IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 5, Issue 10, June 2025
Impact Factor: 7.67

Smart Parking System Integrated with Real Time Booking Application

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Abstract: *The paper additionally depicts an abnormal state perspective of the framework engineering. With the increasing urbanization and the rise in the number of vehicles, managing parking spaces has become a significant challenge in modern cities. This paper presents a Smart Parking System integrated with a real-time booking application, designed to optimize parking space utilization and provide a seamless user experience. The proposed system uses sensors to monitor parking space occupancy in real-time, offering users the ability to search, reserve, and pay for parking spots through a mobile application. By providing live updates the system reduces the time spent searching for vacant spaces, minimizes congestion, and enhances the overall efficiency of urban parking management., the integration of a real-time booking system ensures that users can plan their parking in advance. The system's adaptability to different parking structures, combined with its user-friendly interface, presents a scalable solution for smart cities aiming to streamline urban mobility and reduce environmental impact through reduced traffic congestion and improved traffic flow.*

Keywords: Smart Car Parking, IOT, real time, optimization, streamline mobility, reduce traffic congestion

I. INTRODUCTION

At the point when IoT is increased with sensors and actuators, the innovation turns into an occurrence of the more broad class of digital physical frameworks, which likewise incorporates advances. For Example, keen networks, virtual power plants, brilliant homes, astute transportation and shrewd urban communities. Among the difficulties that confront in everyday life one of most unavoidable test is parking the car wherever people go. Saved parking zone gets leaves the client to scan for their parking among other parking area.

To build up a canny, easy to understand robotized car stopping framework which diminishes the labour and movement blockage.

To offer sheltered and secure stopping openings inside constrained territory.

Internet of Things (IOT) plays a vital role in connecting the surrounding environmental things to the network and made easy to access those un-internet things from any remote location. It's inevitable for the people to update with the growing technology. In this study we design a Smart Parking System (SPS) which enables the user to find the nearest parking area and gives availability of parking slots in that respective parking area. Thus it reduces the fuel consumption which in turn reduces carbon footprints in an atmosphere.

Our system is a Raspberry pi based parking sensor which contains pi-camera to detect the empty parking spaces and sends this data to server, this stored data is accessed by users. Some embedded systems such as auridino, raspberry pi, Tsgate, Tsmote etc. are used to develop internet of things applications.

A few existing parking system by using sensors like video sensors in a parking system are expensive so our aim is to develop a system with less cost with more performance.

DOI: 10.48175/IJARSCT-28811

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II. CONTRIBUTIONS

User-Friendly Mobile Application Interface: The application also provides real-time notifications regarding parking space availability, booking confirmations, and reminders for parking times, enhancing the overall user experience and accessibility. Parking Data Analytics for Optimization: The system collects valuable data on parking usage patterns. This data can be analyzed to optimize parking management, improve the overall parking strategy of cities or parking facilities. Seamless Payment Integration: The inclusion of secure payment gateways allows for cashless transactions, Scalability and Flexibility: The smart parking system with real-time booking capabilities is highly scalable, making it adaptable to various types of parking environments, from small private lots to large, multi-story public parking garages. The flexibility of the system allows for easy expansion and integration into different urban areas or parking infrastructures.

III. METHODOLOGY

This seeking prompts 30 to 40% of activity blockage. This project perceives how to diminish the stopping issue and to do secured stopping utilizing the shrewd stopping under Slot Allocation strategy with the assistance of Arduino UNO. The primary commitment of our proposed frameworks is to discover status of the stopping territory and give secured stopping. In the course of recent years, movement experts have built up a model called Parking Guidance and Information (PGI) framework for good stopping administration. PGI frameworks, tells about the dynamic data of stopping in the controlled region and aides the clients to the empty stopping spaces.

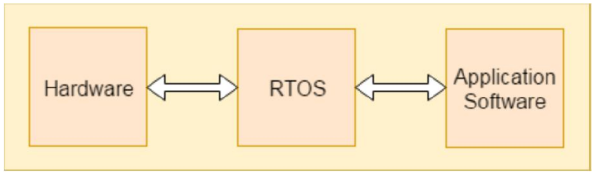

FIGURE 1 : Design of Embedded System

An embedded system is a combination of three major components:

- **Hardware:** Hardware is physically used component that is physically connected with ES. It comprises of microcontroller based integrated circuit, power supply, LCD display etc.
- **Application software:** Application software allows the user to perform varieties of application to be run on an embedded system by changing the code installed in an embedded system.

RTOS supervises the way an embedded system work. It act as an interface between hardware and application software which supervises the application software

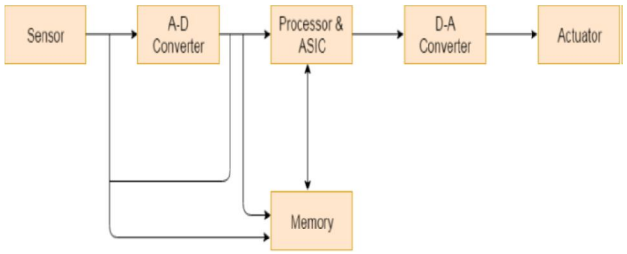

FIGURE 2: Design Of Embdded System

- **Sensors:** They are used for sensing the change in environment condition and it generate the electric signal on the basis of change in environment condition. Therefore it is also called as transducers for providing electric input signal on the basis of change in environment condition.
- **A-D Converter:** An analog-to-digital converter is a device that converts analog electric input signal into its equivalent digital signal for further processing in an embedded system.
- **Processor & ASICs:** Processor used for processing the signal and data to execute desired set of instructions with high-speed of operation. Application specific integrated circuit (ASIC) is an integrated circuit designed to perform task specific operation inside an embedded system.

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- **Converter:** A digital-to-analog converter is a device that converts digital electric input signal into its equivalent analog signal for further processing in an embedded system
- **Actuators:** Actuators is a comparator used for comparing the analog input signal level to desired output signal level for providing the error free output from the system.

The elements of the proposed framework are:
Drivers find accessible parking spots close to them.
Less number of drivers seeking to stop, in this way decreases the movement clog.
Avoids air contamination and a dangerous atmospheric deviation.
Scalable, hearty and solid.
Reduces the driver stretch and enhances the urban range.
Parking can happen when a driver is not cautious about another driver's rights. This is handled by the advancement of robotized keen car parking framework.

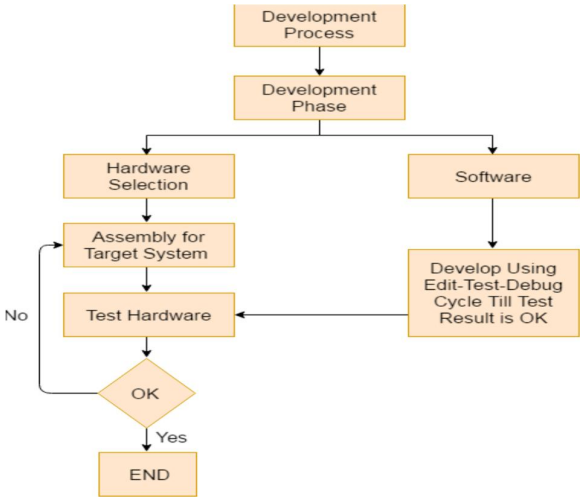

FIGURE 3: Flow Chart Development of Embedded System

Embedded System processors: Processors are the major part in embedded systems that take response from sensors in digital form and processing of this response to produce output in real-time processing environment is performed using processors. For an embedded system developer it is essential to have the knowledge of both microprocessors and micro controllers.
Processors inside a system: Processors inside a system have two essential units.
Control unit: This unit in processors performed the program flow control operation inside an embedded system. The control unit also acts as a fetching unit for fetching the set of instructions stored inside a memory.
Execution unit: This unit is used for execution the various tasks inside a processors. It mainly comprises of arithmetic and logical unit (ALU) and it also include a circuit that executes the instruction sets used to perform program control operation inside processors.

IV. RESULTS

It guarantees snappy and computerized parking and simple recovery of vehicles. Up to 3 cars can be effectively and securely parked in the outlined model.
The surface space required is identical to the parking spot of two cars as it were. Minimal effort framework, giving most extreme computerization. It doesn't require observable pathway operation. Cordial reorientation of cars for driving in and out. Security of vehicle. Hardware Connections: Working model of Smart Car Parking System
Connect the Vcc stick to the positive rail on your breadboard. Connect the Gnd stick to the negative rail on your breadboard.

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Connect the Trig stick to any advanced stick on the arduino. Connect the Gnd stick to the negative rail on your breadboard.

Finally, interface the positive rail of the breadboard to 5V stick on the arduino and the negative rail of the breadboard to the Gnd stick on the arduino.

In this section, the results are discussed for the smart parking system using IOT. In Fig, the image of the prototype design is shown. This system helps user to find parking space availability with the help of Internet of Things (IoT) technology by providing status of parking slots. The database of the parked vehicles is maintained through a shared server. A real time mobile application provides a platform for the drivers to book the slots in advance and the parking information is then updated in server.

System Performance: continuously fetches the parking slot statuses from the server every 5 seconds.

Range: Infinity. Noise in accelerometer data.Wifi signal interference.

Improvements: Use of Wi-Fi for more robust communication. Add more features for advanced controls.

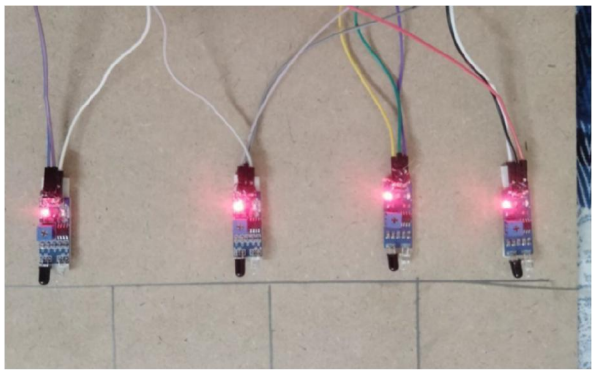

FIGURE 5: Result

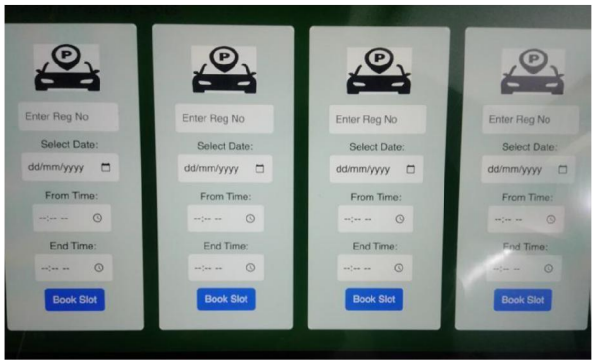

FIGURE 5: Results

V. DISCUSSION

A smart parking system integrated with a real-time booking application is an innovative solution to address urban parking challenges using IoT, cloud computing, and mobile technologies. Here's a structured discussion around it.

Overview of Smart Parking System : A smart parking system uses IoT sensors, cameras, and embedded systems to detect real-time availability of parking spaces. These systems can monitor occupancy, guide drivers to available spots, and optimize the use of parking areas. Integration with Real-Time Booking Application When integrated with a real-time booking app, the system becomes more user-centric. Key functions include: Real-time availability: Drivers can view and book parking spots remotely via the app. Navigation: Once booked, the app provides turn-by-turn navigation to the reserved spot. Payment Gateway: Users can pay digitally through integrated wallets or UPI. Time-based Reservations: Users can book for specific durations and get notified before expiry.

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Core Technologies Involved -

IoT Sensors: To detect vehicle presence in parking slots. Cloud Platform: Stores and processes data from parking lots across different locations.

Mobile App: Acts as the user interface for booking, payment, and navigation.

Machine Learning: Can predict peak hours, suggest alternative spots, or optimize parking lot usage. API Integration: To connect with maps, payment systems, and third-party platforms. Benefits

Reduced Traffic Congestion: Less time spent looking for parking

Convenience: Pre-booking eliminates last-minute stress.

Optimized Revenue: Dynamic pricing and better space management increase profits for lot owners.

Data Analytics: Insights into usage patterns can help urban planners.

Challenges:

Initial Cost: Installation of sensors and infrastructure.

Maintenance: Hardware and software up keep.

Data Security: Protecting user data and payment information. Scalability: Adapting the system to different cities or types of lots.

Use Cases Smart Cities: Municipal parking lots integrated into a central app.

Airports & Malls: Priority parking for frequent users.

AI-based Spot Prediction: Predict free spots based on user behavior and historical data.

VI. CONCLUSION

Our project detects the empty slots and helps the drivers to find parking space in unfamiliar city. The average waiting time of users for parking their vehicles is effectively reduced in this system. The optimal solution is provided by the proposed system, where most of the vehicles find a free parking space successfully. Our preliminary test results show that the performance of the Arduino UNO based system can effectively satisfy the needs and requirements of existing car parking hassles thereby minimizing the time consumed to find vacant parking lot and real time information rendering. This smart parking system provides better performance, low cost and efficient large scale parking system. When car enters the parking area, the driver will park the car in the nearest empty slot when slot is occupied the LED light glows and when slot is empty LED lights are turned off carmatically indicating that the parking slot is empty to be occupied. It also eliminates unnecessary travelling of vehicles across the filled parking slots in a city.

Recommendation

Technical Recommendations: Adopt Modular Architecture: Use microservices for flexibility and scalability. Separate modules for sensor data collection, user management, booking, and payment. Use Edge Computing: Process some data locally (e.g., vehicle detection) to reduce latency and dependence on cloud. Implement Robust API Layer: RESTful APIs for seamless integration with maps, payment gateways, and third-party services. Real-Time Data Synchronization: Use WebSocket or MQTT for pushing real-time updates to the app (spot availability, booking status).Use AI for Prediction & Optimization -Integrate machine learning for demand forecasting, dynamic pricing, and usage heatmaps. UX & Mobile App Recommendations; Simple, Intuitive UI: Prioritize map-based navigation and one-click booking/payment experience. Push Notifications: Reminders for expiring bookings, offers, and spot availability in favorite locations. Voice & Chatbot Support: Integrate voice commands or chatbots for accessibility and ease of use. Multi-language Support: Make the app inclusive by supporting regional languages. Operational & Business Recommendations Partner with Municipalities and Private Operators Enable public-private collaboration for wider coverage and consistent service. Offer Subscription Model: For daily commuters or frequent users, offer monthly packages or loyalty rewards. Enable Data-Driven Decision Making Share anonymized data with city planners to support smart city initiatives Pilot Launch in High-Demand Areas Start with locations with known parking issues to test and refine the system. Security and Compliance Recommendations Implement End-to-End Encryption : Secure communication between app, cloud, and IoT devices. Ensure Compliance : Adhere to local data protection laws (e.g.,

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GDPR, CCPA) and payment regulations. Conduct Regular Penetration :Test the system for vulnerabilities in both the app and infrastructure.

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