

Design and Simulation of a Multi-Level Automatic Car Parking System Using PLC by Eng. Guled Abdi Ahmed

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Abstract: this project presents design & simulation of PLC based, automatically controlled multi-level car parking system. The system is used to park large number of vehicles in least possible area. Doing this task in real life, requires very high technical instruments & control skills. The simulation is for one building of 3 floors & a ground floor with 2 doors (drive-in forward & drive-out forward). Each floor has one parking slot so this model is to accommodate 3 cars at a time (same area as for one car). Availability of space for parking is detected by IR sensors placed on the slots. A motor controlled elevator is used to lift car up & down. The elevator status is indicated by LED placed on the ground floor. Since building is 3 floors LS is mounted on each floor to ensure correct stopping of elevator. The controlling platforms & checking of available spaces is done by PLC. For retrieving of car keyboard is interfaced with the model for entering slot number. To save time & energy used to park vehicles, all considerations are made to decrease the number of items to be used in this system. These items are: PLC, Display section, Keyboard, Lift and motor section, Sensor section, Pneumatic system, power and supply.

Introduction: Car parking problems in crowded cities is major concern due to limited availability of parking spaces & complicated management & traffic control tasks. Now, there are many types of smart parking systems. This Project is an example for design of a Smart Car parking system using recent concepts of sequential automatic control by PLC System that uses selective/parallel branching. Next Fig. shows the concepts of a Smart Parking multi-store building.



<u>Parking Steps</u>: The car in red is to unpark. PLC Smart Parking System needs to be automatically instructed & controlled do following actions (using proper sensors, mech., Hydraulic/Pneumatic & electric Input/output equipment): 1-Convey pallet in same level with red car slides to fully back of red car, then the conveyor conveys a Mini message: red car to the pallet. 2-The convey pallet with the red car slides to the adjacent position with elevator, and then puts red car on elevator. 3-Elevator shift down to ground level to the exit of the car (center figure). 4-The convey pallet conveys the car to the parking room. 5-The rotation pallet has to rotate to turn the car, to ensure the front of the car is outward. 6-The red car can now leave parking room.

<u>Features of this System include:</u> A-There is no need of ramp to save land area & vertical parking capacity density is big to take full use of available space. B-Park/unpark is automatic, easy & is done by button press. C-The most suitable building place is underground garage with long laneway & not too many levels. D-It is equipped with all needed safety protection devices to ensure safety & reliability to avoid accidents and addition to fire fighting protection. E- This system adopts photoelectric safety inspection to control dimension & quantity of parking cars. F- This system does not, generally, need forced ventilation and there is no large area lighting so it shall also save energy.

Project Objectives: Project main idea is based on an automatic multi storied car parking system. The concept of this system is driven by 2 factors: need for parking spaces & scarcity of available land. To achieve the target, it's going to: 1. Design an automated multi storied car park system with maximum parking spaces and minimum of land capacity. 2. Reduce car parking and mechanized car parking process to be more convenient process for Clients.

3rd Floor is Full

n empty Space

park in 2nd Floor conveyor

1st Floor is Full

- 11

.Systematic flow chart approach

3. Apply PLC technology in controlling parking model & in programming the PLC using the Tri-Logic software.

Moto

IR Receiver circuit

IR Sensor

Parking Room parking is detected by IR sensor which placed on the slots. A motor controlled elevator is used to lift car up & down. in Ground Floor Entrance Exit The elevator status is indicated by LED placed on ground floor. Since building is 3 floors, LS is mounted on each floor to ensure correct stopping of elevator. The controlling platforms and checking available spaces is done by PLC. **Block Diagram of PLC System Programming Languages** Lift Motor Power supply Displav Assembly Drive Sensor Graphical Languages Textural Languages 0 m Central u 0 Car Т processing 0 Parking/Retrieving Ladder Sequential Functional Structured Instruction unit (CPU) PLC Function Chart Block Diagram D Diagram Text List Memory u Standard IEC 61131 PLC programing Languages Pneumatic Push/Pull Limit program data Input Initial step in which the Start Output System Car Slot Switch system is ready to start ROW 1 sensing Optical A load Transition condition Optical Isolation devices devices Isolation State/step output Block diagram of car parking system Programming device Transition condition Understand the requirement of the current system ROW4 Final step SFC COL1 COL 3 Stop List steps in general flow of the process Keyboard interface with PLC aa+ b+ Translate the steps into a ladder diagram \diamond \diamond Display section One of the car parking status Connect all the I/O points of the system Check all I/O connections Program the desired ladder diagram into PLC Simulate the program and debug the software **Push-button Switches** Push/Pull ☆☆☆ Modify the Catch/Release ☆△☆ If code Obstacle F3 Modify the 3rd Floor If code program P3 program F2 **IR** reflected Q1 2nd Floor BC55 P2 F1 Connect all input and output devices to PLC 1st Floor Check all I/O connections R2 P1 Sensor 470 Check all I/O connections G Lift **IR** emitted D Ŧ **Description of**

the flow chart

As in next fig., this project will is designed for a building of 3 floors & ground with two doors, drive- in forward and drive-out forward. Each floor has one slot so this model is to accommodate 3 cars at a time. Availability of space for

