Automated Car Storage and Retrieval System

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Abstract— This paper presents the design and implementation of an automated car storage and retrieval system that leverages Aduino technology, aiming to simplify the parking process while ensuring security and efficiency. Unlike traditional parking systems, this innovative approach streamlines the process, reducing the time spent searching for parking spots and making complex turns. The key objective of this automated parking system is to manage incoming and outgoing vehicles swiftly, without the need for constant manual monitoring. The system features a single entrance and exit point, eliminating the need for vehicles to navigate through intricate turns and saving space. Each parking slot, supported by rail-mounted mechanisms, can rotate horizontally along a fixed path for vehicle entry and exit. In this system, every parking slot is equipped with an Arduino-based control system. Instead of RFID tags, Arduino controllers manage the slot allocation and rotation process. When a vehicle arrives, a unique identifier is scanned by an Arduino-based reader. The corresponding slot, controlled by an Arduino, automatically rotates to facilitate vehicle entry or exit. This automated process enhances both convenience and security, as only authorized vehicles are granted access. To indicate slot availability, Infrared (IR) sensors and light-emitting diodes (LEDs) are employed. Red LEDs indicate slots in use, while blank LEDs signal unoccupied slots. This combination of Arduino technology and IR sensors ensures a reliable and user-friendly parking experience.

Key words: Automated Car Storage, Retrieval System

I. INTRODUCTION

With the rapid growth in population and urbanization, the demand for transportation services has soared. This increase in vehicular traffic has led to significant challenges, particularly in parking infrastructure. Many urban areas face the issue of unregulated and disorderly parking practices. Vehicles are often parked haphazardly along roadsides and on pavements, causing congestion and hindering traffic flow. In the absence of efficient parking systems, the situation has deteriorated. Traditional parking methods often lack discipline and structure, with drivers parking their vehicles at will. This chaotic approach to parking makes it difficult to manage vehicle entry and exit points, leading to the risk of collisions and damage due to limited space. Such scenarios result in costly vehicle repairs and aggravating traffic jams for commuters. Typically, finding an available parking slot is a time-consuming endeavour, and the security of vehicles is compromised, especially when cars are parked on both sides of a roadway. In response to these challenges, an automated car parking system has been developed, emphasizing enhanced efficiency, convenience, and safety. The automated car parking system under discussion is based on Arduino technology, replacing the RFID-based approach. It is designed to optimize parking space utilization while streamlining the process of parking and retrieving vehicles. In this system, each parking slot is equipped with Infrared (IR) sensors, which efficiently detect the presence or absence of vehicles. This Arduino-based automated parking system features horizontally rotating parking slots. The slots can move from their initial positions to accommodate vehicles and then return to their original location when the car is parked or leaves. Instead of relying on RFID technology, the system uses Arduino controllers to manage parking slot allocation and rotation. Each vehicle has a unique identifier, and an Arduino reader verifies the identification. Upon successful verification, the system directs the driver to an available parking slot by activating LEDs. This system eliminates the need for complex turns and angles within the parking area, thereby optimizing space utilization.

II. MOTIVATION

The burgeoning growth of vehicles on the roads has significantly outpaced the development of parking systems. This discrepancy is particularly evident in high-traffic commercial areas, including shopping malls, amusement parks, hospitals, residential neighborhoods, and offices. During peak hours, the influx of vehicles to these locations often occurs simultaneously, creating a chaotic and time-consuming situation for car owners. Traditional parking methods have proven to be inadequate for addressing these challenges, leading to a variety of issues, including wasted time and a lack of vehicle security. In this context, the motivation for the development of an advanced automated car parking system is to alleviate the pain points experienced by car owners and enhance the safety of their vehicles. The following factors illustrate the driving force behind this innovative parking system:

- Optimizing Parking Efficiency: The primary objective is to simplify the process of finding available parking spaces in the shortest possible time. This system is designed to counteract the congestion and traffic jams that typically result from the arduous search for parking spots.
- Minimizing Risks: The system's efficient operation significantly reduces the risks associated with obstacles, collisions between vehicles, and potential damages, which are common occurrences in traditional parking setups.

III. METHODOLOGY

The development of this project is mainly dependent on a flow of processes in Figure-1 that will gradually build up to accomplish the task. We have developed 3 parking slots to make the structure of this parking system. The method which is being proposed in this paper can be divided into three major subdivisions

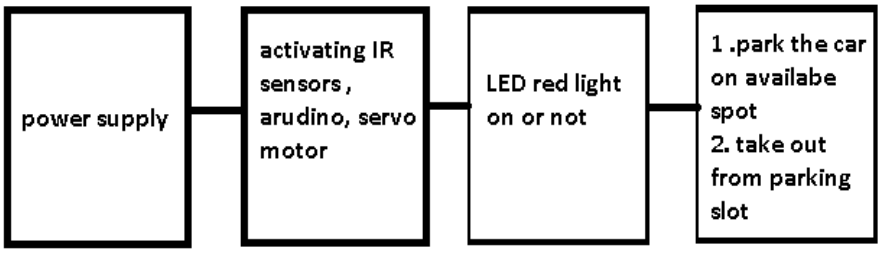

Fig. 1: Block diagram of automated car parking system

1) Application of arduino technology
2) Operating the horizontal rotating parking slot. Arduion uno

Which is a remote correspondence innovation ready to distinguish labelled articles or individuals. Arduion uno technology is applied in this system to monitor the flow and control system for parking. The Arduino controller serves as the brain of the system, overseeing all operations. It processes data from IR sensors, controls the gate motor, and updates the LCD display. IR sensors are strategically placed in the parking slots to detect the presence of cars. Each IR sensor can differentiate between an empty and occupied slot by detecting the presence or absence of a vehicle. Parking slot at the arrival and retrieval of the parking area with the same entrance and same exit is as shown in Figure 4.

IV. WORKFLOW

For accomplishing the working procedure, this workflow is developed that is shown in Figure 2. From the beginning of the flow diagram, there is an initial phase where the car owner may park the vehicle or take out the parked vehicle. So, in this case, the car owner might have two intentions. If the ir sensor LED turns on they can park the vehicle just verifying that slot are available if not they cannot park a car. Besides if anyone wants to take out the parked car they can detect by ir sensor can leave afterwards .Slot available or not is a displayed in the led display.

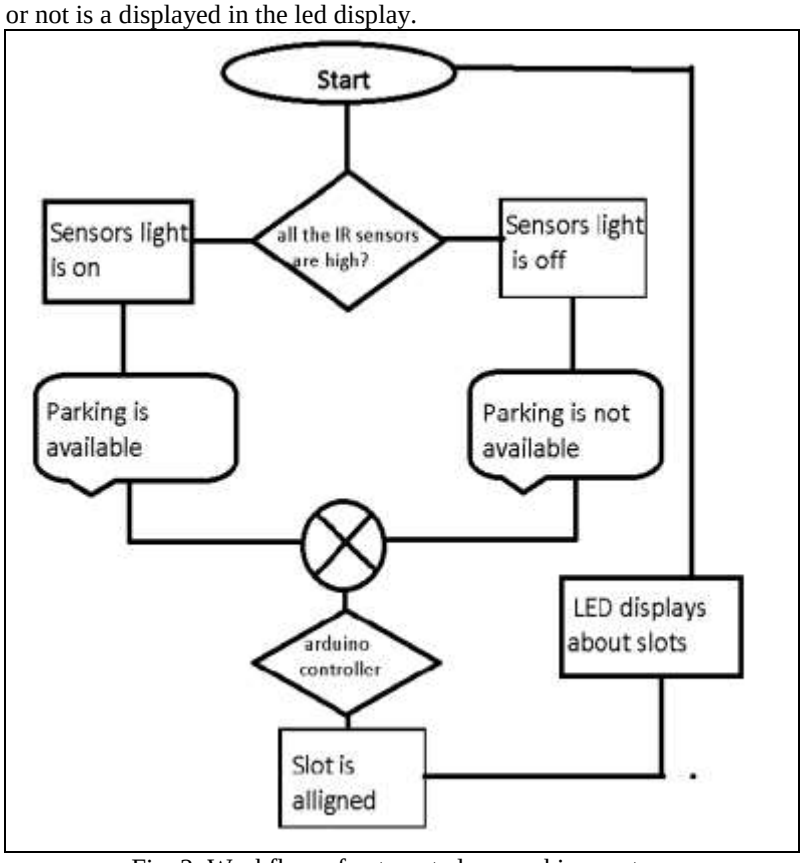

Fig. 2: Workflow of automated car parking system

A. Working Principal

The power supply is provided by the power supply adapter, which connects to the port of the buck converter. The buck converter is an all-around DC-DC converter that transforms high voltage effectively into low voltage. The automatic car storage and

retrieval system operates on a straightforward yet effective principle that optimizes the parking process and enhances user experience. At its core, the system employs a network of components meticulously orchestrated by an Arduino controller. When a vehicle approaches the entry gate, the integrated infrared (IR) sensor detects its presence and communicates with the Arduino, prompting the gate's motor to open. Simultaneously, six IR sensors positioned within the parking slots continuously monitor and relay data regarding slot occupancy. This real-time information is displayed on an LCD panel, conveniently guiding drivers to available parking spaces. As the vehicle navigates to an empty slot, the IR sensors within the parking slot ensure accurate positioning. Once the car is securely parked, the gate closes under the control of the Arduino, ensuring security. The 5V 2A power supply serves as the lifeblood of the system, sustaining its consistent and reliable operation. In this way, the automated car parking system streamlines the parking process, reduces traffic congestion, maximizes security, and simplifies the search for parking spaces, all orchestrated by the Arduino's intelligent control, providing a hassle-free and efficient parking solution.

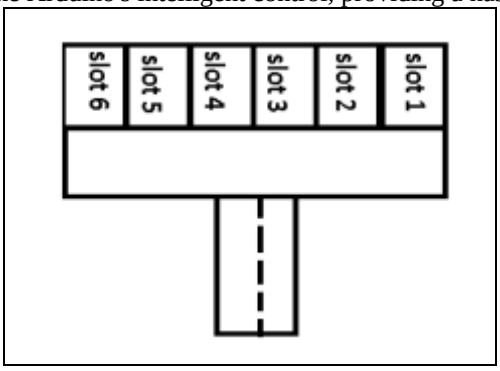

Fig. 3: positions for 6 parking slots

B. Structure Modeling

The structural model of the automatic car storage and retrieval system is an intricately designed framework that seamlessly integrates various components to optimize parking procedures. At its core, the system features a robust entry gate operated by a reliable driver motor. To facilitate smooth entry and exit, high-precision infrared (IR) sensors are strategically placed, ensuring accurate car detection as vehicles approach or depart. These sensors seamlessly communicate with a central Arduino controller, acting as the brain of the operation. The controller processes data from the IR sensors, orchestrating the synchronized opening and closing of the entry gate as vehicles arrive or exit. Simultaneously, six additional IR sensors are embedded within the parking slots to monitor slot occupancy continually. The real-time data is thoughtfully conveyed to an LCD display, which serves as a user-friendly interface. This dynamic display offers drivers a convenient visual guide, indicating available parking slots, effectively minimizing search times and reducing congestion.To support the system's uninterrupted operation, a stable power supply of 5V and 2A is meticulously provided. This power source ensures the consistent functioning of all components, guaranteeing reliable performance. By merging these elements into a structured model, the automatic car parking system enhances parking efficiency, maximizes space utilization, enhances security, and simplifies the user experience. The synchronized synergy between the motor, IR sensors, LCD, Arduino controller, and power supply forms the backbone of a highly efficient and user-centric parking solution.

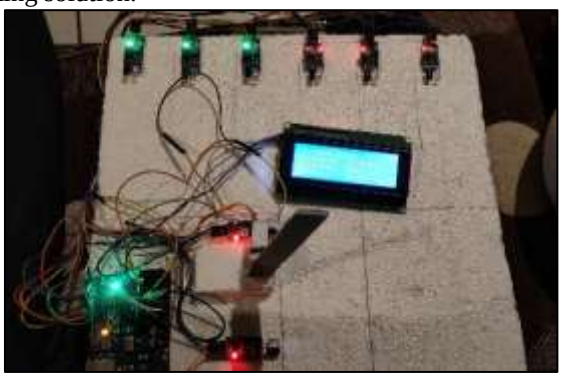

Fig. 4: Car storage and retrieval System

V. RESULT

The implementation of the automatic car storage and retrieval system, with a driver motor controlling the gate and an array of IR sensors strategically positioned for vehicle detection at the entry and exit points, has yielded promising results. The responsive IR sensors effectively detect incoming and outgoing vehicles, seamlessly communicating with the central Arduino controller. This controller, serving as the system's brain, orchestrates the gate's swift and precise operation, enhancing the overall traffic flow. In addition, the IR sensors thoughtfully integrated into the parking slots consistently monitor occupancy. The real-time data collected is efficiently relayed to the LCD display, which, with its user-friendly interface, proves instrumental in providing drivers with instant updates on available parking slots. This feature significantly reduces the time taken to locate a parking space and mitigates congestion. Furthermore, the reliable power supply ensures uninterrupted system functionality,

reinforcing its efficiency and reliability. The culmination of these elements results in a highly effective and user-centric automatic car parking system, delivering on its promise of optimizing parking operations, improving space utilization, enhancing security, and streamlining the overall user experience.

VI. CONCLUSION

In conclusion, the automatic car storage and retrieval system represents a pivotal advancement in urban infrastructure and transportation management. By seamlessly integrating multiple components, including the precision-controlled driver motor for gate operation, infrared (IR) sensors at entry and exit points, a user-friendly LCD display, an Arduino controller, and a reliable 5V, 2A power supply, this system has redefined the parking experience. According to the planning and working principles of this automated car parking system, there are many opportunities to upgrade this methodology. We have prepared this storage and retrieval system for six parking slots. The parking slots can be increased to a certain number where this model will work efficiently. It can also be connected with a mobile application for showing the nearby parking areas with empty parking slots where the car owners can book the parking slot by mobile application. This automatic car parking system can also be upgraded as a multi-storied parking system. This storage and retrieval system can also adapt IoT (Internet of things) to increase the operational efficiency of the car parking area.

REFERENCES

[1] Noor N.M, Z Razak and Mohd Yamani, 'Car Parking System: A Review of Smart Parking System and its Technology', Information Technology Journal, 2009.
[2] "Embedded Systems: Introduction to Arm Cortex-M Microcontrollers" by Jonathan W. Valvano.
[3] "Sensors and Actuators: Engineering System Instrumentation, Second Edition" by Clarence W. de Silva.
[4] Abdulkader, Omar, et al. 'A novel and secure smart parking management system (SPMS) based on the integration of WSN, RFID, and IoT', 15th Learning and Technology Conference (L&T). IEEE, 2018.
[5] Noor N.M, Z Razak and Mohd Yamani, 'Car Parking System: A Review of Smart Parking System and its Technology', Information Technology Journal, 2009.