

Rafik Hariri University	Spring 2025
College of Engineering	MECA542 Industrial and Manufacturing Control
Mechanical and Mechatronics Engineering Department	Project Topics and Deliverables

Automated Car Parking System

The aim of this project is to design and simulate a control system for an automated car parking system using a Programmable Logic Controller (PLC). The project will provide hands-on experience with real-world applications of PLCs and reinforce key concepts learned throughout the course.

Project Objectives

- Design and develop ladder logic for a PLC to control an automated car parking system.
- Simulate the car parking system operation.
- Integrate safety features into the control system.
- Document the project, including system design, ladder logic program, troubleshooting and simulation procedures.

System Description

The automated car parking system will consist of a multi-story parking structure with automated entry, parking, and retrieval of vehicles. Students will be responsible for defining the number of parking levels (min 3 levels) and the number of parking slots per level. The system will have the following simulated components:

- **Entry Gate:** Controlled barrier to allow or deny vehicle entry.
- **Exit Gate:** Controlled barrier to allow or deny vehicle exit.
- **Ticket Dispenser:** For issuing tickets with unique identifiers upon entry.
- **Parking Slot Sensors:** Sensors to detect the presence of a car in each parking slot.
- **Level Sensors:** Sensors to detect the position of the car transfer mechanism.
- **Car Transfer Mechanism:** A system of motors and conveyors or a lifting mechanism to move cars between levels and parking slots.
- **Payment Terminal:** To process parking fee payments.
- **Emergency Stop Buttons:** Located at various points to halt the system operation immediately in case of emergencies.

Ladder Logic Design

Students will develop the ladder logic program for the PLC to control the entire car parking system operation. Key functionalities include:

Entry Sequence:

- Detect vehicle presence at the entry gate.
- Dispense a ticket.

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- Open the entry gate.
- Detect vehicle entry and close the gate.

Parking Slot Allocation:

- Determine available parking slots.
- Direct the car transfer mechanism to the appropriate slot.

Car Transfer Control:

- Control the movement of the car transfer mechanism (e.g., conveyor or lifting system) to move cars to and from parking slots.

Exit Sequence:

- Accept ticket and payment.
- Direct the car transfer mechanism to retrieve the car.
- Open the exit gate.
- Detect vehicle exit and close the gate.

Parking Availability Monitoring:

- Update parking slot availability information.
- Display the number of available slots.

Payment Processing:

- Generate payments.

Safety features:

- The PLC will integrate emergency stop functionality, prevent car transfer with obstructions, and ensure safe gate operation.

Project Deliverables

- **System Design Document:** A document outlining the elevator system specifications, including the number of floors, components used, and sensor/button locations.
- **Ladder Logic Program:** The complete ladder logic program developed in the PLC software, with detailed comments explaining each functionality.
- **Simulation Report:** A report documenting the simulation results, including successful operation, troubleshooting of potential issues, and identified areas for improvement.
- **Project Presentation:** A presentation summarizing the project design, ladder logic program, and key learnings from the simulation process.

Project Constraints

- **Group Members:** Preferred 2 students. 3 are also allowed. 4 is strictly forbidden!
- **Deadline for Completion:** Last week of Spring 2025 semester.

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Assessment Criteria

- Functionality of the ladder logic program in meeting the project objectives
- Integration of safety features
- Clarity and efficiency of the ladder logic code
- Documentation quality
- Presentation effectiveness

Additional Considerations

- Students can explore implementing additional features like priority parking for certain vehicles or any other beneficial features.