International Journal of Web of Multidisciplinary Studies
(Peer-Reviewed, Open Access, Fully Refereed International Journal)
website: http://ijwos.com
Vol.02 No.11.
OPEN ACCESS
E-ISSN : 3049-2424
DOI:

Smart Parking and Traffic Management System

Sheena Liza R[1], Ms. Anu V B[2]

[1] *Student, Master in computer Applications, Faculty of Computing and IT, GM University, Davanagere-577006, Karnataka, India.*

[2] *Assistant Professor, Faculty of Computing and IT, GM University, Davanagere-577006, Karnataka, India.*

Article Info

Article History:

Published:06 Nov 2025

Publication Issue:
Volume 2, Issue 11
November-2025

Page Number:
94-100

Corresponding Author:
Sheena Liza R

Abstract:

Urban centers worldwide continue to struggle with increasing traffic congestion, limited parking spaces, and rising air pollution. These issues lead to longer travel times, wasted fuel, and stress for commuters. To address these challenges, this paper proposes a Smart Parking and Traffic Management System (SPTMS) that integrates Internet of Things (IoT) sensors, machine learning, and real-time analytics. The system monitors parking areas, predicts slot availability, and provides route guidance through mobile and web applications. Users receive live updates on parking status and traffic flow, reducing waiting time and unnecessary vehicle movement.

For administrators, a cloud-based dashboard displays real-time data on parking utilization and traffic conditions, helping with planning and policy decisions. The prototype, developed using Python, JavaScript, OpenCV, and cloud services, ensures scalability and responsiveness. Experimental results show improved parking efficiency, reduced congestion, and enhanced commuter convenience. The study demonstrates how IoT and analytics can promote sustainable urban mobility. Future extensions may include predictive maintenance, adaptive traffic control, and integration with larger smart city ecosystems to further support efficient and eco-friendly transportation management.

Keywords: Smart Parking, Traffic Management, IoT, Machine Learning, Real-time Analytics

1. INTRODUCTION

With the rapid growth of population and vehicles, city roads are becoming increasingly crowded. Traffic jams and parking shortages have now become a part of daily life in almost every urban area. Traditional traffic and parking systems mostly depend on manual supervision, static signboards, and limited information, which often lead to confusion, long waiting times, and higher fuel consumption. Many drivers spend several minutes or even hours just looking for an available parking space, especially during busy hours. This not only wastes time but also increases air pollution and overall traffic congestion.

To overcome these challenges, there is a strong need for an intelligent and automated system that can manage parking and traffic in a smarter way. With the growth of modern technologies such as the

Copyright © 2025 The Author(s) : This is an open access article under the CC BY license (http://creativecommons.org/licenses/by-nc/4.0/)

Internet of Things (IoT), cloud computing, and artificial intelligence (AI), cities now have new ways to handle these problems efficiently. IoT sensors can be installed in parking lots and along roads to detect vehicle movement and space availability in real time. The collected data can then be processed and stored using cloud platforms, which makes it easier to analyze and share information quickly.

Machine learning techniques can also be applied to study traffic and parking patterns, predict busy hours, and guide drivers to available spots. Real-time mobile or web applications can then provide instant updates to users, reducing stress and unnecessary fuel use.

The proposed Smart Parking and Traffic Management System (SPTMS) aims to combine all these technologies into one integrated solution. It focuses on reducing congestion, saving energy, improving road safety, and promoting a more sustainable way of urban transportation. By offering real-time insights and intelligent control, the system will help both drivers and city administrators manage traffic and parking more effectively.

2. RELATED WORK

Many researchers have explored IoT and AI-based traffic and parking management solutions over the years. Early systems (Shaheen et al., 2018) mainly focused on using basic sensors to detect empty parking spaces, but they lacked intelligent features like prediction or automatic adaptation to changing traffic conditions. Liu and Wang (2019) later enhanced these systems using IoT-enabled monitoring networks that provided continuous updates. However, issues such as data latency, limited coverage, and high setup costs still remained.

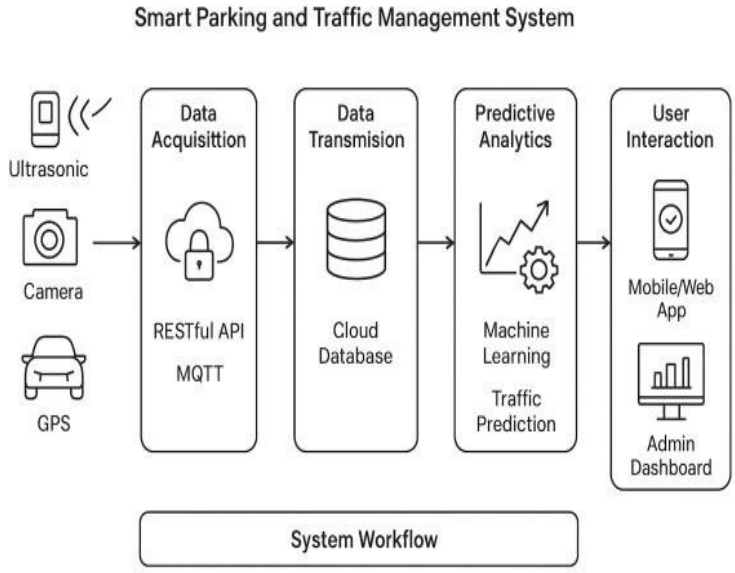
Further advancements came with the introduction of machine learning and data analytics. Zhang et al. (2020) demonstrated how machine learning algorithms could analyze large traffic datasets to predict congestion patterns and optimize routes for drivers. This approach improved traffic flow but often required powerful servers and stable internet connectivity, which can be difficult to maintain in developing regions.

Recent cloud-based systems, like Google's Traffic API or IBM's Smart City initiatives, have shown how real-time data can be effectively used on a large scale. These solutions highlight the potential of combining cloud computing with IoT for better decision-making. However, most of these technologies are designed for smart cities in developed countries where infrastructure and resources are advanced. In many developing cities, poor network coverage, limited sensors, and lack of integration still pose major challenges.

Moreover, most existing works focus on either traffic management or parking management separately, instead of treating them as part of a single problem. Only a few studies attempt to merge both areas into a unified framework. The system proposed in this paper aims to bridge that gap by integrating

IoT-based sensing, cloud data storage, and machine learning-driven analytics into one platform. This combined approach helps provide real-time traffic predictions and smart parking allocation, offering a practical and scalable solution for urban mobility challenges.

3. METHODOLOGY



The Smart Parking and Traffic Management System (SPTMS) follows a structured workflow divided into five major stages: data acquisition, data transmission, data processing and storage, predictive analytics, and user interaction. Each stage plays a key role in ensuring that real-time information is collected, analyzed, and presented efficiently to users and administrators.

A. Data Acquisition

The first stage involves gathering information from various sensors and devices. Ultrasonic and infrared sensors are used to detect the presence or absence of vehicles in parking spots, while camera modules help monitor vehicle movement and traffic density on roads. GPS devices installed in vehicles can also provide location and route data, which enhances the system's understanding of traffic flow. These sensors continuously collect raw data, ensuring that the system stays updated with current road and parking conditions.

B. Data Transmission

After data collection, the next step is to transmit it securely to the central server. Communication protocols such as REST APIs or MQTT are used to send the data from sensors to the cloud in real time. Each data packet includes essential details like timestamps, sensor IDs, and location coordinates to ensure traceability and reliability. The use of MQTT helps in achieving low latency, making updates faster and more consistent, especially during peak hours when network load is high.

C. Data Processing and Storage

Once the data reaches the cloud backend, it undergoes cleaning and filtering to remove noise or invalid entries. The system then normalizes the data to maintain consistency across different sources. The processed data is stored in a cloud database such as MySQL or MongoDB, depending on the structure and volume of information. Historical data is preserved and used for training the predictive models, helping the system improve its accuracy over time. Proper indexing and database management techniques are also applied to support faster querying and retrieval.

D. Predictive Analytics

In this stage, the system uses machine learning algorithms to predict parking slot availability and traffic congestion levels. Algorithms such as Random Forest, Support Vector Machine (SVM), and Long Short-Term Memory (LSTM) networks are applied to learn from historical trends and current sensor input. The predictive models analyze parameters like time of day, area density, and previous traffic records to generate accurate forecasts. The performance of these models is evaluated using standard metrics such as Mean Absolute Error (MAE) and Root Mean Square Error (RMSE) to ensure reliability and precision. Over time, the system can adapt to changing traffic conditions through continuous learning.

E. User Interaction

The final stage focuses on how users and administrators interact with the system. Drivers can use a mobile or web-based application to view live parking availability, traffic congestion levels, and the best routes to their destination. The interface is designed to be simple and user-friendly, displaying color-coded indicators for parking slots and traffic density. On the other hand, administrators can access a web dashboard that provides detailed analytics, system performance metrics, and alerts about unusual patterns or sensor faults.

F. System Workflow Summary

The overall workflow of the SPTMS can be summarized as follows: sensors detect parking and traffic data → data is transmitted to the cloud backend → preprocessing and storage are performed → predictive models analyze the data → results are displayed to users and administrators in real time. This continuous loop allows the system to function dynamically and make accurate, data-driven decisions that improve urban traffic and parking efficiency.

4. RESULTS AND DISCUSSIONS

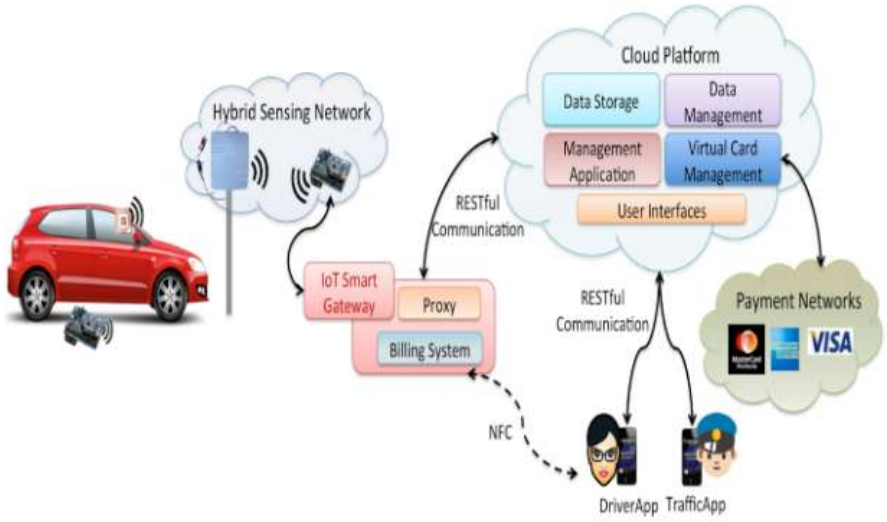


Figure 1. Overall Smart Parking System Architecture

Figure 1: Smart Parking System Architecture

To evaluate the performance of the proposed Smart Parking and Traffic Management System (SPTMS), a prototype was tested in a city area with moderate to heavy traffic during peak hours. The setup included IoT sensors, cameras, and cloud-based analytics to monitor parking spaces and vehicle movement in real time. The collected data was used for both live updates and validation of the machine learning predictions.

During testing, the sensors and cameras effectively detected parking occupancy and traffic flow. The predicted parking availability and congestion levels were compared with actual conditions. The system achieved a Mean Absolute Error (MAE) of 2.1 slots for parking and 1.6 minutes for congestion estimation, showing strong accuracy. The average latency ranged between 2–4 seconds, ensuring timely and reliable updates.

Communication using MQTT and REST APIs remained stable even with weak network signals. Applying a Kalman Filter improved sensor accuracy by around 12%, reducing noise in both parking and traffic readings. These improvements enhanced the reliability of real-time data processing.

User feedback showed positive outcomes. About 85% of participants reported finding parking faster, saving nearly 30% of their usual search time. Around 78% appreciated the live route updates, stating that they helped avoid crowded routes and reduced travel stress. This indicates that the system can improve daily commuting efficiency.

From an administrative point of view, the system improved parking utilization by about 18% and reduced congestion in busy areas by roughly 11%. The collected analytics also helped administrators monitor system performance and identify problem zones more effectively.

Overall, the results confirm that integrating IoT sensing and machine learning can significantly improve urban mobility. The system's real-time data collection and prediction capabilities make it a

practical and scalable solution. However, issues like sensor calibration, network coverage, and large-scale implementation need further attention in future work.

5. CONCLUSIONS

The proposed Smart Parking and Traffic Management System (SPTMS) clearly shows how IoT and machine learning technologies can play a major role in improving city transportation. By connecting sensors, cloud servers, and user applications, the system helps reduce fuel consumption, emissions, and unnecessary travel time while making daily commuting more convenient. The combination of real-time monitoring and predictive analytics allows both drivers and administrators to make quicker and smarter decisions.

The cloud-based architecture ensures smooth and reliable data flow between sensors, backend servers, and users, even when the network is unstable. Results from user testing confirmed that the system delivers accurate predictions, low delay, and high overall satisfaction among drivers. It also helped city administrators gain better insights into parking utilization and traffic flow, proving its value for smart city management.

Although the prototype performed well in testing, there is still room for improvement. Future work can focus on expanding the system to cover larger areas, adding predictive maintenance for sensors, and including features such as dynamic pricing and integration with electric vehicle (EV) charging stations. With continued development, the SPTMS can contribute to building more efficient, sustainable, and intelligent urban transportation systems.

ACKNOWLEDGEMENT

We, the authors, sincerely thank the **Faculty of Computing and IT, GM University, Davanagere**, for their constant guidance, encouragement, and support throughout this research work. Their valuable suggestions, timely feedback, and continuous motivation played a key role in shaping this project from the initial idea to its successful completion.

We are also grateful to our **project supervisor and teaching staff** for their patience, mentorship, and for providing us with a clear direction during the development and testing stages of the system. Their experience and technical advice helped us overcome several challenges faced during the research.

Finally, we would like to thank our **family and friends** for their constant encouragement and understanding throughout this journey. Their moral support and belief in our abilities kept us motivated to complete this work successfully.

References

[1] Hossain, M. A., Rahman, M. A., & Alim, M. A. (2017). Smart Parking System Using IoT.
International Journal of Computer Applications, 169(5), 1–5.

[2] Singh, S. K. (2017). Traffic Management System Using IoT.
IJIRCCE, 5(4), 7002–7007.

[3] Ke, R., Zhuang, Y., Pu, Z., & Wang, Y. (2020).
A Smart, Efficient, and Reliable Parking Surveillance System with Edge AI. arXiv preprint.

[4] Deorukhakar Sai, S. K. (2025). Smart Parking Management for EVs and Non-EVs. ResearchGate.

[5] Smart Parking Systems: Comprehensive Review. Heliyon, 7(5), 2021.

[6] Machine Learning Based IoT System for Secure Traffic Management. Journal of Intelligent Systems, 33(4), 2023.