smart-car-park

Testing & Observations

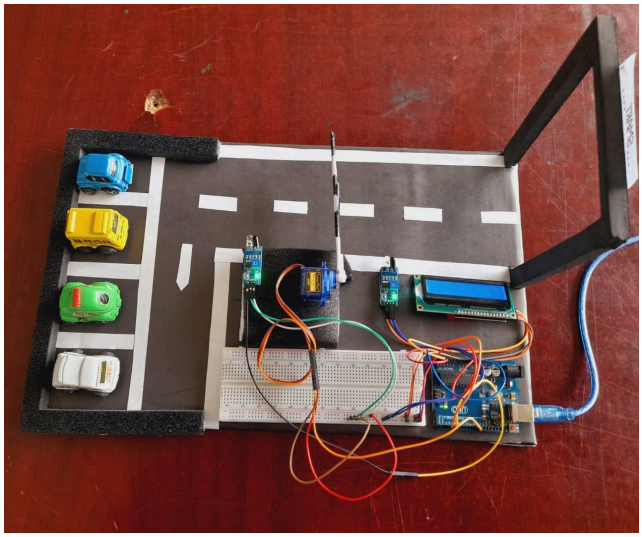
Test Case	Action	Expected Result	Observed Result	Pass/Fail
Vehicle enters	Block entry IR	Slot increases by 1	Works as expected	Pass
Vehicle exits	Block exit IR	Slot decreases by 1	Works as expected	Pass
Full	4 cars enter	Display	Correct	Pass

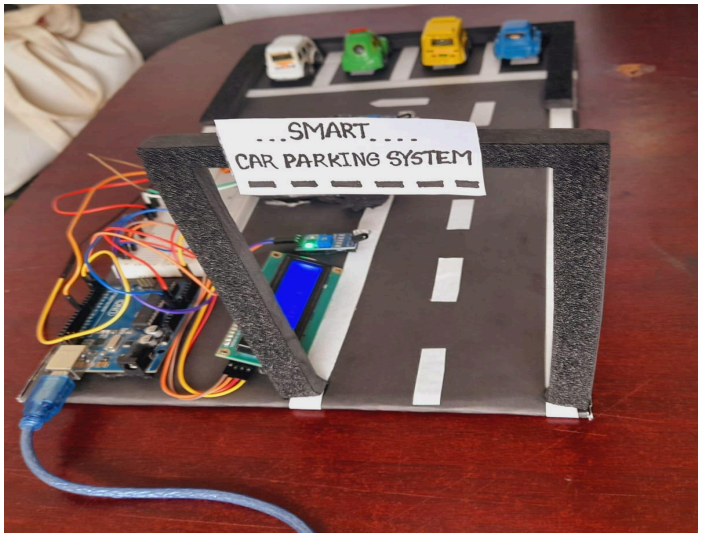
parking		shows “Parking Full”		

Problems Faced:

- Servo jittering → Solved using delay stabilization
- IR false triggers → Solved by adding small delay before reading

Photos:





Applications & Future Scope

Applications:

- Mall or office parking
- Hospital parking automation
- Residential societies

Limitations:

- Fixed slot count
- No authentication for cars

Improvements:

- Add RFID access
- Use ultrasonic sensors for better accuracy
- IoT integration to check status online

Conclusion

This project successfully demonstrated a low-cost, scalable smart car parking system. We gained practical experience in using sensors, actuators, and interfacing with displays. Through hands-on testing and debugging, we learned how to manage real-world problems like false triggering and timing. This project has strong relevance in smart city development and IoT-based automation.