



STREAMLINING PARKING MANAGEMENT: A LOGICAL APPROACH TO AUTOMATED CAR PARKING

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Abstract: In today's era, automobiles serve as a primary means of transportation. Consequently, the demand for parking facilities, especially in large shopping malls, is significant. To address this need efficiently, automation is a viable solution. The objective of this project is to develop software for an automated parking system. This system will autonomously manage gate operations and provide real-time information on the number of parked vehicles. When a driver approaches the gate, sensors will detect the vehicle, automatically opening the gate. A similar mechanism will be in place at the exit. Once the parking lot reaches full capacity, entry will be restricted until a space becomes available. The Automated Parking System employs a Programmable Logic Controller (PLC) for effective control and management

Index Terms - Programmable Logic Controller (PLC), Automated parking system, Automation

I. INTRODUCTION

With the population on the rise, residential areas have expanded, leading to increased human mobility in daily life. Consequently, the number of vehicles for transportation, particularly cars, is steadily growing. As a result, the demand for parking spaces, designated as parking lots, is escalating. In today's era of automation, there is a possibility to develop a straightforward and efficient parking system.^[1] Taking this concept into account, a software program has been developed to operate within a Programmable Logical Controller (PLC), designed to manage parking facilities. The programming is executed using CoDeSys software, employing a ladder diagram approach. The functionality of the system can be observed in the visualization section of the software. Using suitable PLC and appropriate sensors, new program can be generated.^[2]

This system will automatically monitor the entry and exit of cars through sensors and display the parking lot's status. Once the parking lot reaches full capacity, it will refrain from opening the gate and will only allow another car to enter once a space becomes available due to a car leaving.

II. LOGIC OF PROGRAM

Any program's development hinges on its underlying logic. Similarly, for the operation of the car parking system, a program will be created in CoDeSys software, utilizing a ladder diagram format. The logic behind the functionality of the parking system is elucidated based on the following diagram.

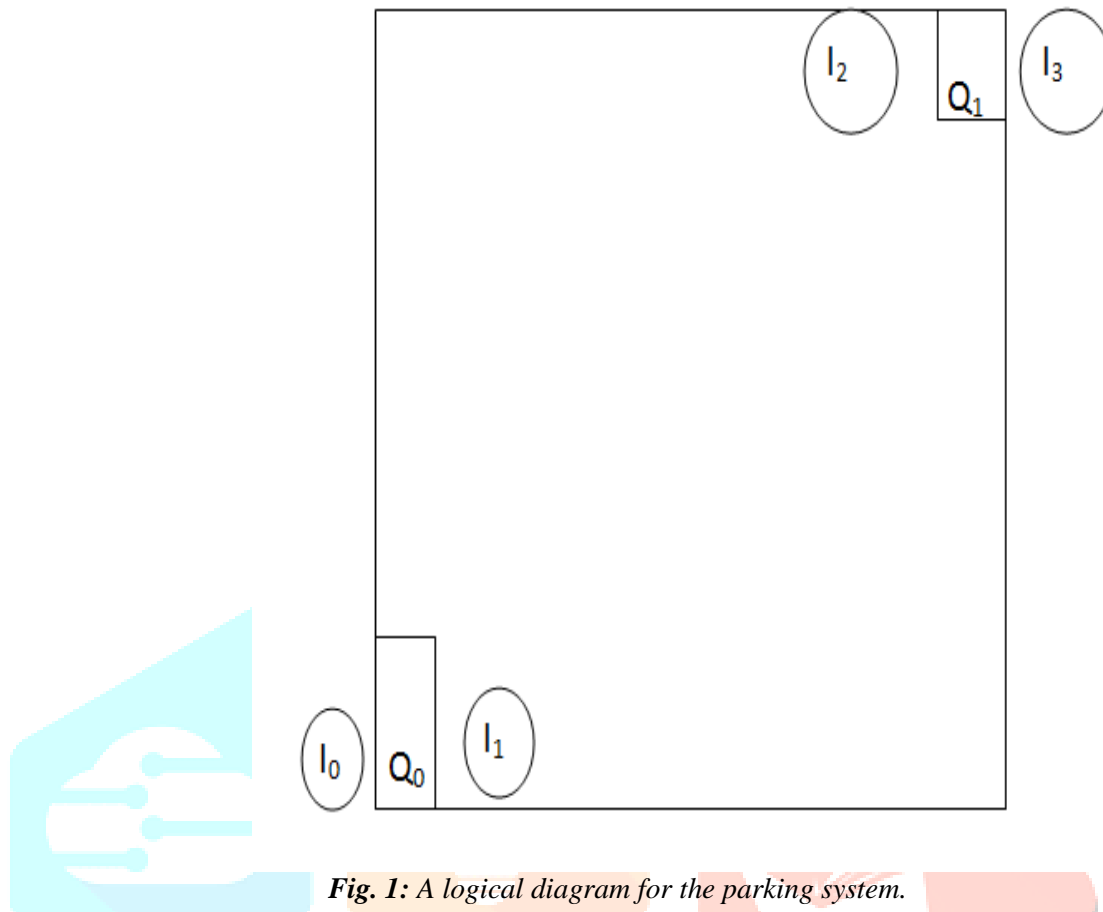


Fig. 1: A logical diagram for the parking system.

This diagram represents the logical flow of the parking system, illustrating the process from vehicle entry to exit, including gate operations, sensor detection, and lot occupancy management.

Here I_0 , I_1 , I_2 , I_3 represent the sensors that are used to sense the cars. These sensors send the signals to the PLC which will operate the gates. Here Q_0 , Q_1 represent the gates for the entry and exit respectively. The logic is explained below.

- I_0 ON, Q_0 OPEN
- I_1 OFF, Q_0 CLOSE
- I_1 OFF Count Up
- I_2 ON, Q_1 OPEN
- I_3 ON, Q_1 CLOSE
- I_3 OFF Count Down

III. SIMULATION OF PROGRAM

The visualization of the same program is done by clicking on the visualization option and then generating a visualized parking system. The visualization can be run by following specific commands, Visualization>Online>Login>Run. The visualization will be as under:-

Figure 1, 2, 3, 4, and 5 depict the cars currently occupying spaces within the parking lot. The program has been designed to accommodate a parking capacity of 5 cars. However, it can be adapted to accommodate a greater number of vehicles by adjusting the value associated with the preset value (PV) in the counter.

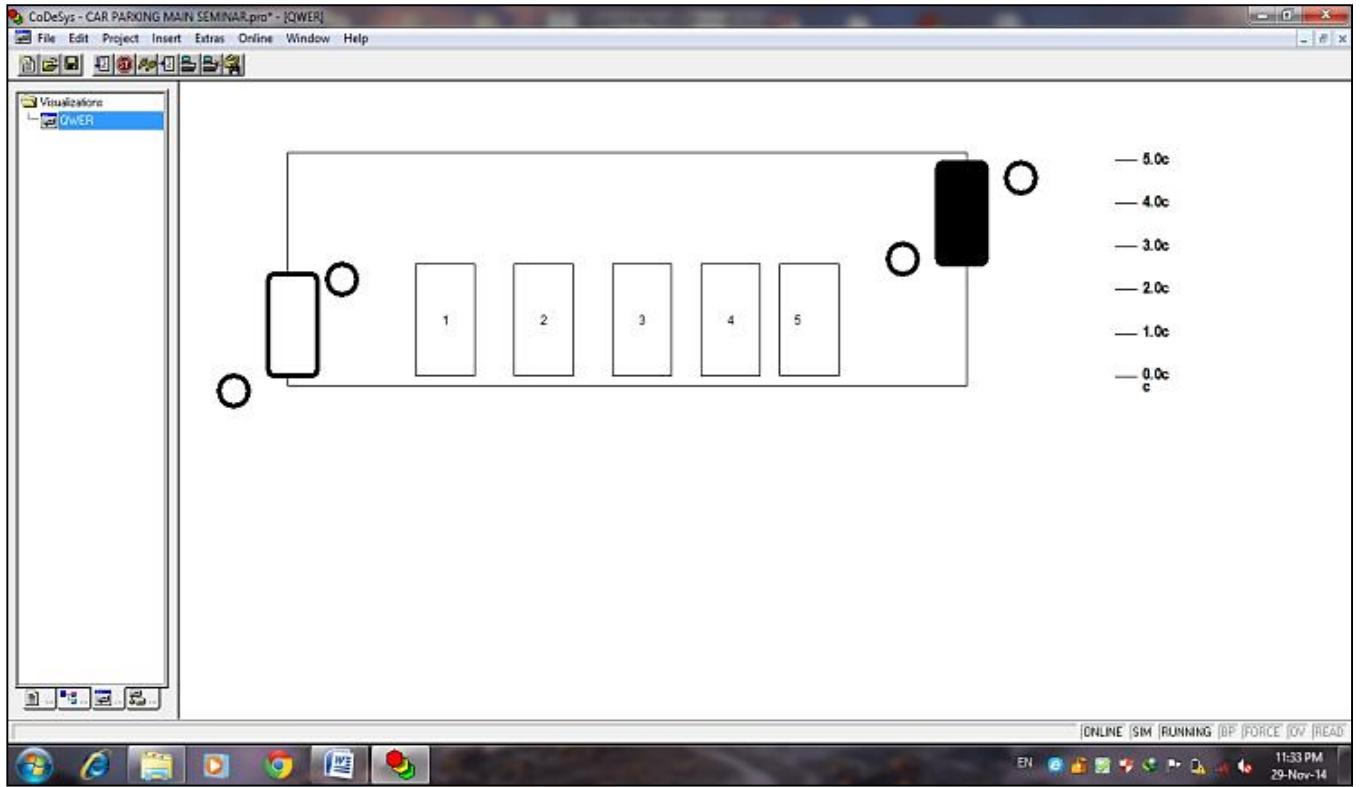


Fig. 2: Visualization for gate's opening

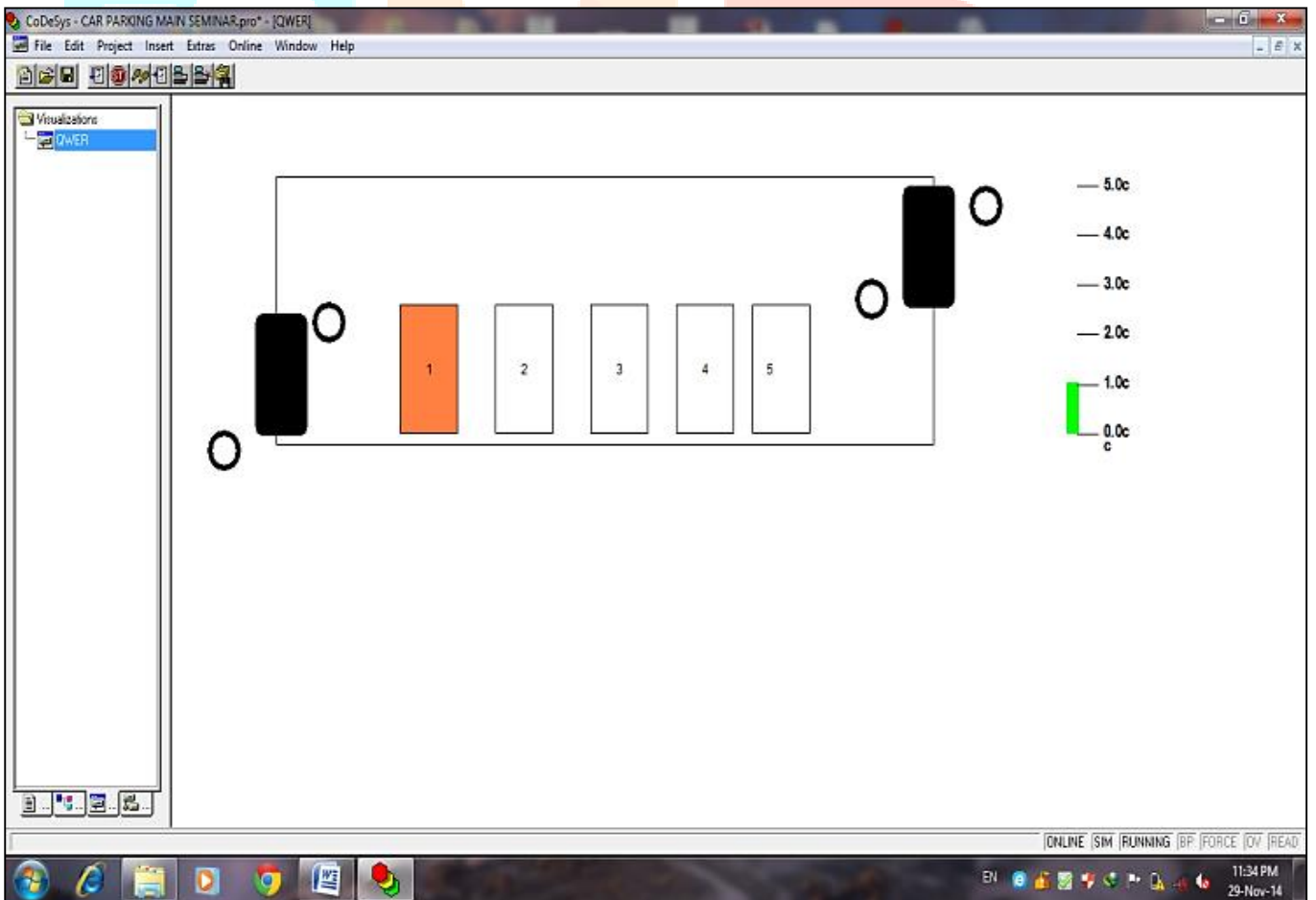


Fig. 3: Car's entry and counter display

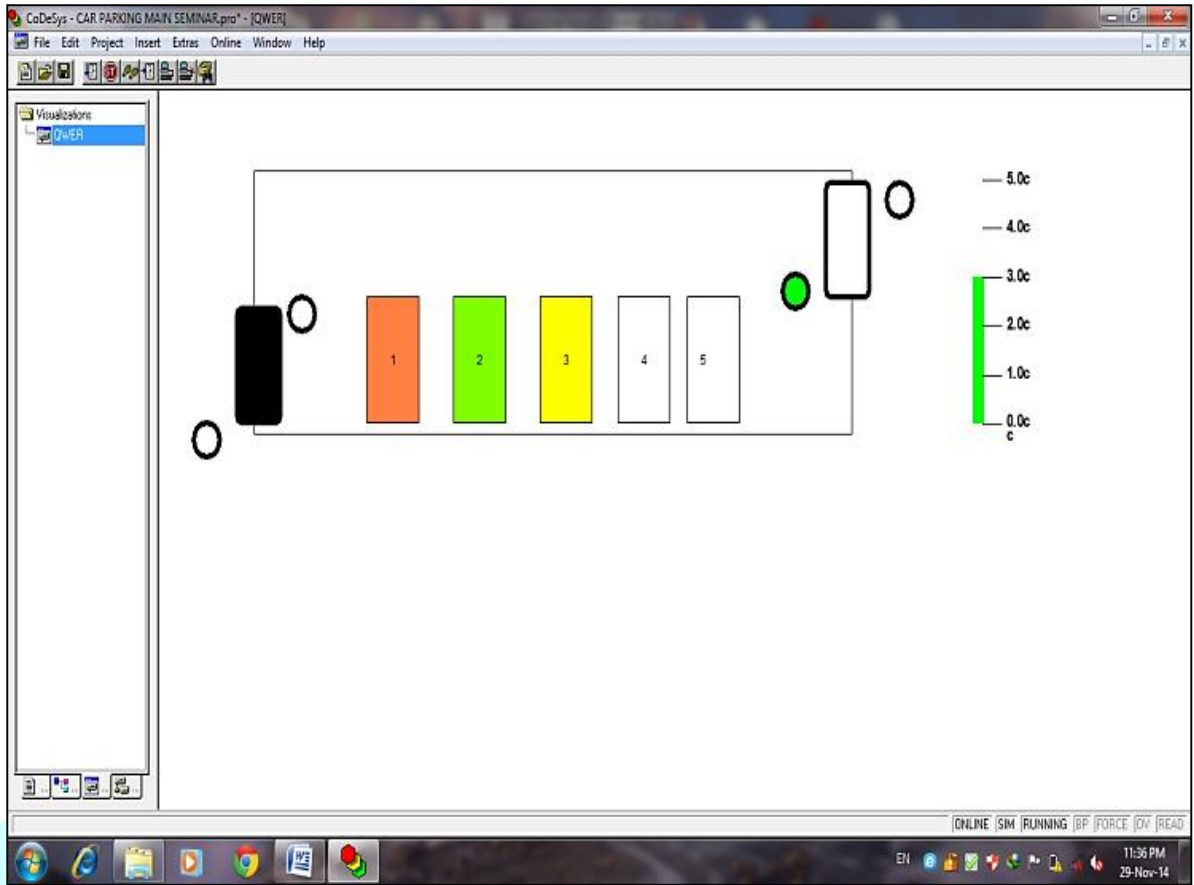


Fig. 4: Gate's opening and car's exit

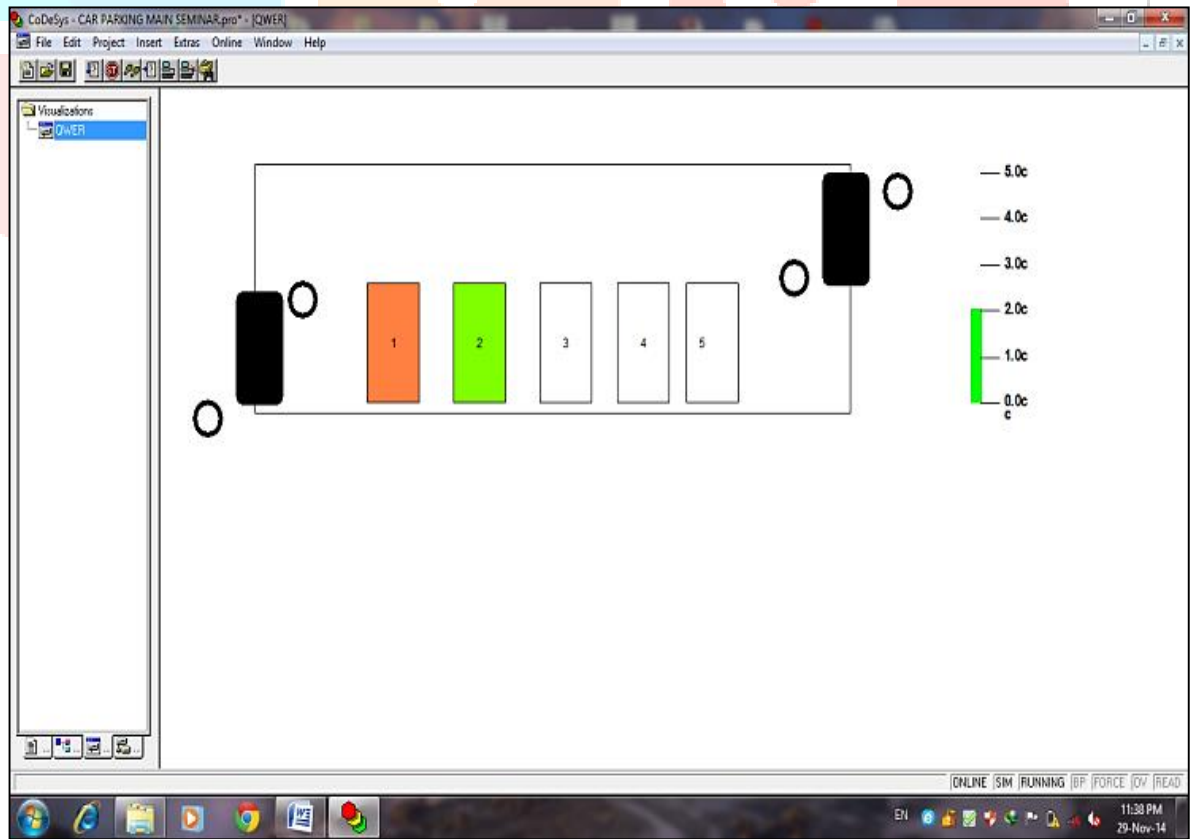


Fig. 5: Car's exit and down count

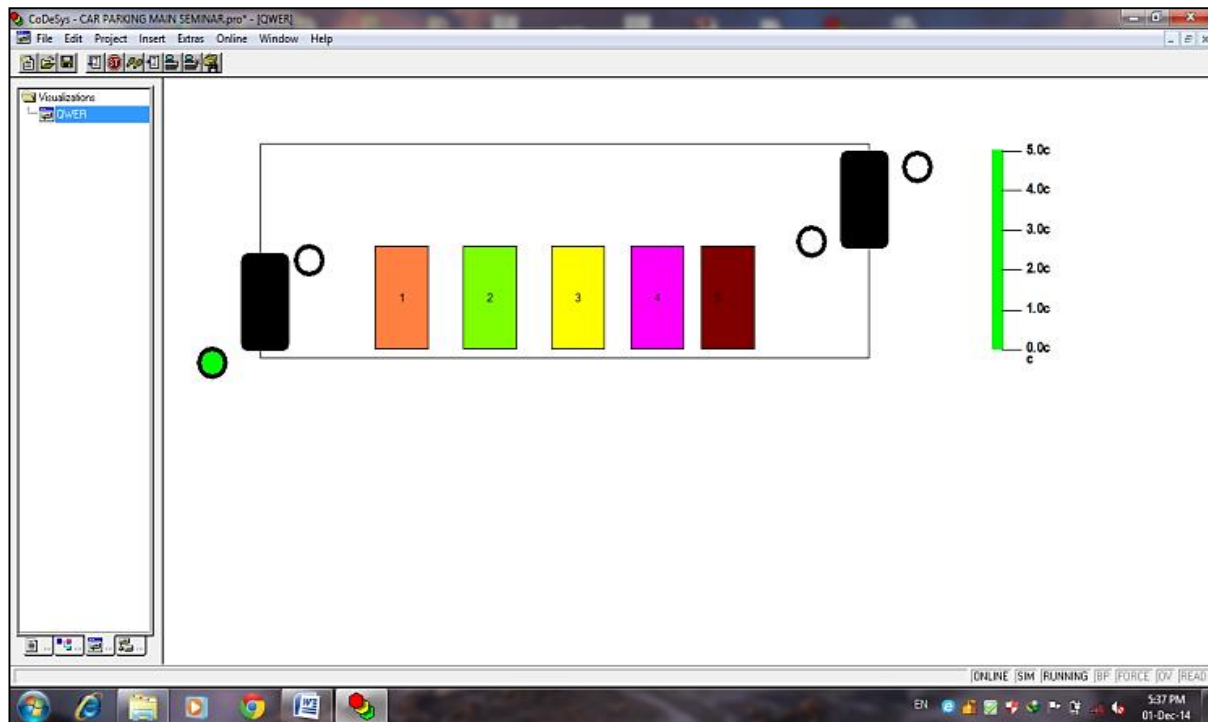


Fig. 6: Gate doesn't open when the lot is full

IV. CONCLUSION

The program aims for complete automation, making it not only efficient but also cost-effective. It's designed with simplicity and adaptability in mind, offering a logical solution for parking management. This investment is one-time, promising long-term time and cost savings. Moreover, the program serves as a foundational template for various types of automated parking systems, allowing for easy modifications and enhancements to incorporate additional features as needed.

V. FUTURE SCOPE

The current program is adaptable and can undergo further development and customization to suit various needs. For instance, it could be tailored for a fee collection system at toll plazas, card-based or registration number-based parking for residential complexes or high-rise buildings, and the management of parking facilities at malls, theaters, and shopping centers. Additionally, highly secure parking solutions could be implemented at government offices by incorporating high-speed cameras to capture both individuals and vehicle license plates. A key aspect for an optimal automated parking system is accurately calculating the parking lot's area and dividing it into smaller rectangles based on the dimensions of the largest vehicle to be accommodated. This approach helps to mitigate congestion within the parking area. However, the fundamental logic for gate operation remains consistent. Consequently, this program lays the groundwork for the development of customized car parking systems.

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