Metropolitan Pay2Park System

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Abstract : With the increasing number of vehicles on city streets, finding parking spaces has become increasingly difficult. This leads to drivers spending more time and fuel circling streets in search of parking, contributing to city congestion. To address this issue and align with the trend of developing smart cities, various techniques used by smart parking systems are being evaluated. One such technique involves a mobile sensing unit attached to vehicles, which measures the distance to the nearest roadside obstacle and utilizes supervised learning algorithms to estimate parking occupancy. This system's accuracy is significantly improved when coupled with precise GPS readings and map matching techniques. Furthermore, the adoption of smart parking systems not only enhances convenience for drivers but also promotes environmental sustainability by reducing unnecessary fuel consumption and emissions. By optimizing parking space utilization, smart cities can effectively alleviate traffic congestion and improve the overall quality of urban life.

Keywords: *: vehicles, parking spaces, city streets, congestion, smart cities, smart parking systems, mobile sensing unit, supervised learning algorithms, GPS readings, map matching techniques, convenience, environmental sustainability, fuel consumption, emissions, traffic congestion, urban life.*

I. INTRODUCTION

It remains a common challenge for individuals to find suitable parking spots for their cars. For example, drivers often struggle to locate available parking spaces in a timely manner, especially when navigation assistance is unavailable due to GPS issues. Consequently, the difficulty in finding parking leads to unnecessary driving around in search of a spot, resulting in increased carbon dioxide emissions and environmental degradation, particularly in densely populated urban areas during peak rush h s.

The availability of parking spaces varies greatly across different locations, with some areas having an excess while others are scarce. Pricing policies have historically played a significant role in determining parking availability. This raises an important question: should focus on creating more parking spaces or improving parking management practices? advocate for the latter, emphasizing the importance of fair and effective pricing policies. Historical data suggests that adjusting parking prices based on anticipated demand can help balance supply and demand, ultimately increasing overall utilization.

Ho ver, solely relying on historical data may not always yield accurate results. In metropolitan locations where parking congestion is a major concern, the proposed parking management system seeks to completely transform the way vehicles are parked. The system offers a practical remedy for the problems that conventional manual parking systems encounter by automating the recording of arriving and departing vehicles. Administrators may quickly retrieve car records using vehicle numbers thanks to the system's user-friendly interface, which simplifies data management and lo rs the possibility of errors. The b-based application is specifically made for urban settings and reduces data entry errors to ensure efficient and seamless operations. Reducing parking issues that are frequently experienced in public spaces like malls, hospitals, and businesses is one of the system's main goals. The system optimizes res ce use and saves users time and effort by doing away with the necessity for people to physically look valuable data for urban planning and traffic control. By tackling the complexities of urban parking, the Metropolitan Pay2Park Management System aids in establishing more accessible, orderly, and eco-friendly metropolitan settings. Therefore, the application is designed to be user-friendly. The parking management system outlined above aims to create an errorfree, secure, reliable, and fast system. This will assist organizations and public spaces in maximizing res ce utilization. Presently, many public venues such as malls, theaters, hospitals, offices, and market areas face significant parking challenges. Drivers often struggle to find parking spaces, leading to manual labor and financial investments. application aims to alleviate these issues by providing a low-cost, secure parking solution, reducing the risk of vehicle towing. Moreover, the application will not only benefit individual users but also provide valuable insights for parking administrators. Through an administrative dashboard, administrators can monitor bookings, track occupancy rates, and generate reports for informed decision-making and res ce allocation. goal is to develop a scalable and user-centric application that enhances the parking experience for vehicle owners while improving traffic management and parking space utilization in urban settings.

In today's bustling metropolitan landscapes, urban mobility poses significant challenges, with parking management emerging as a critical aspect of urban infrastructure. the demand for parking spaces escalates, exacerbating issues like traffic congestion, environmental pollution, and revenue collection inefficiencies for municipal authorities. The development of a mobile application tailored to metropolitan pay-to-park systems presents a transformative solution, offering a myriad of advantages for both users and city administrations alike.

With the ubiquity of smartphones, the application provides users with a seamless experience, allowing them to effortlessly locate available parking spots, make payments, and even extend parking durations—all from the palm of their hand. This eradicates the inconvenience of queuing at physical payment meters or kiosks, streamlining the parking process and saving valuable time for urban d llers on the go.

Moreover, the app's real-time parking availability revolutionize the way users navigate urban landscapes. By providing instant information on nearby parking options, including street parking and garages, as ll as pricing dynamics, drivers can make informed decisions, optimizing their parking experience.

Moreover, the app offers various payment methods to meet the needs of different users, including credit/debit cards, mobile wallets, and prepaid accounts. This adaptability improves user experience and enc ages more people to use the pay-to-park system, thereby increasing revenue for city authorities.

II. LITERATURE SURVEY

In the early stages of parking management, systems primarily operated manually, requiring human personnel to oversee parking areas and manage fee collection. This manual approach involved parking attendants directing vehicles to available spaces, issuing tickets or permits, and collecting payments from parkers upon entry or exit. Ho ver, with technological advancements, parking management under nt a profound change. Automated systems emerged streamline and improve the efficiency of parking operations. Furthermore, electronic payment methods revolutionized the collection of parking fees. Instead of relying solely on cash transactions managed by attendants, users now have the flexibility to make electronic payments using options like credit cards, mobile payments, or prepaid parking cards. This shift to electronic payments not only enhances convenience for users but also improves revenue collection for parking operators while reducing the risk of cash theft or mishandling. Overall, the transition from manual to automated parking systems signifies a significant progression in parking management technology.[1]

This paper introduces the role of infrared and ultrasonic sensors in parking management systems, which are vital for detecting vehicle presence within parking spots. These sensors operate by sensing environmental changes, such as the presence or absence of a vehicle, and relay this data to the parking management system. Ticketing is another integral aspect of automated parking systems. Rather than manual ticket issuance, automated ticketing systems enable users to receive tickets automatically upon entering the parking facility, eliminating the need for attendants to issue tickets or collect payments. Ho ver, advancements in technology have reduced the necessity for human involvement in the ticketing process. Barrier controls also play a critical role in automated parking systems, equipped with sensors and automated mechanisms to regulate access based on ticket validation or electronic permits. By automating entry and exit procedures, barrier controls facilitate traffic flow management within the parking facility and optimize space.[2]

This paper presents a groundbreaking application of machine learning (ML) in parking management systems, where video feeds are analyzed to determine available parking spaces. This innovative approach harnesses artificial intelligence to automate the identification and monitoring of parking availability in real-time. By utilizing machine learning for this purpose, parking management systems can achieve increased automation, efficiency, and precision in monitoring parking space availability. This technology not only benefits drivers by providing immediate parking information but also enhances overall parking facility management, resulting in improved traffic flow and customer satisfaction[3]

A comprehensive approach to parking management involves integrating diverse technologies and services to create a holistic solution that improves urban mobility. This strategy aims to tackle urban parking challenges by providing drivers with updated information, reservation options, and convenient payment methods. Let's explore each aspect further. Real-time information entails delivering current data on parking space availability, traffic conditions, and other pertinent factors to urban drivers. By employing sensors, cameras, and IoT devices, parking management systems continuously monitor parking spots and collect occupancy data. This real-time data is then made accessible to drivers via mobile apps, bsites, or digital displays, empo ring them to make ll-informed decisions about parking locations. Furthermore, advancements in technology have led to significant changes in parking management. Automated systems have emerged as a solution to streamline and improve parking operations' efficiency. These automated systems have transformed how parking facilities are managed, enhancing the overall parking experience for operators and users alike. Ho ver, as technology continued to advance, parking management under nt a significant transformation. Automated systems emerged as a solution to streamline and enhance the efficiency of parking operations. These automated systems revolutionized the way parking facilities re managed and optimized the overall parking experience for both operators and users alike.[4]

Parking guidance and information (PGI) systems are believed to enhance the control and management of traffic and the utilization of available spaces in urban areas. Although these systems have been installed in numerous cities and have been operational for some time, their usage levels are considerably below anticipated levels.

The aim of this paper is to assess how various forms impact system performance through a simulation model. This model comprises three sub-models: demand, performance, and information service. It is structured to depict the dynamic interplay bet en demand and system performance, allowing for the analysis of fluctuations in drivers' parking decisions over time and the resulting congestion in parking areas.[5]

The availability of spaces varies greatly across different locations, with some areas having an excess while others are scarce. Pricing policies have historically played a significant role in determining parking availability. This raises an important question: should focus on creating more parking spaces or improving parking management practices? advocate for the latter, emphasizing the importance of fair and effective pricing policies. Historical data suggests that adjusting parking prices based on anticipated demand can help balance supply and demand, ultimately increasing overall utilization. Ho ver, solely relying on historical data may not always yield accurate results.[6]

III. METHODOLOGY

Proposed System:

The proposed system follows the waterfall model methodology to ensure systematic development. In the Requirement Gathering and Analysis phase, thorough research and stakeholder consultation will identify project needs. System Design focuses on creating a user-friendly architecture using UML diagrams. Implementation involves coding modular units, each rigorously tested in Unit Testing. Integration Testing ensures compatibility, leading to System Testing for overall performance. Deployment involves transitioning the system into the customer environment or market with proper documentation and support. Maintenance ensures ongoing updates and bug fixes, addressing evolving requirements. Through this structured approach, the system aims to deliver a reliable, scalable solution meeting stakeholder expectations.[5]

The process of assessing parking space utilization based on car driver trips recorded in travel surveys involves a sequential analysis to track the movement of vehicles over time and space. This enables the examination of user behavior regarding parking space usage throughout a typical day during the fall period when the survey was conducted. Further details on the data s ces will be provided later. The manual parking capacity of an area is determined by observing the maximum accumulation of vehicles throughout the day. The validation approach proposed in this study combines various methods, some of which are derived from traditional techniques such as field surveys and conventional measurements, while others utilize ne r tools like Google Street View, OpenStreetMap, and other publicly available geographic information s ces.[15]

A parking management system is utilized to maintain records of vehicles entering and exiting a parking facility, simplifying data retrieval for administrators by enabling them to access vehicle information using license plate numbers. This record is crucial for authorizing access to the Vehicle Parking Management System. It assigns usernames and passwords to users (staff), categorizing them based on their level of authority, thereby distinguishing bet en regular users and administrators.

1. System Architecture:

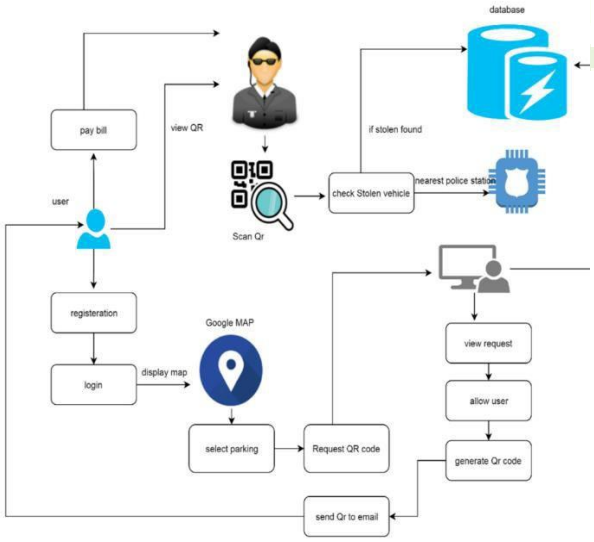

Figure 1- System Architecture

The The method proposed for assessing parking space utilization based on car driver trips recorded in a travel survey adopts a sequential processing technique. This method monitors car movements over time and space, enabling the examination of parking space usage patterns throughout a typical day during the fall period specified in the survey. Further elaboration on the data s ces utilized will be provided later in the study.[10] The manual parking capacity of an area is determined by identifying the maximum accumulation of vehicles observed during a day, shedding light on the peak demand for parking spaces in that area. The validation strategy outlined in this study combines various methods, drawing from traditional techniques like field surveys and conventional measurements, as ll as ne r approaches utilizing OpenStreetMap and other publicly available geographic information s ces. By incorporating diverse data s ces and methodologies, the validation process aims to ensure the accuracy and reliability of the parking space utilization analysis. This system facilitates easy retrieval of vehicle visit data using license plate numbers, streamlining authorization for the Vehicle Parking Management System. Furthermore, it assigns usernames and passwords to users, distinguishing bet en regular users and administrators based on their level of authority. This hierarchical access control mechanism ensures that only authorized personnel can access and manage sensitive parking data, thereby enhancing security and accountability within the system.. In summary, the proposed method for evaluating parking space utilization and the accompanying parking management system offer comprehensive solutions for understanding and optimizing parking operations. By blending traditional and innovative approaches, these methods strive to tackle the challenges associated with parking management in urban environments while ensuring user-friendly operation and robust security measures.[3]

2. Algorithm:

This module provides the user with the flexibility of registering, logging in, booking and making the payment. If the user is new to the application, then, the user must register in the application by providing the user's details. After the registration, the user logs in using the user-id and password. Once the user logs in, then the user browses the parking slot then books that parking slot follo d by the making the online payment.

Administrator Module :[7,8]

This is the operative module of the application. It works in the backend for managing the database and performs various operations on it. The administrator stores all the user's data in the database as soon as he gets registered with the application. Administrator maintains the details of all parking slots (both empty and reserved), their price for booking, user details in database and the modification on these data is only can be done by the administrator. The administrator also provides the payment method to the user.

Booking Module :

This is the main module of the application and it deals with the booking of the parking slot. When the user is ready for booking then the booking module comes in the scenario to provide user the necessary information for booking. The available slot, cost to book the slot and the necessary processing in regards to these, are done by this booking module.

Client Side :

1. Start the application:

The person desires to put in the application on his Android primarily based totally device. After installation, the icon of the app will function at the Home Screen of the person's device. App lcome display might be flashed to the person on beginning the software.

2. Registration:

For the first use, users need to register their details on the application, a one-time process. Required information includes name, gender, phone number, and email. These details are securely stored on the server. Slot booking is mandatory and must be done a day before arrival. The parking owner also registers available slots for different vehicle types and sets corresponding fees on the server.[9,11]

3. Login:

Once the user registers, he can use his email id and phone number to login in future. This authenticates the user.

4. Selection of location for parking:

Users are presented with several parking locations and must choose one where they wish to park their vehicle. [16]

5. Select vehicle type:
After selecting the location, options for the vehicle type are provided i.e., 2-wheeler or 4-wheeler alongside the rate chart for parking charges is prompted.

6. Availability:
The system displays slot availability based on selected vehicle types, utilizing color-coded indicators. Grey denotes vacant slots, while red signifies full occupancy. Total reserved slots for each vehicle type are also shown. This setup facilitates easy identification of available and occupied slots, streamlining the reservation process for users.[12]

7. Payment:
On availability of empty slot, the consumer can verify his reserving of his preferred slot. After booking a specific slot, the use can continue to the charge alternative in any other case terminate the complete process. The system requires full payment in advance /Hence, the person needs to provide all his card info to book his preferred slot. After a success payment he gets a slot number, each to his cellular and mail. [13,14]

Upon successful reservation, users are directed to an editable confirmation page displaying their information, with a green indication denoting the reserved parking slot. The Parking Dashboard enables efficient slot distribution, allowing parking owners to manage allocations and deallocations. Administrators log in with a username and password, gaining access to features such as adding/viewing parking locations, managing users, bookings, and feedback. They can also view all users, bookings, and feedback, responding or deleting comments as needed. After completing tasks, administrators can log out by clicking the logout button, ensuring secure access control and data management.

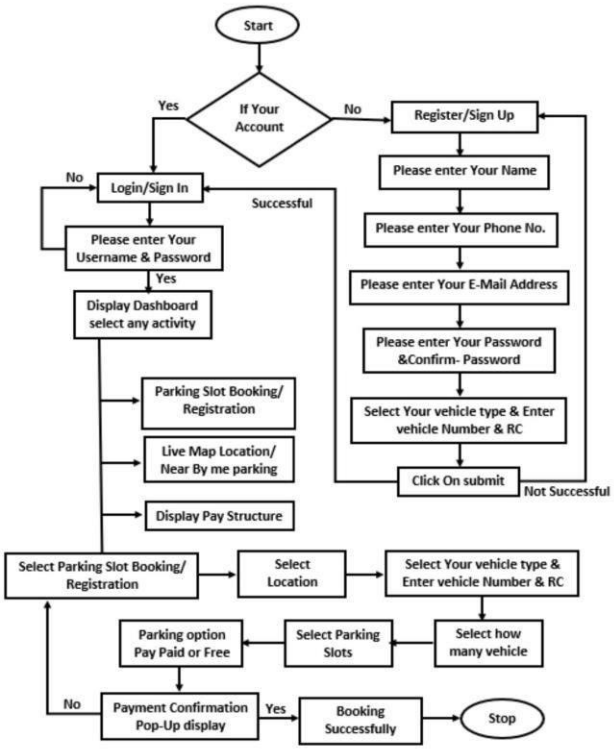

Figure 2- System Algorithm

IV. RESULTS

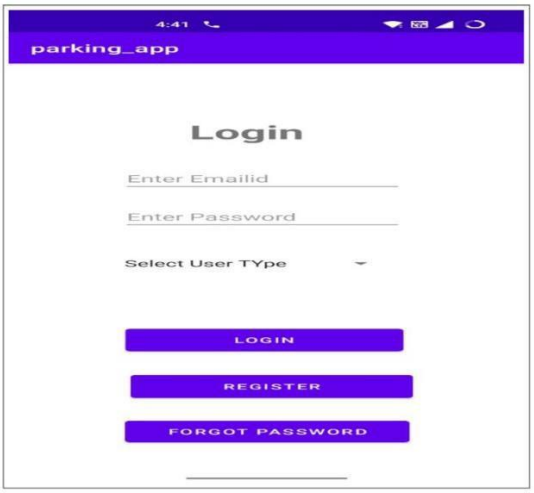

Fig 3. Frontend

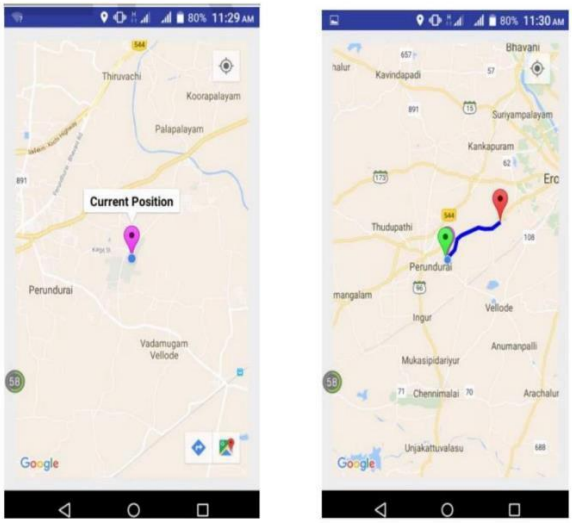

Fig 4. Location for user

Fig.5 Placeorder

V. APPLICATION ADVANTAGE

Developing a mobile app for urban pay-to-park systems provides numerous benefits. It offers users convenience by enabling them to easily locate parking spots, make payments, and extend parking durations remotely. Real-time updates on parking availability and pricing enhance decision-making. Flexible payment options, such as credit cards or mobile wallets, improve user experience. The app reduces traffic congestion by facilitating quicker parking spot identification, leading to smoother traffic flow. For city administrations, it automates revenue collection processes and provides valuable insights through data analytics, optimizing parking management strategies. Moreover, it enhances enforcement efficiency and fosters customer engagement through information dissemination and promotions.

VI. CONCLUSION

The eParker system 've developed is a novel smart parking solution based on a MILP model. It optimally allocates parking res ces to users through both real-time and share-time reservations, offering flexibility in booking. 've also introduced pricing strategies for static and dynamic reservations to maximize parking profitability. Additionally, 've integrated navigation features to guide users to parking areas from their current location. Extensive simulations demonstrate that system significantly reduces the overall cost for all users, showcasing its effectiveness in improving parking management.

VII. Acknowledgment

We are grateful for the insights of urban planners, municipal authorities, and researchers, as ll as the innovation of developers. Thanks to the input of residents and commuters, and the guidance of mentors and colleagues, this exploration of mobile applications in parking management has been enriched. The commitment of advocates for sustainable urban development inspires us all. In recognizing the collaborative nature of this endeavor, We humbled and motivated to contribute to the advancement of smarter, more sustainable cities.

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