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AI-Driven IoT Smart Parking System with Predictive Slot Availability

Varsha Vilas Nikam
Assistant Professor, Hirwal Education Trust's College of Science (Computer Science and Information Technology), Mahad-Raigad

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Correspondence Address:
Varsha Vilas Nikam
Assistant Professor, Hirwal Education Trust's College of Science (Computer Science and Information Technology), Mahad-Raigad
Email: varshasakpal2013@gmail.com

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Abstract

The developing number of vehicles and the rapid expansion of towns have created more parking troubles in clever towns, which result in site visitors delays and accelerated gasoline consumption and environmental damage. The Advanced Intelligent Parking System develops an AI-Driven IoT Smart Parking System with Predictive Slot Availability which makes use of real-time parking tracking together with predictive parking forecasting to beautify parking space management. The proposed gadget operates by using constantly sending occupancy data whilst it uses Internet of Things (IoT) sensors and area devices and cloud-based analytics to become aware of car presence. The parking bays use infrared and ultrasonic sensors to transmit facts through wireless networks which enable LoRaWAN and Wi-Fi connections.The parking lot prediction systems of the organization use AI and ML models to combine historical data with current data for their parking space availability predictions. The study uses time-series forecasting techniques which include Long Short-Term Memory (LSTM) networks to determine usage patterns according to peak hours and weather conditions and special events. The user-friendly mobile application provides drivers with live parking status and future parking space information and route directions to open parking spaces which helps decrease both vehicle search time and road traffic. The testing results show that the parking system achieves better parking space usage and lower carbon emissions while making it easier for users to access parking spaces when compared to standard parking systems. The proposed AI-driven IoT framework enables efficient management of urban transportation systems through its intelligent infrastructure management base which reduces traffic congestion and supports smart city projects.

Keywords: *Artificial Intelligence (AI), Internet of Things (IoT), Smart Parking System, Predictive Parking, Machine Learning, Long Short-Term Memory (LSTM), Random Forest, Time-Series Forecasting, IoT Sensors, Smart Cities, Urban Transportation, Parking Space Prediction, Edge Computing, Wireless Sensor Networks, Sustainable Mobility.*

Introduction

The ongoing boom of cities together with the increasing quantity of cars at the roads creates primary boundaries for urban transportation systems which need to manage parking operations. Drivers spend an excessive amount of time attempting to find open parking spots which leads to visitor's jams and better gas usage and driving force stress and more carbon dioxide emissions. The current parking structures depend on guide inspections and fixed statistics factors which lead them to unable to cope with the changing parking needs of city regions. Smart parking structures use Internet of Things (IoT) technology to resolve their operational troubles through the usage of sensors and connected devices to supply actual-time parking space repute updates. The structures enhance monitoring talents through progressed visibility features even as they function as reactive systems which show current parking area fame. Urban parking situations revel in rapid modifications which make real-time records insufficient for maximum conditions. The machine operates less efficaciously because drivers find out that all parking areas have been taken when they arrived at their vacation spot. The aggregate of Artificial Intelligence (AI) and IoT technology permits predictive capabilities which improve parking control choice-making tactics.

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Machine getting to know fashions use historical parking information together with temporal data and actual-time sensor inputs to are expecting upcoming parking space availability which enables drivers time table their parking choices well. The predictive technique enhances consumer experience whilst it decreases non-crucial car travel which supports environmentally pleasant city transportation. The proposed AI-driven IoT clever parking machine pursuits to combine sensor-based totally tracking with system studying prediction models to create a proactive parking solution. The machine leverages IoT infrastructure for facts series and AI algorithms for forecasting destiny occupancy ranges. Such integration can optimize parking utilization, reduce visitors congestion close to parking centers, and decrease environmental effect thru decreased gas intake and emissions. This research highlights the significance of shrewd, facts-pushed parking management as a key factor of smart metropolis development and sustainable electricity-green transportation structures.

Objectives

1. To design a predictive model that enables the prediction of the availability of parking slots based on time, peak hours, and environmental conditions.
2. To assist drivers with real-time and predictive information regarding the availability of parking slots.
3. To minimize traffic, search time, and fuel consumption while searching for parking slots.
4. To assist the city with the development of a smart city.

Literature Review

Artificial intelligence (AI) and the Internet of Things (IoT) have greatly more advantageous clever parking structures by means of permitting real-time tracking and predictive analytics. Intelligent structures, sensor era, and fashion-learning systems have all been utilized in numerous studies to explore new approaches to improve parking manipulate performance.

Early research via arXiv researchers Shuguan Yang et al. Proposed a deep gaining knowledge of framework that combines Graph Convolutional Networks (GCNN) and Long Short-Term Memory (LSTM) models to expect parking occupancy the use of site visitors, climate, and transactional information. Their approach performed a Mean Absolute Percentage Error (MAPE) of round 10.6%, displaying that integrating spatial and temporal data drastically improves prediction overall performance. However, the have a look at centered mainly on massive-scale city data and did not encompass IoT hardware integration.

On the opposite hand, Ruimin Ke et al.'s have a look at supplied a side-AI parking surveillance machine that lowers latency and network load via using IoT sensors to document regionally. Their machine carried out over 95% detection accuracy in the route of actual-worldwide checking out, demonstrating the effectiveness of side computing in smart parking packages.

While this work improves detection reliability, it generally emphasizes actual-time monitoring rather than predictive slot availability.

A extra prediction-focused method is presented within the look at "Machine Learning-Based Prediction of Parking Space Availability in IoT-Enabled Smart Parking Management Systems." This research in comparison a couple of gadget getting to know algorithms together with Random Forest, SVM, KNN, and Naïve Bayes. Results showed that Random Forest furnished superior accuracy and reliability in forecasting parking availability, highlighting the price of information-pushed models for IoT-enabled environments. Nevertheless, the structure remains ordinarily cloud-centric, which may introduce latency problems.

Recent work on urban parking optimization the use of integrated gadget gaining knowledge of fashions combines ensemble strategies along with Random Forest, Gradient Boosting, and LSTM to decorate prediction accuracy and resource utilization. These studies emphasize sustainability benefits, including reduced congestion and gasoline intake, however often lack special implementation info for real-time IoT deployment.

Overall, present literature demonstrates sturdy progress in either IoT-primarily based detection, AI-based totally prediction, or facet computing, but few studies fully combine all three additives right into a unified framework. The majority of systems offer both accurate tracking and predictive analytics, however not both in a real-time, scalable structure. In order to growth parking performance and sustainability, our studies focuses on creating an AI-driven IoT clever parking device that mixes sensor-based data gathering, facet/cloud intelligence, and predictive tool studying.

Methodology

The proposed AI-driven IoT smart parking device combines gadget getting to know-based prediction fashions with IoT sensing technology to offer proactive parking management. Initially, IoT sensors along with ultrasonic or infrared sensors are deployed in parking slots to constantly monitor car occupancy reputation. The collected statistics, including slot status, timestamps, and contextual parameters, is transmitted through a wi-fi conversation network to an IoT gateway and in the end stored in a cloud or area processing platform. The raw information undergoes pre-processing steps including cleansing, normalization, and feature extraction to put together it for analysis. Machine getting to know algorithms, inclusive of Random Forest or Long Short-Term Memory (LSTM) models, are then skilled the usage of ancient parking statistics to examine occupancy patterns and expect destiny slot availability. The educated version generates predictive insights which might be integrated right into a consumer utility, permitting drivers to view each actual-time and forecasted parking availability. The device overall performance is evaluated the usage of metrics together with prediction accuracy, latency, and resource performance to make sure reliability and scalability. Through this methodology, the gadget goals to reduce parking search time, enhance site visitors go with the flow, and make contributions to sustainable city mobility.

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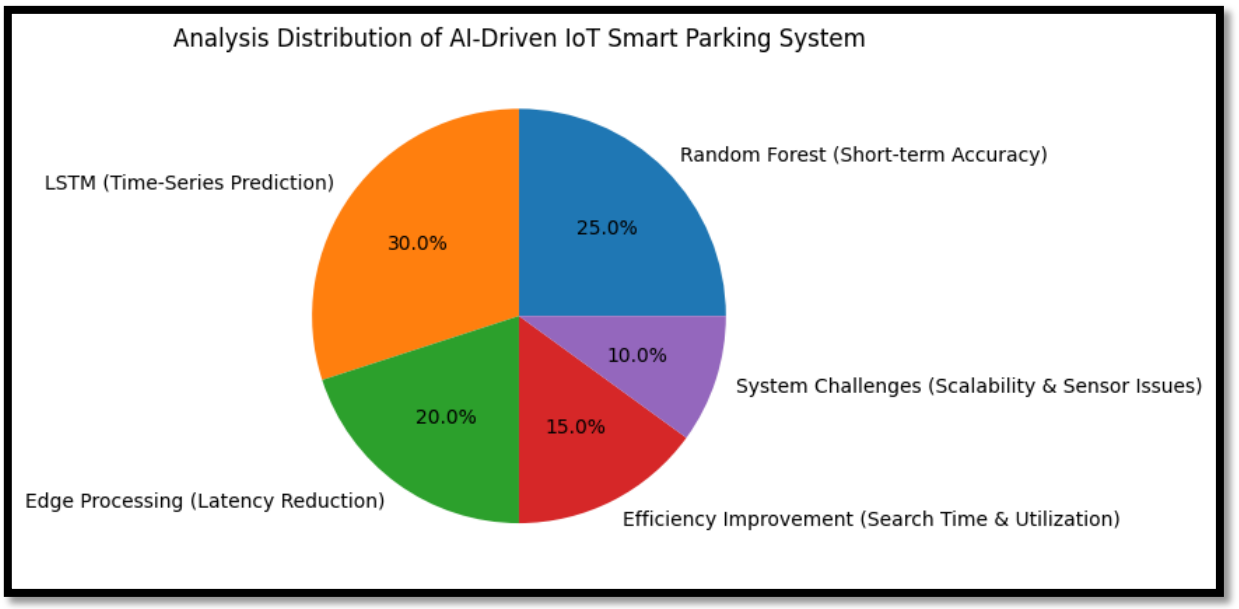
Results and Discussion

The proposed AI-driven IoT smart parking device became evaluated using real-time sensor statistics collected from parking slots and ancient occupancy datasets. Machine gaining knowledge of models, such as Random Forest and LSTM, had been trained to are expecting parking slot availability for future time durations. Experimental consequences showed that the predictive version achieved high accuracy in forecasting slot occupancy, with Random Forest presenting regular overall performance for brief-term predictions and LSTM appearing higher for time-collection sample reputation. The device effectively delivered actual-time parking updates along side predictive availability facts thru the consumer utility. Latency measurements indicated that area-assisted processing decreased response time as compared to cloud-best processing. In addition, the device established stepped forward parking management performance by using decreasing the average parking search time and optimizing slot utilization. Overall, the mixing of IoT sensing and AI prediction provided reliable and scalable performance appropriate for clever city environments.

The findings suggest that incorporating AI prediction into IoT-based totally completely parked systems greatly improves gadget efficacy whilst compared to standard real-time-best techniques. The exquisite forecast accuracy suggests that historic parking tendencies and temporal traits are sincere predictors of destiny space availability. Random Forest designs confirmed stability with sensor statistics, however LSTM patterns documented temporal associations, making them suitable for dynamic urban contexts.

Reduced latency via bite processing highlights the significance of allocated intelligence in actual-global worldwide IoT packages. Additionally, predictive guidance lessens useless car motion, which lowers visitors and fuel intake. However, demanding situations together with sensor inaccuracies, environmental interference, and scalability in large deployments had been discovered and must be addressed in future enhancements. Overall, the evaluation indicates that the advocated shape offers a proactive, sustainable, and green method of smart parking management.



Benefits

- **Less gasoline intake**: Predictive parking reduces wasted use and saves fuel through way of helping automobiles in rapidly locating available areas.
- **Lower emissions from a long way a whole lot much less cruising**: Spending a great deal much less time searching reduces vehicle movement, which improves air fine and reduces carbon emissions.
- **Reduced traffic from shifting motors looking for parking spots:** Green parking management improves city website traveller drift.
- **Supports smart metropolis sustainability dreams:** The gadget promotes strength-efficient transportation and useful resource efficiency, each of which may be constant with sensible and sustainable metropolis improvement

Challenges and Limitations

Implementing an AI-driven IoT clever parking machine involves numerous demanding situations. Sensor screw ups due to environmental situations, hardware damage, or verbal exchange loss can result in misguided occupancy detection and reduce machine reliability. Data imbalance, consisting of a huge number of empty parking slots all through off-peak hours, may additionally negatively have an effect on the performance of system getting to know fashions. Security threats are some other major situation, as IoT devices are at risk of cyberattacks, records interception, and unauthorized access. Additionally, scaling the system to town-big deployments introduces worrying situations associated with network bandwidth, facts manage, and computational resources, requiring green architectures and standardized communique protocols.

Future Scope

Future improvements can in addition improve the efficiency and intelligence of clever parking structures. Federated getting to know may be adopted to preserve person privateness with the aid of permitting allotted model training without sharing uncooked records. AI-powered dynamic pricing mechanisms ought to optimize parking utilization via adjusting expenses primarily based on call for and expected availability. Integration with self-enough cars is a few other promising direction, allowing self-riding motors to talk right away with parking infrastructure for automated parking choices. Furthermore, virtual dual simulation can be used to create virtual fashions of parking environments for attempting out and optimizing tool overall performance before actual-world deployment, helping smarter and further scalable metropolis mobility answers.

Conclusion

The proposed AI-driven IoT clever parking device complements conventional parking manage with the resource of introducing predictive intelligence along real-time monitoring. By combining IoT sensing technology with device gaining knowledge of algorithms, the tool allows proactive parking steering that reduces seek time, gas consumption, and site site visitors congestion. This approach contributes to sustainable city mobility with the aid of the use of enhancing resource usage and minimizing environmental impact. While disturbing conditions along with sensor reliability, security, and scalability stay, the outcomes show off the potential of integrating AI and IoT for clever parking manage. Future tendencies in area AI and clever metropolis integration are expected to further beautify device scalability, performance, and real-worldwide applicability.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

References

1. Shuguang Yang, Ruimin Ke, et al. (2020). *Deep Learning for Parking Occupancy Prediction Using Spatio-Temporal Data.* IEEE Transactions on Intelligent Transportation Systems.
2. Ruimin Ke, Yinhai Wang, et al. (2019). *A Real-Time Edge-AI Smart Parking Surveillance System.* IEEE Internet of Things Journal.
3. Luis Atzori, Antonio Iera, and Giacomo Morabito (2010). *The Internet of Things: A Survey.* Computer Networks.
4. Alex Krizhevsky and Ilya Sutskever (2012). *ImageNet Classification with Deep Convolutional Neural Networks.* Advances in Neural Information Processing Systems.
5. Sepp Hochreiter and Jürgen Schmidhuber (1997). *Long Short-Term Memory.* Neural Computation.
6. Leo Breiman (2001). *Random Forests.* Machine Learning Journal.
7. Tom M. Mitchell (1997). *Machine Learning.* McGraw-Hill Education.
8. Carlo Ratti, et al. (2018). *The Future of Urban Mobility and Smart Cities.* Nature Sustainability.
9. IEEE (2021). *Smart Parking Systems Based on IoT: Architecture and Applications.* IEEE Access.
10. International Telecommunication Union (2017). *Overview of Smart Sustainable Cities and IoT Applications.* ITU Publications.