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IOT BASED PARKING SYSTEM & DISPLAY ON MOBILE

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ABSTRACT

The increasing number of vehicles in urban areas has led to severe parking challenges, such as traffic congestion, time wastage, and pollution. This paper proposes an Internet of Things (IoT)-based Smart Parking System that detects available parking slots in real time and displays them on a mobile application. Using sensors like ultrasonic or IR sensors connected to microcontrollers such as Arduino or NodeMCU, the system collects data about each parking slot's occupancy. The data is transmitted to a cloud server and visualized on a user-friendly mobile interface. This solution enables drivers to easily locate vacant parking spaces, reducing traffic congestion and fuel consumption. The proposed system provides a cost-effective, scalable, and energy-efficient approach to modern parking management.

Keywords: IoT, Smart Parking, Cloud Computing, Mobile Application, Real-Time Monitoring, Automation, Smart Cities.

I. INTRODUCTION

With rapid urbanization and the continuous increase in vehicle ownership, parking has become a major problem in cities. Conventional parking systems lack automation and real-time data, causing drivers to spend considerable time searching for available slots, thereby increasing fuel wastage and air pollution. The integration of IoT technology into parking systems has emerged as a promising solution to these challenges.

IoT allows the interconnection of sensors, devices, and mobile applications to collect, process, and share parking data in real time. Through wireless communication technologies, the system can efficiently update the status of parking spaces and guide users to vacant ones via a mobile interface. This real-time information helps in reducing congestion, improving the driver experience, and optimizing space usage.

The IoT-based Parking System not only enhances parking efficiency but also contributes to building smart cities. It can be integrated with payment gateways, automatic number plate recognition (ANPR), and traffic management systems to offer a complete smart parking solution for both public and private sectors.

II. LITERATURE SURVEY

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[1] S. C. Koumetio Tekouabou, E. A. Abdellaoui Alaoui, W. Cherif, and H. Silkan – "Improving Parking Availability Prediction in Smart Cities with IoT and Ensemble-Based Model"

Koumetio Tekouabou et al. proposed an advanced IoT-driven approach to enhance parking availability prediction in smart cities through the integration of ensemble-based machine learning models. Their work focused on combining multiple predictive algorithms to achieve higher accuracy and reliability in determining future parking slot availability. The system utilized IoT sensors distributed across parking areas to collect real-time occupancy data, which was then analyzed using ensemble learning techniques to forecast demand patterns and optimize parking resource utilization.

The authors highlighted the importance of predictive analytics in modern smart parking systems. By implementing ensemble models that integrate decision trees, random forests, and boosting algorithms, their approach improved the overall precision of parking availability forecasts. The system was evaluated using real-world datasets and demonstrated superior performance compared to conventional single-model approaches. This advancement supported efficient urban mobility management and reduced unnecessary vehicle circulation caused by searching for parking spaces.

Furthermore, the study emphasized the scalability of IoT infrastructure and the adaptability of the ensemble framework to various urban environments. The integration of real-time IoT data with predictive modeling contributed to a smarter, data-driven city ecosystem. The findings from this research establish a strong foundation for integrating IoT sensing technologies with intelligent analytics, which can be further extended to enhance user experience through mobile-based real-time displays and navigation systems.

[2] A. Khanna and R. Anand – "IoT Based Smart Parking System"

Khanna and Anand developed an IoT-based smart parking architecture designed to monitor and manage parking spaces efficiently using sensors and wireless communication technologies. Their system employed infrared sensors connected to a microcontroller that detected the presence or absence of vehicles in each slot. The collected data was transmitted to a cloud server, which maintained an updated database of parking slot availability accessible to users via a mobile or web interface.

The research demonstrated the practicality of integrating IoT with embedded systems to create cost-effective and efficient parking management solutions. By leveraging technologies like Arduino, Wi-Fi modules, and cloud platforms, their system was capable of real-time monitoring and display of parking status. The authors conducted experiments in controlled environments to validate system accuracy, latency, and reliability, showcasing how IoT can transform traditional parking systems into intelligent, automated infrastructures.

Their work also addressed challenges such as connectivity issues, power management, and data synchronization in IoT networks. The paper

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concluded that IoT-based parking systems can substantially minimize time spent searching for parking spaces, lower fuel consumption, and reduce environmental pollution. This foundational study set the stage for more advanced research integrating cloud computing, mobile applications, and predictive analytics into smart parking systems.

[3] M. Ramasamy, S. G. Solanki, E. Natarajan, and T. M. Keat – "IoT Based Smart Parking System for Large Parking Lot"

Ramasamy et al. presented a comprehensive IoT-based solution designed specifically for large parking lots, focusing on real-time data acquisition, efficient space utilization, and user convenience. Their approach involved deploying ultrasonic sensors across multiple parking slots, interfaced with microcontrollers and connected via Wi-Fi modules to a centralized server. The system continuously monitored each parking slot's status and updated the availability on a web and mobile platform accessible to users.

The authors emphasized scalability as a major challenge when expanding smart parking systems to large facilities such as malls, airports, and corporate complexes. Their proposed architecture used modular components and cloud-based infrastructure to handle large volumes of data from multiple sensors without latency or data loss. This ensured that users could access real-time slot information, enabling quick and hassle-free parking experiences.

Moreover, the paper discussed system reliability, cost-efficiency, and ease of maintenance as critical design aspects. The experimental setup demonstrated a high detection accuracy and rapid response time, even under dynamic conditions. The study provided valuable insights into managing extensive IoT networks and integrating them into existing urban systems, thereby contributing to the broader vision of smart city development.

[4] D. Ashok, A. Tiwari, and V. Jirge – "Smart Parking System Using IoT Technology"

Ashok, Tiwari, and Jirge proposed a smart parking system utilizing IoT technology to address the increasing demand for efficient urban parking management. Their work focused on developing a robust architecture that connected sensors, controllers, and user interfaces through cloud computing. The system used IR sensors to detect vehicle presence and transmitted the data to a mobile application in real time, enabling drivers to view available slots and navigate directly to them.

The study provided a detailed explanation of hardware and software integration, including the use of microcontrollers, wireless modules, and IoT platforms like Blynk and Firebase for data communication. The authors tested their system under real-time conditions, evaluating parameters such as accuracy, latency, and communication reliability. Results indicated that the IoT-based system significantly improved parking efficiency,

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reduced human intervention, and enhanced the user experience through a responsive mobile interface.

Additionally, the authors discussed the potential integration of smart payment and automated slot reservation systems for future enhancements. The research demonstrated that IoT can serve as a sustainable and scalable solution for urban mobility challenges. By merging IoT with mobile technology, their work laid the groundwork for developing adaptive systems that can evolve with the growing demands of smart cities and intelligent transportation networks.

III. EXISTING SYSTEM

The existing parking management systems are largely manual or semi-automated. They rely on human attendants, paper tickets, and physical inspections to manage parking slots. In many public and commercial parking areas, users are required to search for available slots by driving through the premises, which leads to delays and traffic congestion. These systems lack real-time data and remote monitoring capabilities.

IV. PROPOSED SYSTEM

The proposed IoT-based Parking System overcomes these challenges by automating parking management using sensors and wireless communication. Each parking slot is equipped with an ultrasonic or IR sensor to detect whether a space is occupied or vacant. The sensor data is processed through a microcontroller (such as Arduino or NodeMCU) and sent to a cloud server via Wi-Fi. The data is then displayed on a mobile application that shows the real-time status of all parking slots. Users can view available spaces before arriving, navigate to the nearest parking spot, and even make reservations in some cases.

V. SYSTEM ARCHITECTURE

The system architecture consists of the following components:

1. **Sensors:** Ultrasonic or IR sensors installed in each parking slot to detect vehicle presence.
2. **Microcontroller Unit:** Arduino or NodeMCU used to process sensor data and communicate with the cloud.
3. **Wi-Fi Module:** Ensures data transmission from sensors to the cloud in real time.
4. **Cloud Server / Database:** Stores parking data and updates the mobile application.
5. **Mobile Application / Web Interface:** Displays real-time parking status to users.
6. **Power Supply:** Provides required energy to the sensors and microcontroller.

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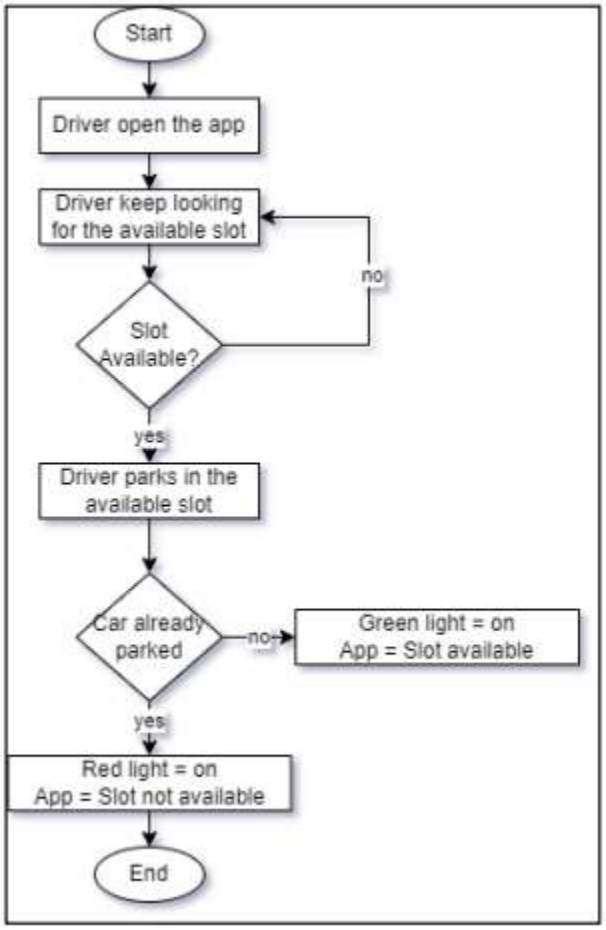

Fig.5.1: Flowchart for proposed model

VI. IMPLEMENTATION

The system implementation begins with setting up sensors in each parking slot. The ultrasonic sensors measure the distance to detect the presence of a vehicle. The microcontroller reads this data and sends it to a cloud platform such as ThingSpeak, Firebase, or MQTT server using Wi-Fi. A mobile application or web dashboard retrieves this data in real time and visually represents it using icons or color codes.

Software implementation involves programming the microcontroller (Arduino IDE), developing the cloud database, and creating the mobile app interface (using Android Studio or web technologies). The app provides functionalities such as slot availability view, navigation to nearest slot, and optional booking. The system is tested in a real or simulated parking environment to ensure accuracy and reliability.

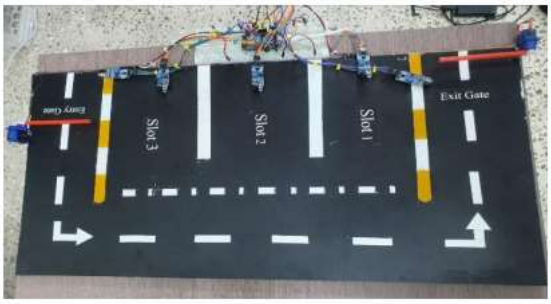

Fig.6.1: Implementation of proposed model

VII. CONCLUSION

The IoT-based Parking System and Display on Mobile provides a smart, efficient, and eco-friendly solution to modern parking problems. By automating parking slot detection and real-time data visualization, it reduces congestion, saves time, and enhances user convenience. The integration of IoT and mobile technology ensures scalability and adaptability to different parking environments, including malls, offices, and smart cities.

VIII. FUTURE SCOPE

Future enhancements of the system can include integration with automatic payment gateways, number plate recognition for security and billing, and AI-based prediction of parking availability using historical data. The system can also be linked with city-wide traffic management platforms to guide

vehicles dynamically to available parking spaces. Incorporating renewable energy sources like solar power for sensors and controllers can make the system more sustainable and environmentally friendly.

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