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Smart Car Parking System using PLC

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Abstract: *This project involves the development of a system tailored for multilevel parking facilities. The system aims to streamline the parking process by providing real-time information to drivers upon entry. Outside the parking area, a LED indicator is used which displays the available parking spots along with their corresponding numbers. Additionally, the system keeps track of the total number of parking spots available, updating the LED indicator accordingly. By presenting drivers with specific vacant spot numbers upon arrival, the system minimizes the time spent searching for a parking space, ultimately enhancing efficiency and convenience for drivers.*

Keywords: PLC, Arduino, IR sensor, Servo Motor, Ladder Diagram.

I. INTRODUCTION

In today's era, vehicle ownership is ubiquitous, particularly in densely populated cities like Delhi, Mumbai, and Bangalore. Consequently, parking issues have become increasingly prevalent, especially in locations such as malls, public parking areas, cinemas, commercial buildings, and hospitals. The challenges faced by drivers in public parking areas include waiting in queues at entry points, spending time searching for vacant parking spots, and dealing with the inconvenience of availing the first free hour of parking while struggling to find a spot.

Furthermore, accurately assessing the current occupancy of a parking area or determining the number of available spots poses additional difficulties. To address these issues, our project aims to develop an automated system that efficiently guides drivers to available parking spaces. This system not only reduces parking time but also provides real-time data on the total number of parked cars and available parking spots. Additionally, it boasts easy installation, minimal maintenance requirements, and affordability. By streamlining the parking process, this system will help alleviate waiting queues at parking facilities.

1.1 Concept

The primary objective of this project is to simplify the parking process for both drivers and parking area operators. It encompasses a comprehensive exploration of various industrial automation components such as PLCs, HMIs, Arduino boards, sensors, and other related instruments. Additionally, the project involves gaining foundational knowledge of panel box wiring techniques. Specifically, the project features a simulated parking setup capable of accommodating up to 10 cars simultaneously, complete with distinct entry and exit points for vehicles.

II. DESCRIPTION OF SYSTEM

2.1 Hardware Required

1. PLC: selec TWIX-2

Used to keep the record of the number of cars and to indicate the available parking slots on LED.
Language: Ladder diagram
Software: SELPRO

2. Sensor: IR Sensor

Used to check the condition of the parking slot and give the signal to PLC according to the parking situation.

3. Arduino Board

Used to control the movement of barricades at the entry and exit point.

4. Servo Motor

It is a 3-pin servo motor. Which is used to lift the barricade up and down at entry and exit point.

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5. 4 Relay Module

Used for switching ON the LEDs.

6. LEDs

Use to indicate the parking situation i.e. When the LED turns ON the parking slot is empty.

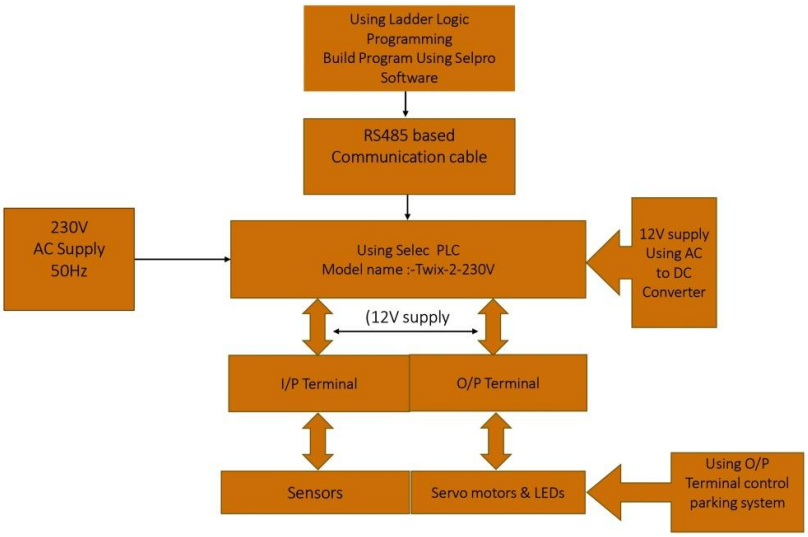

Fig.1: Flow of Work

2.2 How it works?

IR sensors are installed at every parking slot and entry and exit point to detect the presence of vehicles, transmitting signals to the PLC. Upon receiving these signals, the PLC accurately tallies the number of parked cars and gives the status to an LED indicator which will be installed outside of the parking area, which shows the current condition of each slot whether the slot is occupied or empty in the parking area as shown in fig.2.

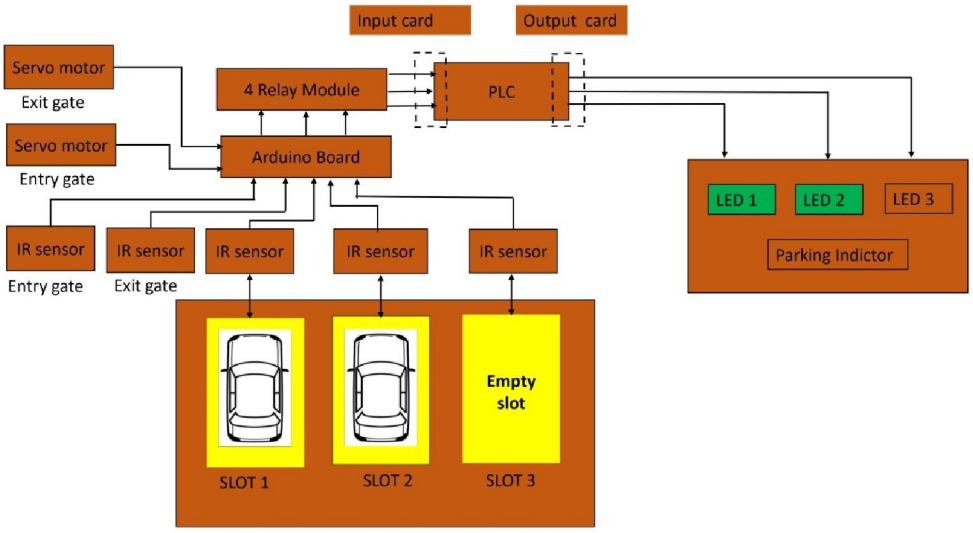

Fig. 2: Block diagram of arduino to PLC

The car will arrive at the entry gate, and the driver will see the LED indicator situated outside the parking area where available as well as occupied parking slots will be displayed. Then the driver will decide where to park his/her car. As the car moves forward and reaches near the entry gate, the IR sensor will detect the car, and the barricade will open with the help of a servo motor. As the car enters inside, the barricade will close automatically. The driver will park his/her car at the decided slot. For example, if he/she has parked the car in slot no. 1, the IR sensor will detect the car,

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and the LED indicator for slot 1 will glow, indicating that slot 1 is occupied. When the car leaves slot 1, the LED at the LED indicator will turn off. When the car leaves the slot to exit the parking area, it will reach the exit point where the IR sensor will detect the car, and the barricade will open with the help of a servo motor.

2.3 Working of Arduino

For the movement of the barricade when the car enters or exits there is a servo motor connected with an arduino uno board. When the car arrives at the entry or exit point there is an IR sensor which will detect the car.

2.4 PLC Ladder Logic

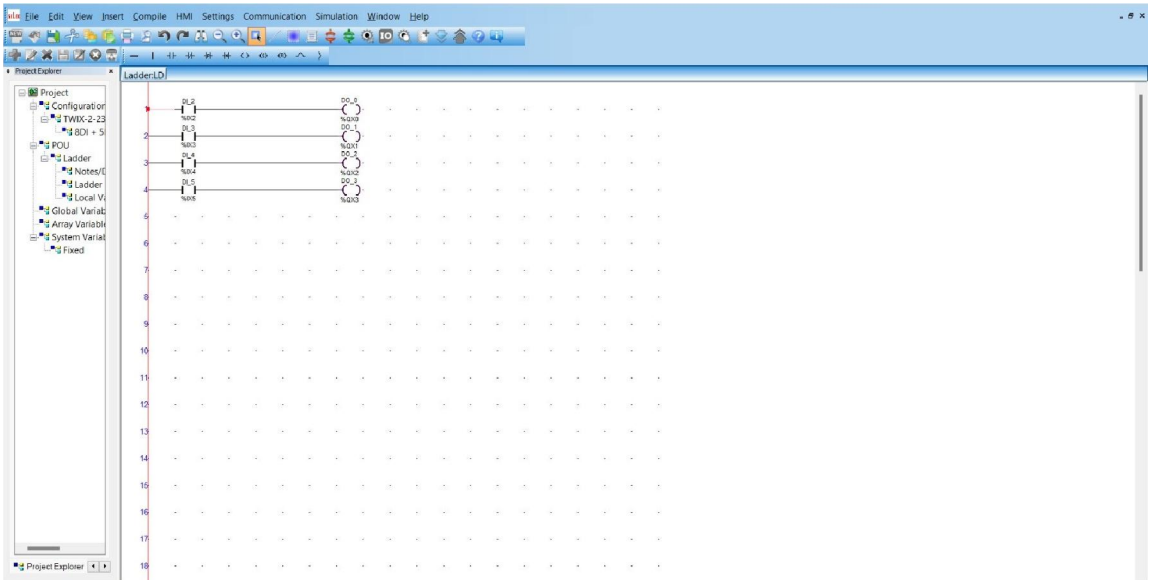

Fig.3: PLC Ladder Diagram

Fig. 3 shows a basic ladder diagram developed for a smart car parking system. This ladder diagram is designed in SELPRO software version 5.4.1. It is a four-line ladder diagram because there are four LEDs in the LED indicator as outputs in our paper. The symbols named D11, D12, D13, D14 represent normally open switches. The symbols named D0-0, D0-1, D0-2, D0-3 are used for output purposes. The straight lines shown between the symbols are known as rungs. The symbols named D11, D12, D13, D14 represent digital inputs where IR sensors are connected, and the symbols named D0-0, D0-1, D0-2, D0-3 represent digital outputs where LEDs are connected.

III. METHODOLOGY

This paper proposes a smart car parking system for multilevel parking facilities to enhance efficiency and convenience for drivers by providing real-time information on available parking spots. Importance of the project in optimizing parking processes and minimizing search time for drivers. Explanation of the LED indicator system and its role in displaying available parking spots. Description of the overall system architecture, including hardware components (sensors, LEDs, relay module).Explanation of how the system interacts with parking infrastructure.

Detailed specifications of the hardware components required for the system, including sensors for detecting occupancy, LED display panels, and microcontroller units for data processing. Installation procedures for sensors at each parking spot, ensuring accurate detection of vehicle presence. Configuration of LED display panels at strategic locations for maximum visibility to drivers. Development of algorithms for real-time data processing, available parking spots and updating the LED indicator accordingly. Implementation of a user-friendly interface for drivers to access parking spot information upon entry.

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IV. RESULTS AND DISCUSSION

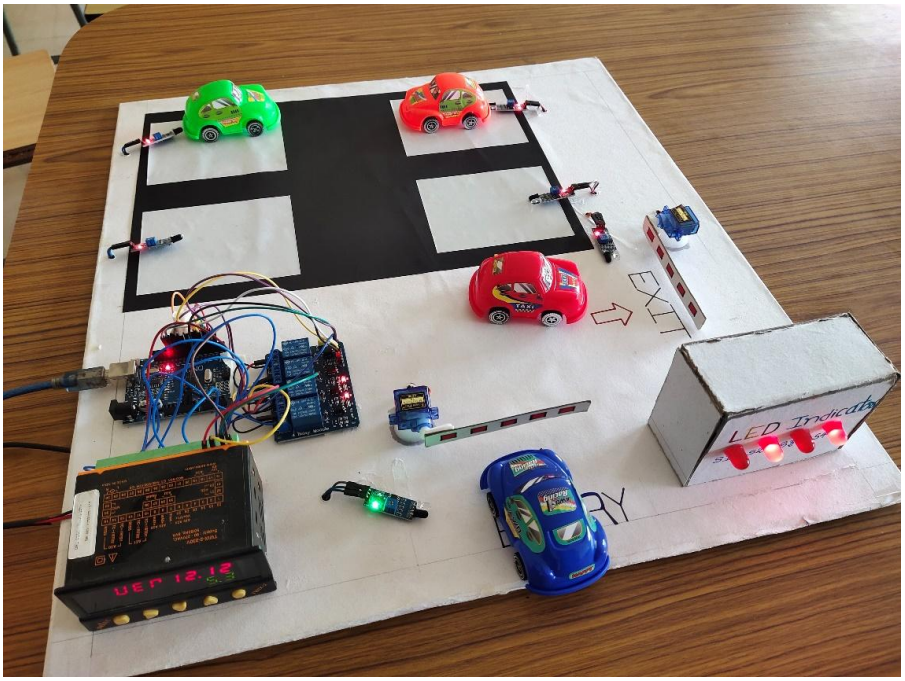

Fig.4: Hardware Prototype

Hardware prototype is shown in fig.4. The LED indicator situated outside the parking area effectively displays the availability status of parking slots in real-time. This feature empowers drivers with essential information to make informed decisions regarding parking space selection. By providing visibility into both available and occupied parking slots, the LED indicator enhances efficiency and reduces the time taken for drivers to find suitable parking spaces.

The integration of IR sensors for automatic gate control at entry and exit points has streamlined the vehicle entry and exit process. Upon detecting a vehicle approaching the entry gate, the barricade opens automatically, facilitating seamless entry into the parking facility. Similarly, when a vehicle approaches the exit point, the IR sensor triggers the opening of the barricade, enabling smooth egress from the parking area. This automation minimizes the need for manual intervention, thereby improving operational efficiency. The use of IR sensors for occupancy detection within parking slots ensures accurate tracking of parked vehicles. When a car occupies a slot, the corresponding LED indicator illuminates, indicating its occupancy status. This functionality enables effective slot management, allowing parking operators to monitor occupancy levels and allocate available spaces efficiently. It also enhances user experience by providing visibility into parking availability in real-time.The seamless integration of real-time parking information display and automatic gate control using IR sensor enhances the overall user experience and convenience for drivers. Drivers no longer need to manually search for available parking spaces or interact with gate attendants, resulting in a hassle-free parking experience.

V. CONCLUSION

This project demonstrates that we can effectively diminish queues outside parking areas while also optimizing the time spent by drivers during parking of vehicles. Moreover, it displays the number of vehicles parked inside the parking area.

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