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DESIGN AND TESTING OF AUTOMATIC CAR PARKING USING PUZZLE LOGIC

[1]Miss. Gaikwad Tanuja Kalyan, [2]Miss. Gaikwad Ankita Dattatraya, [3]Miss. Ware Aakanksha Vasant, [4]Prof. Gawali Ghanshyam D.

[1]UG Scholar, Electrical Engg., Dept. HSBPVT'S GOI Faculty of Engineering, Kashti
[2]UG Scholar, Electrical Engg., Dept. HSBPVT'S GOI Faculty of Engineering, Kashti
[3]UG Scholar, Electrical Engg., Dept. HSBPVT'S GOI Faculty of Engineering, Kashti
[4]Asst. Prof., Electrical Engg., Dept. HSBPVT'S GOI Faculty of Engineering, Kashti
aakankshaware2004@gmail.com

ABSTRACT - Parking shortage in residential and commercial locations has become a major issue as urbanization rises, necessitating creative, space-saving solutions. In order to maximize car stacking in smaller areas, this study suggests an intelligent, puzzle-based parking system that makes use of a fuzzy Logic Controller (FLC). In contrast to traditional parking, the suggested solution uses a modular 2D/3D matrix layout in which automated lifts are used to rearrange automobiles in order to optimize maximum density. Retrieval times are decreased by using the FLC to control slot allocation based on factors like vehicle dimensions and entry proximity. In order to address the requirement for high-density parking, this study outlines the design and development of an automated multilevel puzzle parking system.

To reduce parking and urban traffic congestion, intelligent parking technologies are crucial. shortages. This study presents a smart puzzle-based parking system that uses fuzzy logic control to maximize parking space use. The development of intelligent parking systems with improved space use and operating efficiency is required due to the fast increase in urban vehicle density. The design and implementation of an autonomous parking system based on puzzle logic for the best possible vehicle layout in confined spaces are presented in this study. For real-time vehicle identification, positioning, and movement control, proximity sensors are interfaced with a microcontroller-based control architecture.

I. INTRODUCTION

During the prototype's flowchart. To start the system, flip the switch on. After the system is turned on, the vehicle advances until it finds a parking spot. The system is prepared to reverse

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and then reverse into the parking place if it has located a suitable spot. An impediment can be detected by the car's rear infrared sensor.

BLOCK DIAGRAM DESCRIPTION

5.1 POWER SUPPLY:-

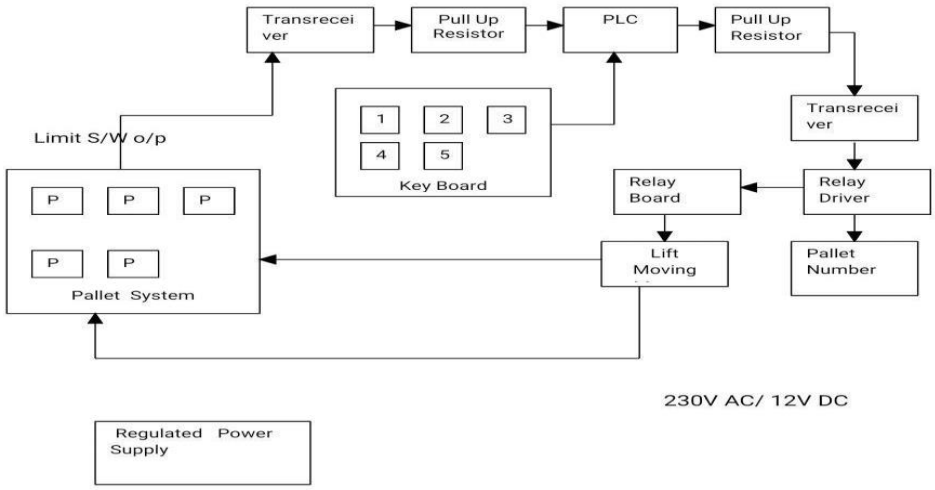

Fig 5.1:- Block Diagram of the PLC Based Automatic Car parking Systems

II. FUZZY LOGIC TOOLS

Fuzzy logic toolbox is used to build a membership function of the Fuzzy Inference System (FIS). Membership function of input; which are front sensor 4 (S4) (0, 1), rear sensor 2 (S2) (0, 1), two right-sided sensors for the distance and decision input with distance (near:

N, middle: M, far: F), and decision (front, rear), while two output variables are steering (left: L, center: C, right: R) and direction (reverse: RV, stop: S, forward: FW), are shown as in Table I.

Limit Switch Status	Relay Status	Motor Status
U1=0v	R1=OFF	M1=OFF
D1=5v	R2=OFF	
U2=0v	R3=OFF	M2=OFF
D2=5v	R5=OFF	
U3=0v	R5==OFF	M3=OFF
D3=5v	R6=OFF	
L1=0v	R7=OFF	M4=OFF
R1=5v	R8=0FF	
L2=0v	R9=OFF	M5=OFF
R2=5v	R10=OFF	

Table1. Test conditions

Limit switch status	Relay Status	Motor Status
U1=5v	RL1=ON	M1=ON
D1=0v	RL2=OFF	
u2=0v	RL3= OFF	M2=OFF
D2=5v	RL4= OFF	
U3=0v	RL5= OFF	M3=OFF
D3=5v	RL6= OFF	
L1=5v	RL7=ON	M4=ON
R1=0v	RL8= OFF	
L2=5v	RL9= OFF	M5=ON
R2=0v	RL10= OFF	

Table2 Pallet condition when P1 is pressed with respect to the home

1. A puzzle-based parking lot

The mechanical assembly is consisting of pallets up and 2 pallets down leaving one place empty for puzzling. The cars are parked automatically with belts pu;;eys systems. The plenty cars can be parked in this fashion.

When a particular particular pallet key number is pressed by the car holder, the signal goes to micro controller via transceiver. Before taking the decision, it checks wheather route for the car which is accepted to come down is free or not. And if not abstructing pallets are too cleared first. It searches for the output to go high and thus energizing the particular relay. The relay drives the motor in forward and reverse direction and also in up and down motion

Example: Upper layer consist of three pallets and lower layer with two pallets, leaving one place empty I/f user has parked his car in pallet one then he will press key P1 from keyboard which will be given to micro controller through input port.

Thus the input also consists of signal from limit switch from the mechanical assembly. The conditions of limit switches are according to initial condition. The limit switch is closed it will give logic zero (0) else logic one (1).

The initial motor M5 will start to move pallet five to right side R2 and will make R3=0 to closed limit switch and when the switch is closed motor M4 will start to bring pallet P4 to R1 position which will finally to given pallet one and bring to down. The user will gate the car out when he will see the LED indication. Thus, RL1 is energized finally to move motor M1 in forword direction.

2. Designing a large parking lot

We can easily calculate the number of cars in a small parking lot using the exact graph method shown in Section 2. However, as the size of the parking lot increases, the state space explodes, e.g., a 5 × 5 parking lot graph has 2.6 million nodes. Exploring such a large state space is computationally expensive. Thus, we need an efficient method to overcome this difficulty.

1.1. Limited egress design

From the parking structure shown in Fig. X, we observe that the system consists of three vertical parking columns and five parking platforms. The parking positions are monitored using sensors, and a fuzzy logic controller determines the availability of parking spaces. Based on the sensor inputs, the controller allocates the nearest available parking slot and controls the vertical movement of the parking platform. Using this approach, a maximum of five cars can be parked efficiently within a compact parking area. This method reduces parking time, improves space utilization, and minimizes driver effort.

The parking system continuously monitors all five parking slots using proximity sensors.

When a vehicle arrives at the entry point, the sensors detect the occupancy status of each parking platform.

The fuzzy logic controller processes the sensor data and determines the most suitable

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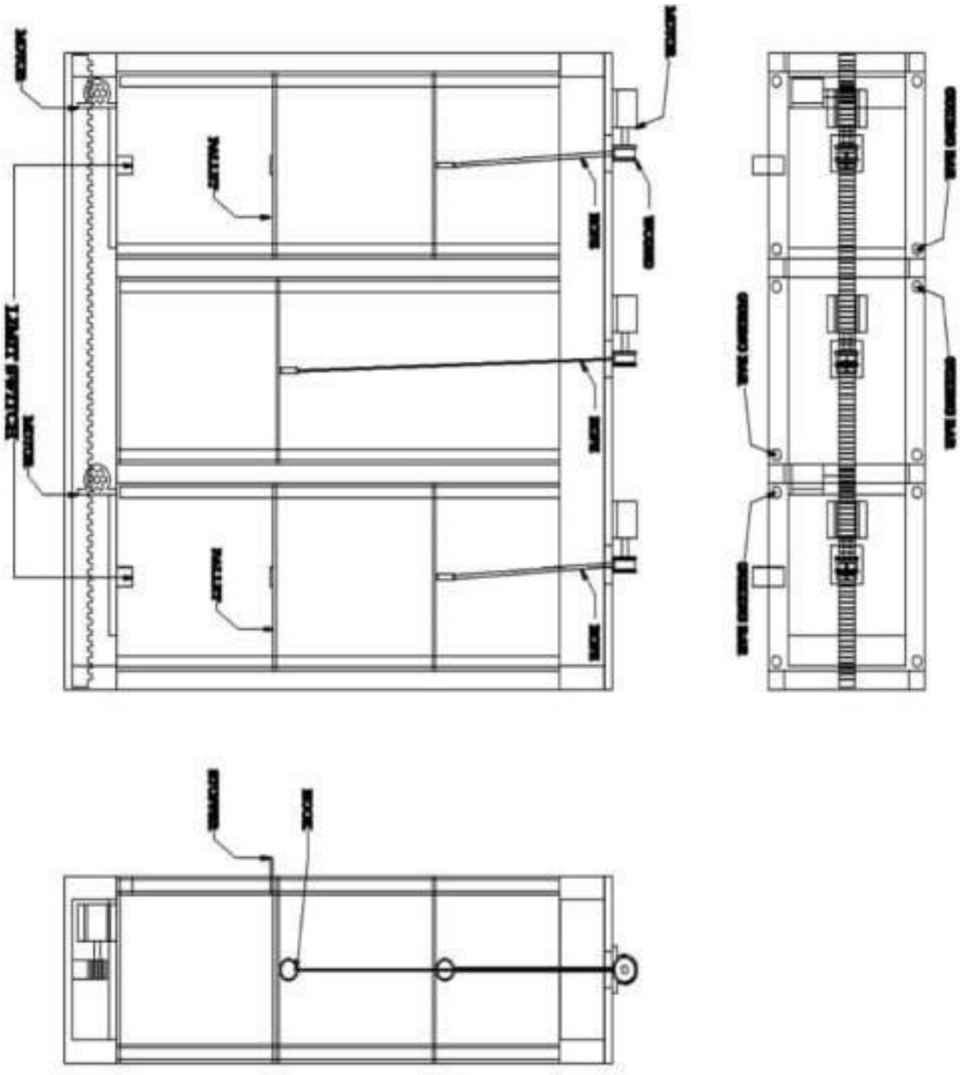
vacant slot.

The empty platform is aligned with the entry level through the vertical lifting mechanism.

The vehicle is moved onto the assigned platform and stored in the corresponding parking position.

This process is repeated until all five parking slots are occupied.

During vehicle retrieval, the fuzzy logic controller identifies the requested vehicle location and brings the corresponding platform to the ground level. The parking status is updated automatically after every parking and retrieval operation.



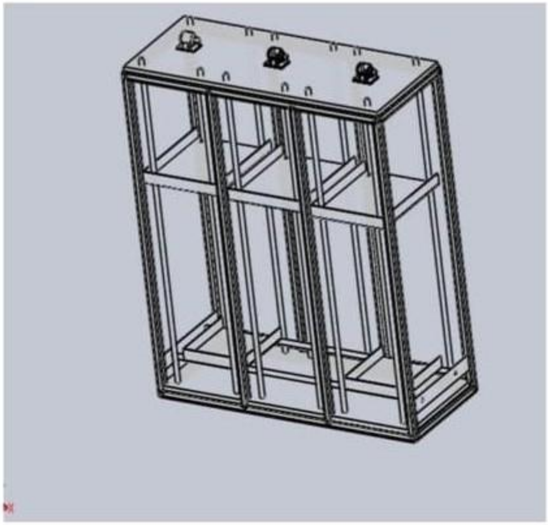
1.2. Parking density

The proposed Fuzzy Logic Based Automated Parking System utilizes a vertical multi-level parking structure consisting of three vertical columns and five parking platforms. By using vertical space effectively, the system increases the number of vehicles that can be parked within a limited ground area.

In a conventional parking system, five vehicles would require separate ground-level parking spaces. In the proposed system, the same number of vehicles can be accommodated in a compact vertical structure, thereby significantly improving parking density.

The fuzzy logic controller continuously monitors slot availability and allocates parking spaces efficiently. This minimizes unused space and ensures optimum utilization of the parking structure. As a result, the proposed parking system achieves higher parking density, reduced land requirement, and improved space management compared to traditional parking methods.

Therefore, the proposed automated parking system provides an effective solution for urban areas where parking space is limited and land costs are high.



III. RESULTS

The entire autonomous car parking system is designed using fuzzy logic, which combines an infrared sensor circuit, a microcontroller AT89S52 circuit, a motor driver circuit, and a pulse width modulation (PWM) circuit. The steering/direction output is -0.5 for left/reverse, 0.5 for center/stop, and 1.5 for right/forward. Fuzzy logic is effectively used in the creation of autonomous parking. Using an infrared sensor, this prototype can find a suitable parking spot and reverse the park on its own. The DC motor's speed is managed using PWM. Thus, the vehicle may smoothly enter the parking place and proceed forward or backward. However, this prototype can also turn left and right with success.

IV. CONCLUSION

We suggest puzzle-based parking, a high density parking lot design that makes use of autonomous cars' self-parking and sophisticated communication technologies. When we model the parking lot as a graph, we see that there are three different kinds of parking lot designs: limited egress, entire egress, and traditional. Cars in a restricted egress configuration can only exit in a last-in, first-out order and totally block one another. Cars obstruct one another in a complete egress design, yet there is still room for any automobile to exit by pushing other vehicles. Lastly, no vehicle blocks another in a conventional parking lot. We provide a heuristic technique known as the puzzle-based parking algorithm to address computational complexity in modeling bigger architectures.A large puzzlebased parking lot, both limited egress and complete egress, can park 50% more cars than the traditional lots. However, for large limited egress designs, mean waiting time to retrieve a car is longer. Whereas, in large complete egress designs, cars have to be relocated many times to retrieve a target car. Therefore, we recommend keeping puzzle-based designs small to reduce waiting time and number of relocations. We also show that in small parking lots, it is possible to achieve 80% higher density, on average, than a traditional parking lot.

We discover that a compact parking lot with puzzle elements works well in urban environments. Limited egress designs are an option available to transportation network firms. They can benefit greatly from the last-in, first-out operation sequence, in which the last vehicle in the parking lot departs to service whenever a trip request is made. As a result, other automobiles are unaffected by the time it takes to retrieve a car. To handle more vehicles in a crowded downtown location, commercial garages might use the full egress design. To reduce the frequency of relocations, we advise limiting density to 80% or fewer. This study might be expanded in a number of ways. Because the problem is intractable, creating effective retrieval planning in a comprehensive egress design is difficult. Only with minor issues can we provide the best retrieval outcomes. Therefore, creating techniques to collect autos more effectively is a crucial future expansion of our research. Additionally, we have only taken into account one I/O point for a parking lot. Another intriguing development of this study will be the incorporation of various I/O points. Future study could also focus on including different automobile sizes.

REFERENCES

[1] E. Cox, "Fuzzy Fundamentals", IEEE Spectrum, 1992, pp. 58-61.

[2] Arjun Nagappan and Arjun Prakash (2009), “Autonomous Parallel Parking RC Car”, Cornell University, New York

[3] A., Kizil, A.C., Kutlucan, C., Dogan, S., Kocak, V., Sezer, “Design and implementation of

autonomous parallel and vertical parking mobile vehicle," International Conference on Control Engineering and Information Technology, CEIT 2018.

[4] M., Saleh, M., Ismail, N., Riman, "Enhanced algorithm for autonomous parallel parking of a car-like mobile robot," IEEE International Multidisciplinary Conference on Engineering Technology, 2016, pp.191- 195.

[5] S.R., Ganesh, V., Sai Ganesh, M.F., Hamza, S., Ramwal, S., Ghosh, "Automatic parallel car parking system using sensors and arduino UNO," International Journal of Recent Technology and Engineering, 8(11), 2019, pp. 3531-3534.

[6] Wulandari, Malada, A., Arrazi, M. H., Priandana, K., Wahjuni, S., Hardhienata, M., & Buono, A. (2019). Development of an autonomous smart-parallel-parking robot for the prototype of collaborative robots. Paper presented at the IOP Conference Series: Earth and Environmental Science, , 299(1)

[7] B., Li, K., Wang, Z., Shao, "Time-optimal maneuver planning in automatic parallel parking using a simultaneous dynamic optimization approach. IEEE Transactions on Intelligent Transportation Systems, 17(11), 2016, pp. 3263-3274.

[8] R.H., Nedamani, P.M., Khiabani, S., Azadi, "Intelligent parallel parking using adaptive neuro-fuzzy inference system based on fuzzy C-means clustering algorithm." SAE Technical Papers, 2017.

[9] Osório, F., Heinen, F., & Fortes, L. "Autonomous vehicle parking using finite state automata learned by J-CC artificial neural nets." Proceedings

- Brazilian Symposium on Neural Networks, 2002, p. 196 gent Vehicles Symposium (IV), IEEE, pp. 157–164.