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AUTOMATIC CAR PARKING SYSTEM

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ABSTRACT

The Automatic Car Parking System is developed to decrease human effort & parking time by automating the process of vehicle entry, exit, & space distribution. Using sensors, microcontrollers, & actuator mechanisms, the system identifies available parking slots, guides vehicles into the allocated spots, & updates real-time presence. This automation ensures efficient utilization of parking space, decrease traffic congestion within parking areas, & reduces manual errors. The system is particularly needful in malls, offices, hospitals, & smart city applications where parking management is a critical challenge. Moreover, optional aspects like buzzer alerts and LCD displays enhance user interaction & safety. This system supports in efficient use of parking space, decrease traffic congestion, & reduces manual errors. It is needful in malls, offices, hospitals, & smart cities.

INTRODUCTION

The Automatic Car Parking System addresses these problems using modern electronics & automation. The system integrates sensors, a microcontroller, & servo motors to identify vehicle appearance, monitor attainable spaces, & guide cars to developed spots automatically. It ensures efficient space utilization, decreases parking time, & enhances safety. The add-on of LCD displays & buzzer alerts gives clear communication to drivers, developing the parking process smooth & hassle-free. This system can be executed in malls, hospitals, offices, airports, & other areas demanding organized parking management.

Car parking has become a expanding challenge in civic areas due to improving vehicle density. Manual parking management is prone to errors, leads to ineffective use of space, & improves the time drivers consume searching for vacant spots. These issues contribute to traffic congestion, driver irritation, & potential accidents in parking lots.

LITERATURE SURVEY

Research on automated parking systems has proceeded significantly with the arrival of IoT, sensors, & robotics. Earlier systems can be classified as:

1. **Sensor-based Parking Detection**: Studies have used IR sensors, ultrasonic sensors, & magnetic sensors to identify vehicle existence in parking slots. These systems decrease human guidance & give precise real-time inhabitation data.
2. **Microcontroller-based Automation**: Arduino & ATmega microcontrollers have been generally required to process sensor data, control actuators, & control parking logic efficiently.
3. **Actuator Integration for Vehicle Guidance**: Servo motors & motorized gates enable automated control of parking barriers & vehicle alignment.
4. **User Interface Integration**: LCD displays and mobile applications give visual feedback of slot presence & assistance for drivers.

Studies demonstrate that automated parking systems decrease average parking time, enhance space utilization, & reduce human error, particularly in busy urban parking environments. Recent research emphasizes the combination of sensors, microcontrollers, and user-friendly interfaces to increase parking efficiency.

PROPOSED SYSTEM

The introduced system integrates sensors, microcontrollers, & actuator mechanisms to automate car parking. It gives real-time monitoring of parking spaces & guides vehicles automatically to reachable slots.

A. System Overview

1. IR sensors are mounted in parking slots to identify the appearance of vehicles.
2. Sensor data is transmit to the microcontroller, which processes information to determine reachable slots.
3. Servo motors control parking assistance mechanisms like rotating barriers or alignment guides.

4. LCD displays indicate the no. of vacant spots & guide drivers to available spaces.
5. Optional buzzer alerts notify users of improper parking or full slots.
6. The system updates availability in real-time to decrease waiting time & enhance parking management.

B. Key Components

- **IR Sensors:** Identify vehicle occupancy in each parking slot.
- **Servo Motor:** Moves parking barriers or alignment assistances.
- **LCD Display:** Displays available slots & guides the driver.
- **Microcontroller (Arduino / ATmega):** Processes sensor data & controls actuators.
- **Connecting Wires:** For circuit interconnection.
- **Power Supply:** Gives steady electrical power to the system.
- **Buzzer (optional):** Alerts users for full slots or improper parking.

C. Working Principle

1. The system constantly monitors all parking slots using IR sensors.
2. When a vehicle enters, the sensors identify its availability & transmit signals to the microcontroller.
3. The microcontroller detects the closest available slot & enables servo motors to assist the vehicle into the spot.
4. The LCD display indicates the assigned slot number & gives assistance to the driver.
5. After parking, the system updates slot presence automatically.
6. When a vehicle appears exits, sensors detect the clearance, & the microcontroller traces the slot as free again.
7. Optional buzzer alerts inform the driver if the parking slot is previously filled or if improper entry arises.
8. This feedback loop ensures real-time parking management & reduces human involvement.

D. Advantages

- Decreases risk of vehicle collisions & parking errors
- Improves user convenience with LCD displays & buzzer alerts
- Decreases human effort & manual monitoring
- Compatible for smart city applications
- Efficient utilization of parking spaces
- Reduces parking time & congestion

- Gives precise real-time parking information

E. Application

- **Shopping Malls & Commercial Complexes –** Decreases congestion & assists consumers to available parking slots.
- **Hospitals & Healthcare Facilities –** Ensures smooth parking for urgency vehicles & visitors.
- **Event Venues & Stadiums –** Handles large crowds & vehicle inflow during events.
- **Hotels & Resorts –** Offers valet-free automated parking to guests.
- **Government Offices & Institutions –** Assures organized parking & decreases manual supervision.
- **Automated Multi-Level Parking Structures –** Can be integrated with robotic parking platforms for vertical space optimization.
- **Residential Apartment Complexes –** Automates multi-level & basement parking.
- **Smart Cities –** Combines with urban-wide traffic & parking management systems.
- **Airports & Railway Stations –** Manages prominent vehicle traffic efficiently.
- **Corporate Offices & IT Parks –** Gives systematic parking for employees & sightseers.

Figure:

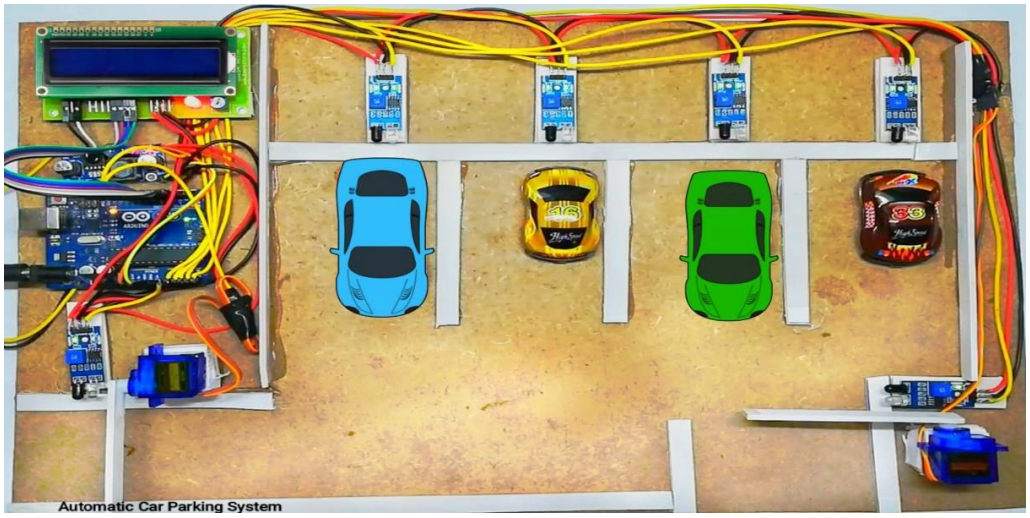
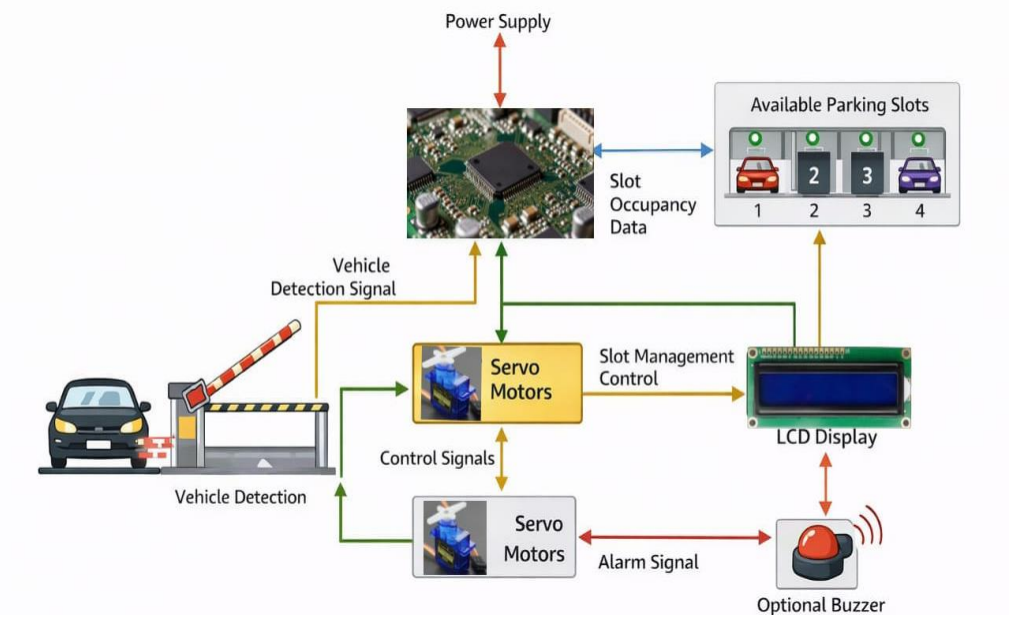


Fig. Hardware Prototype of Automatic Car Parking System

Block Diagram:



RESULTS AND DISCUSSION

The prototype of the Automatic Car Parking System was examined below controlled conditions to evaluate its effectiveness, precision, & reliability. The IR sensors effectively identified the availability of vehicles in every parking slot, sending precise signals to the microcontroller for processing. The microcontroller successfully detected available parking slots & activated the servo motors to guide vehicles into the assigned positions. The LCD display supplied clear information on slot presence & guided the driver efficiently, while the optional buzzer alerts effectively warned users about full slots or improper entries. During testing, the system significantly decreased parking time compared to manual methods & reduced congestion within the parking area. The feedback loop, where sensor data is constantly transmit to the controller, ensured real-time monitoring & instant response to changes in slot inhabitation.

The system also displayed energy efficiency, as the servo motors & sensors operated only when demanded, & the real-time feedback prevented inessential operations. Minor limitations observed contained potential delay in slot identification if multiple vehicles enter concurrently & dependency on correct sensor alignment for precise detection. However, these can be enhanced with additional sensors or IoT-based monitoring integration. Overall, the system verified to be reliable, user-friendly, & competent of optimizing parking space utilization, making it strongly appropriate for implementation in commercial, residential, & smart city applications.

CONCLUSION

The Automatic Car Parking System successfully automates parking management, decreasing human effort & reducing parking-related errors. By integrating IR sensors, microcontroller processing, servo motor control, & visual/audible feedback mechanisms, the system optimizes space utilization & enhances user experience. Real-time monitoring ensures precise slot presence, while automatic assistance decreases congestion & saves time. The system is scalable for multi-level parking, commercial complexes, & smart city applications. Its integration with IoT or mobile applications can further improve efficiency & user convenience, making it a viable solution for modern civic parking challenges.

FUTURE WORK

- **IoT Integration** – Connect the system to cloud platforms for real-time remote monitoring of parking slots via mobile applications.
- **Mobile App Slot Reservation** – Enable users to book & allocate parking slots in advance through a smartphone app.
- **Solar-Powered Operation** – Execute sustainable energy solutions for sustainable parking systems.
- **Voice/Gesture Assistance** – Give voice or gesture-based guidance for improved driver interaction.
- **Vehicle Identification System** – Use cameras or RFID tags to detect vehicles & personalize parking assistance.
- **Emergency Vehicle Priority** – Execute algorithms to automatically allocate slots for urgency vehicles in busy parking lots.
- **AI-based Slot Allocation** – Execute algorithms to optimize parking slot assignment based on traffic patterns & slot usage.
- **Automatic Payment System** – Integrate payment collection with slot allocation for mercantile parking lots.
- **Ultrasonic or RFID Sensors** – Increase vehicle identification precision, especially in large or multi-level parking areas.

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