

Intelligent Allocation of Urban Parking Spaces Using Computational Learning Models

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ABSTRACT

The challenge of urban parking stems from increasing vehicle numbers and static infrastructure. A machine learning-based platform is proposed to generate short-term parking occupancy predictions. Performance will be evaluated through interactive visual tools like bar graphs and accuracy analysis. The system also supports long-term strategic planning, leveraging data on vehicle movement to optimize both present and future parking usage. This research is grounded in real-world data collected over a five-month period within an actual urban environment. (January 2022 to June 2023) in a parking garage at a college is one of its main strengths. Some of the variables incorporated in this report are time, day of week, date, weather and seasonal changes, and the occupancy rates. As more cars fill up large cities with insufficient parking spaces, the parking problem in the cities is getting worse.

Due to population growth and a transportation system reliant on privately owned automobiles, Cities have far more cars than parking spots. Cities that are known for their traffic, fuel waste, sloth, air pollution, and decreased economic output are seriously threatened by this. The system will provide interactive bar graphs that indicate the precision of each machine as it learns the model during testing and training once the model has finished training.

Key Words: Urban parking, Parking, occupation, prediction, Machine learning, Smart parking Systems, Parking Infrastructure, Parking demand Forecasting and Predictive analytics.

INTRODUCTION

Urban dwellers are also under pressure to come up with efficient ways to run their parking lots and shops because to the over-sustainability of the cities.

Original authorities are facing challenges in managing parking due to space limitations and the necessity of vehicles for work-related conditioning. Traditional parking systems warrant the inflexibility to acclimatize to the dynamic requirements of civic areas, and homemade conservation further complicates the situation. Outdated megacity planning and regulations have made it delicate to address ultramodern demands. These limitations contribute to increased waste, business traffic, air pollution, and reduced quality of civic life. still, data- driven approaches using machine literacy and optimization ways could offer a smarter, more adaptable result to civic parking challenges.. Such systems are able to handle real-time parking info, forecast demand, and even set a variable allocation of vehicle storage- effectively alleviating congestion and ensuring that storage space is fully utilised. Additionally, these systems are readilintegrated with cloud-based platforms, Internet of Things (IoT) devices, and smart city infrastructures to enhance decision-making and ensure sustainable urban mobility.

LITERATURE REVIEW

[1] Title: Parking Services in Smart Cities: A Comprehensive Survey

Author(s): Y. Yang, S. Sun, Z. Qiao, and H. Zhu

Abstract:

This survey provides an in-depth analysis of parking services in smart cities, outlining both past advancements and current trends. The four main categories of parking services are: guidance technologies, advance booking systems, shared space usage, and dynamic pricing. The study highlights how these systems are evolving as a result of big data's growing. Significance. cloud

computing, and IoT. It highlights how important it is to collect and distribute data in real-time in order to improve availability and reduce traffic. The efficacy of several machine learning methods in parking management prediction and optimisation tasks is also examined. By comparing case studies from around the globe, the survey draws attention to issues like data heterogeneity, sensor reliability, and user privacy. This work serves as a foundational resource for researchers and urban planners developing intelligent and adaptive parking systems.

[2] Title: Parking Availability Prediction for Sensor-Enabled Car Parks in Smart Cities

Author(s): Y. Zheng, S. Rajasegarar, and C. Leckie

Abstract:

This paper proposes a predictive framework for estimating parking space availability in sensor-enabled car parks. By analyzing real-time data from embedded sensors, The authors develop ML models to forecast parking occupancy in the short term. The study employs time-series models and supervised learning techniques, particularly decision trees and support vector machines, to process and interpret data streams. The system significantly enhances user experience by reducing search time and improves traffic flow efficiency. Key contributions include sensor fusion techniques and the handling of missing or noisy data. The research concludes that accurate prediction models can be implemented in smart city infrastructures to optimize resource use and reduce emissions.

[3] Title: Prediction of Parking Space Availability in Real Time

Author(s): F. Caicedo, C. Blazquez, and P. Miranda

Abstract:

A real-time parking space prediction model based on traffic and occupancy This study presents data from urban parking lot Through mobile applications, the model helps drivers locate available spots and forecasts availability using artificial neural networks. To train their models, the authors gathered information on average parking durations, arrival rates, and departure rates. For short-term intervals (less than 30 minutes), their system achieves a prediction accuracy of over 85%. The study also looks at the effects of external factors like the weather, events, and public holidays. The model's performance demonstrates the viability of AI-powered solutions for real-time urban mobility management and driver convenience.

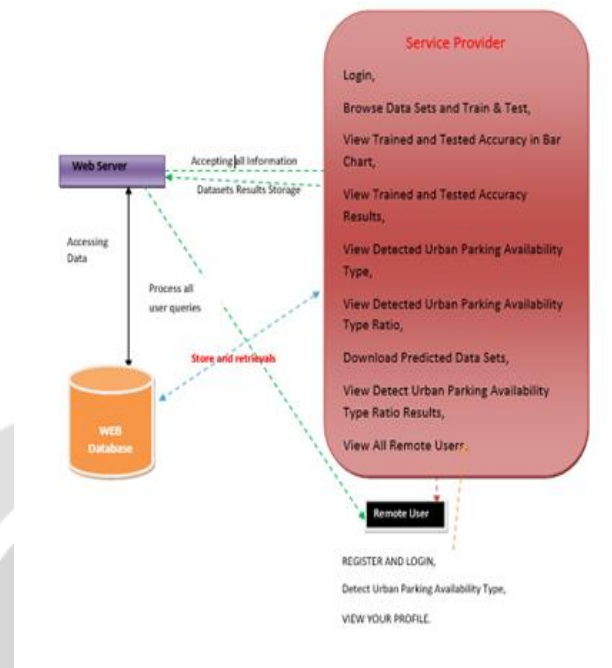
EXISTING SYSTEM

The nature of the traditional styles of civic parking operation systems has been homemade monitoring of parking areas, lack of dynamic structure and limited data analysis, which has created space waste and unsatisfying hassles of the parking guests. The traditional parking systems generally make use of mortal oversight, physical mediums similar as tickets to enter the system, and physical signage and only minimum stoner feedback, in real time. By making motorists drive round and round their places and parking lots in pursuit of available parking space, similar systems add to the air pollution, energy waste and traffic. similar approaches can give no prospective information and will fail to respond to the changing parking and trafficking needs in the metropolises. Over the once ten times, several smart parking results have been created to address these issues. numerous of them make use of IoT detectors. CCTV cameras and RFID are also common to cover the actuality of buses and refresh residency situations. similar systems are generally, still, reactive in the sense of only furnishing vacuity with a true real- time vacuity. also, utmost do n't retain advanced data analytics and can not honor trends in operation nor can they optimise parking spaces allocation across different time and locales.

PROPOSED SYSTEM

The proposed solution overcomes the drawbacks of existing parking management systems by integrating state-of-the-art machine learning models to produce a predictive urban parking efficiency framework. The system would aim to modernise the parking management by transitioning to being less reactive and more proactive based on the availability forecast and occupancy analysis that would leverage historical and real-time data. It relies on data-based strategies and smart city plans to enhance the user experience, minimise traffic, and utilise parking facilities to the best of their abilities. The details are first gathered in one of the university parking lots, considering factors such as the day of the week, weather conditions, and holidays of a national and academic nature. Variable data is pre-processed and feature-engineered to represent the user behaviour and trends over time to create a strong foundation to train and test a variety of machine learning algorithms.

Architecture



IMPLEMENTATION

Service Provider

The Service Provider module is the necessary part of the backend infrastructure of the smart urban parking prediction system. It mediates communication with remote users, supervises machine-learning processes, and data operations. This module demands secure authentication i.e. with a valid username and strong password, so that the unauthorized users with improper credentials cannot perform sensitive operations on the system. This technique of access control contributes to higher security and stability of the platform by preventing the use of vital functionalities by impersonators.

After the training phase on the model, the system presents interactive bar graphs depicting the training and testing accuracy on each model. Such visuals are critical when evaluating the performance of models and making an informed choice related to deploying models under consideration. The accuracy results are also displayed as numerical values in the system for a more advanced evaluation of the numbers and monitoring of the long-term showing.

Additionally, the module realises the possibility of searching in diverse forms of the available urban parking.

Using the trained machine learning model, the system predicts the type of parking availability for a given location and time—categorized into levels such as “Full,” “Partial,” or “Available.” The system’s prognostications help druggies and the administration plan ahead for business logjams, make the most of parking spots, and improve user experience in general. The system is able of taking and proposing the most feasible combination of projected parking types that when combined with the analysis of residency status and time grounded operation tendencies it's possible to formulate the most profitable parking blend. Relating the major trends similar as high on weekends and low during weekdays season is also salutary to the service providers. They convert into information a more common language with the backing of rate tables and the application of bar graphs. The linked findings can be explained by the prophetic modelling, which will enable collection of fresh data to make further rational opinions on the base of precluding the business logjams, easier parking and navigation. The pretensions will be to minimize time that's lost during searching and disquisition and also maximize the use of the available parking space.

View and Authorize Users

The View and Authorize Users module functions as the administrative control center for user management. It is specifically designed for system administrators or super users Utilizing Key machine literacy technic are Random Forest, Decision Tree and SVM, access control, and platform governance. This module allows the administrator to view the complete list of all druggies who have registered on the platform. Each stoner entry includes details similar as username, full name, dispatch address, physical address, and registration timestamp. This transparency allows the administrator to verify and validate the authenticity of the registrants.

RESULT

The urban parking management system has faced significant obstacles due to rising auto power and poor structure. Due to the growing number of motorcars owners and body growth in the communal areas there is now a distinction between the demand of the parking spots and the force of the available spaces. This insufficiency has led to low productivity, business, energy destruction and detriment to the terrain. Heritage parking systems are unreliable in erecting transportation needs as it's so manual and rigid. By covering the occupancy rates and detecting black rush using machine knowledge, the proposed system will radically meliorate on the parking situation in the cosmopolises. It's a dynamic garage control medium that utilises predictive analysis. It also predicts the car parking spot availability together with classifying(categorizing) the occupancy rate by the use of data in a parking garages of a college campus (January 2022 June 2023). Among the data are the temporal-spatial data (date, time, weather and weekday, season patterns and occupancy rates). After that, the data can be delved to identify complex patterns using machine learning algorithms, further strengthen forecasting performance. The objective of the system will be to eliminate time wasted in searching, optimise traffic spaces and reduce environmental expense as caused by congestion.



Fig. Result

CONCLUSION

The increasing demand for parking in urban environments has necessitated the development of intelligent systems capable of effectively managing and maximising available space. The project titled “Enhancing Urban Parking Efficiency through Machine Learning Model Integration” is a significant step forward in addressing this challenge using predictive analytics and data-driven technologies.

Using Important machine literacy ways like Random Forest, Decision Tree, and SVM, and Linear Regression, the system provides a dynamic and intelligent framework capable of forecasting parking space availability and classifying occupancy levels based on temporal and contextual data. Putting such a predictive system into practice not only reduces the stress and The amount of time spent looking for parking but it also helps to reduce traffic congestion. lowering emissions, and enhancing overall urban mobility. The system was developed based on data collected from a college campus parking facility, where real-world parking behavior was analyzed through various features like the day of the week, time of day, academic calendar, and seasonality. To properly train the machine learning models, these features were chosen and preprocessed.. Among the models tested, Random Forest emerged as the most accurate and reliable due to its ensemble nature and ability to handle nonlinear relationships between features.proving effective in certain analytical scenarios. The dual-model approach, combining regression and classification strategies, allowed the system to provide both numeric and categorical insights into parking availability, increasing usability for both administrators and end-users.

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