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A Predictive AI and IoT-Based Smart Parking and Vehicle Tracking Framework for Urban Mobility

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Abstract: ***Rapid urbanization and increasing vehicle density have intensified the challenges of effective parking management in modern cities. Conventional parking systems often lack automation, predictive capabilities, and real-time visibility. This study presents a unified AI and IoT-based Smart Parking and Vehicle Tracking Framework designed to optimize parking space utilization and improve user convenience. The system leverages IoT sensors for real-time data acquisition, machine learning models for predictive analysis, and a web interface for interactive user access. The proposed framework enhances parking efficiency, minimizes traffic congestion, and contributes to sustainable urban mobility through data-driven decision-making.***
Keywords: Artificial Intelligence, Internet of Things, Smart Parking, Predictive Analytics, Urban Mobility, Smart Cities

I. INTRODUCTION

Urban traffic congestion is one of the most pressing challenges in modern cities, primarily caused by the exponential growth of vehicles and limited parking infrastructure. Traditional parking systems are often manually operated, lack real-time updates, and do not provide predictive insights. As a result, drivers spend significant time searching for available slots, which increases fuel consumption and contributes to environmental pollution.

Integrating Artificial Intelligence (AI) and the Internet of Things (IoT) provides an intelligent and data-driven approach to parking management. IoT sensors continuously detect the occupancy status of parking slots, while AI algorithms analyze both historical and real-time data to forecast availability trends. This research proposes a comprehensive AI and IoT-based Smart Parking and Vehicle Tracking Framework aimed at improving parking efficiency, reducing congestion, and supporting sustainable urban transportation.

II. PROBLEM STATEMENT

Existing urban parking systems typically lack real-time monitoring and predictive analytics. Drivers are unaware of slot availability until they physically arrive at the parking area, leading to unnecessary movement and congestion. Moreover, these systems do not support efficient reservation or tracking mechanisms.

To overcome these limitations, there is a need for an intelligent IoT-enabled solution that detects parking slot occupancy in real-time, predicts availability using AI-based models, and provides an interactive platform for booking and vehicle tracking. Such a system can significantly reduce search time, improve user convenience, and optimize urban parking management. Additionally, existing systems often lack centralized coordination, making them unsuitable for large-scale smart city applications.

III. OBJECTIVES

The primary objective of this research is to design and develop an intelligent parking management framework that integrates Artificial Intelligence (AI) and the Internet of Things (IoT) to improve parking efficiency, accessibility, and urban mobility.

The specific objectives are as follows:

1) To design a unified AI and IoT-based framework that integrates sensor data collection, predictive analytics, and web-based visualization for efficient parking management.
2) To implement real-time slot monitoring and vehicle tracking using IoT sensors and cloud connectivity for accurate occupancy detection.
3) To develop predictive models using machine learning algorithms to forecast parking slot availability and optimize utilization.
4) To enhance user interaction through a responsive web dashboard that allows users to view, book, and track parking slots.
5) To evaluate performance improvements by analyzing system accuracy, prediction efficiency, and reduction in search time.

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IV. LITERATURE REVIEW

Numerous studies have explored the use of IoT technology in parking systems, employing sensors such as ultrasonic, infrared, or RFID for slot occupancy detection. However, most existing systems are limited to monitoring functions and lack AI-driven predictive intelligence.

Recent advancements have demonstrated the potential of Artificial Intelligence (AI) and cloud computing to enable real-time analytics and intelligent decision-making in parking management. For instance, Amato et al. [1] utilized deep learning models for parking occupancy detection, while Al-Turjman et al. [2] proposed IoT-integrated frameworks to enhance intelligent mobility. Despite these developments, a fully integrated system that combines IoT sensing, predictive AI algorithms, and an interactive web-based interface remains underexplored.

This research aims to bridge that gap by integrating AI-based prediction with IoT-enabled real-time monitoring and web visualization into a single, scalable framework. Moreover, recent advancements in smart city research, such as the AI-Parking framework proposed by Sharma and Gupta [5], emphasize the growing importance of predictive analytics and cloud integration in intelligent transportation systems.

V. PROPOSED SYSTEM DESIGN

The proposed system architecture consists of four layers:

1) IoT Layer: Equipped with smart sensors (ultrasonic or RFID) for real-time detection of parking slot occupancy.
2) AI Layer: Utilizes machine learning algorithms to analyze historical and live data, enabling accurate prediction of slot availability.
3) Web Layer: Provides an interactive dashboard for users to view available slots, make reservations, and track vehicles.
4) Database/Cloud Layer: Stores sensor data, user transactions, and prediction logs for further analysis and optimization.

This multi-layered design ensures real-time responsiveness, scalability, and seamless integration within existing urban infrastructure.

Figure Placeholder:

[Insert Figure 1: System Architecture of the Proposed AI and IoT-Based Smart Parking Framework]

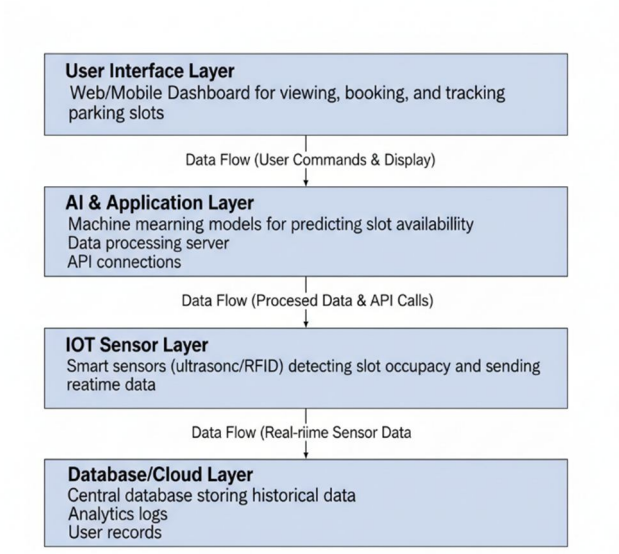


Figure 1. System Architecture of the Proposed AI and IOT-Based Smart Parking Framewark

VI. METHODOLOGY

The methodology involves four main phases: data collection, model training, system integration, and performance evaluation. IoT sensors generate real-time occupancy data, including slot IDs, timestamps, and statuses, which are transmitted to a centralized cloud server for processing.

Machine learning models such as Linear Regression and Random Forest are implemented to predict parking slot availability based on historical patterns and live data. The backend is developed using Python with the Flask framework, while the frontend utilizes HTML, CSS, and JavaScript for user interaction. A cloud database maintains persistent data storage for scalability.

System performance is evaluated using metrics such as prediction accuracy, response latency, and reliability to validate the efficiency of the proposed model.

VII. EXPECTED OUTCOMES

The proposed framework is expected to deliver the following outcomes:

1) Reduction in parking search time by over 40%, improving user convenience and reducing congestion.
2) Accurate prediction of parking slot availability using AI-driven models.
3) Real-time vehicle tracking and user notifications through a web-based interface.
4) Scalable and adaptable system design suitable for smart city deployment.
5) Improved urban mobility and reduced environmental impact through optimized parking management.
6) Integration readiness for future technologies such as automated billing and EV charging systems.

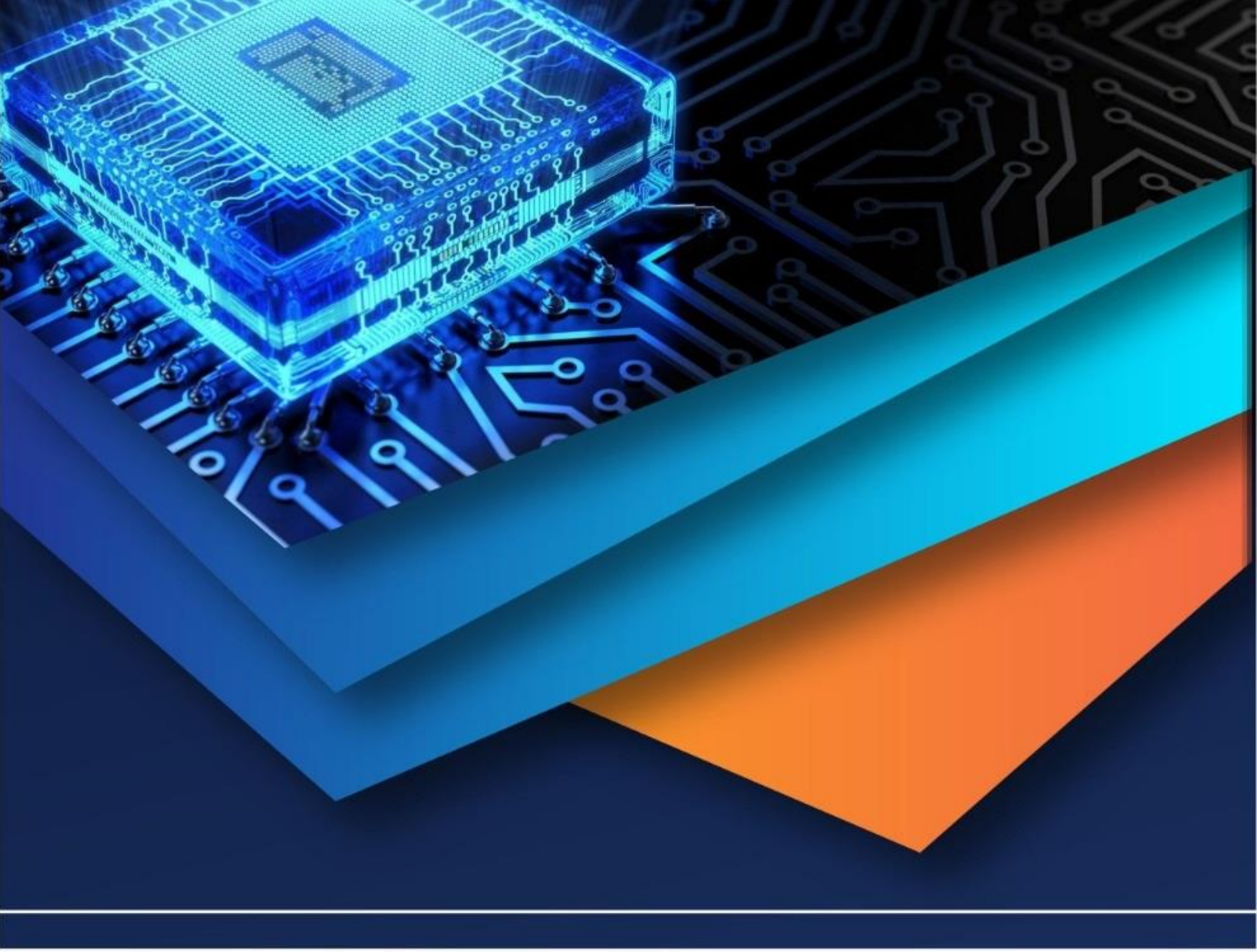
VIII. CONCLUSION

This paper presents a comprehensive AI and IoT-based Smart Parking and Vehicle Tracking Framework designed to address urban parking challenges. By combining predictive analytics with IoT sensing, the system provides real-time insights and forecasts that enhance parking efficiency and management accuracy.

The proposed framework not only reduces traffic congestion but also promotes sustainable urban development. Future work will focus on integrating deep learning techniques, expanding live sensor networks, and developing mobile applications to further enhance system scalability and precision.

REFERENCES

[1] G. Amato, F. Carrara, F. Falchi, et al., “Car Parking Occupancy Detection Using Smart Camera Networks and Deep Learning,” IEEE Access, vol. 7, pp. 119–127, 2019.
[2] M. Al-Turjman, M. Malekloo, “Intelligence in IoT-based Smart Parking System,” Future Generation Computer Systems, vol. 107, pp. 650–660, 2020.
[3] J. Lin, W. Yu, N. Zhang, “A Survey on Internet of Things: Architecture, Enabling Technologies, Security and Privacy,” IEEE Internet of Things Journal, vol. 4, no. 5, pp. 1125–1142, 2017.
[4] R. W. Baker, “Machine Learning Approaches for Smart Parking Prediction,” Sensors, vol. 21, no. 4, pp. 950–958, 2021.
[5] A. Sharma, R. Gupta, “AI-Powered Parking Management in Smart Cities: A Predictive Framework,” IEEE Internet of Things Magazine, vol. 6, no. 1, pp. 42–50, 2023.



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