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Online Parking Booking System.

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***Abstract*—** With the rapid growth of urban populations, efficient management of parking spaces has become a critical challenge for modern cities. Traditional parking systems often lead to congestion, wasted time, and increased carbon emissions. In response, Online Parking Booking Systems (OPBS) have emerged as a promising solution to streamline parking operations, improve user experience, and optimize space utilization.

Keywords *– Online Parking Booking Systems, Urban Areas, Parking Management, Efficient Parking, Space Utilization,Traffic Congestion*

I. INTRODUCTION

In big cities, finding parking can be a big headache. You might drive around for ages looking for a spot, wasting time and fuel. But there's a solution that's making things easier: Online Parking Booking Systems (OPBS). These systems help you find and book a parking space before you even leave your house. It's like reserving a seat at a restaurant! **[1]**

This paper is all about OPBS and how they're changing urban parking. We'll talk about how they work, like using apps on your phone to find available spots in real-time. Plus, we'll explore the cool technology behind OPBS, like sensors and computers that make it all possible.

We'll also look at how OPBS are making cities better by reducing traffic jams and pollution. Through examples from different cities, we'll see how OPBS are improving the way we get around town.

How do these systems work their magic? Well, it's all thanks to smart technology. With OPBS, you can use your phone or computer to see which parking spaces are available in real-time. Some even show you prices and let you pay online. Behind the scenes, databse senses the available parking lots detect when a space is empty or full, updating the system instantly. It's like having your own personal parking assistant, right in your pocket.

The benefits of OPBS go beyond just convenience. They're also helping to make our cities cleaner and less congested. By reducing the time spent circling for a spot, OPBS cut down on traffic jams and emissions from idling cars. Imagine a city where you can zip from place to place without getting stuck in gridlock – that's the promise of OPBS.

Despite all the good they bring, OPBS do face some challenges. Privacy is a big concern – when you book a spot online, you're sharing personal information. There's also the question of how well these systems will scale as more and more people use them. Will they be able to handle the demand during peak times? These are questions we'll explore as we dive deeper into the world of Online Parking Booking Systems.

So, whether you're a city dweller tired of endless parking hunts or a policymaker looking for ways to improve urban mobility, this paper will shed light on how OPBS are changing the game. Get ready to explore the world of smarter, more efficient parking solutions with Online Parking Booking Systems.

Looking at examples from around the globe, we see the impact OPBS can have on urban life. In cities like Amsterdam and Singapore, these systems have revolutionized the way people park. They've turned chaotic parking lots into orderly spaces, where drivers can easily find a spot without adding to the city's traffic woes. **[5]**

Today with the increased utilization of internet surfing, the enormous info produced is not only in textual form but more and more images and videos are being used to convey one's opinions. There has been significant amount of research on analyzing textual data but research related to other modalities of data including image, speech and video content has been limited.

II. PREVIOUSLY AVAILABLE TECHNIQUES

Before the advent of Online Parking Booking Systems (OPBS), urban parking management relied on traditional methods that often led to inefficiencies and frustrations for both drivers and city planners. Here are some previously available techniques:

A. Manual Parking Management

[1] In the past, parking spaces were managed manually by parking attendants. These attendants would collect fees, guide drivers to available spots, and enforce parking rules. While this method provided a human touch, it was labor-intensive and limited in its ability to efficiently utilize parking spaces.

Thereafter, while functional to some extent, often fell short in providing a seamless, efficient, and user-friendly parking experience. They lacked the real-time updates, convenience, and optimization that OPBS now offer. The evolution from these traditional methods to the sophisticated technology of OPBS signifies a significant shift towards smarter, more user-centric urban parking solutions.

Further the limitations of these previously available techniques highlighted the need for a more advanced and efficient solution in urban parking management. Manual methods, such as parking attendants and pay-and-display machines, were labor-intensive and prone to errors, leading to frustrations for both drivers and parking authorities. Parking meters and permits offered some control over parking, but they lacked the flexibility and real-time information that modern drivers require.

III. Online Parking Booking System.

A. User Registration.

The first step for a user is to create an account on the OPBS platform. This typically involves providing personal information such as name, email address, and phone number. Users may also set preferences such as preferred parking locations, vehicle details, and payment methods.

B. Finding Available Parking.

Once registered, users can log into the OPBS platform via a website or mobile app. They can then search for available parking spaces based on their desired location, date, and time. The system will display a list of available options, including details such as location, pricing, and availability status.

C. Selecting Parking

After viewing the available options, users can select the parking spot that best suits their needs. They may consider factors such as proximity to their destination, pricing, and any specific preferences they have set.

D. Booking and Payment

Upon selecting a parking spot, users proceed to book it. They will typically see a summary of their booking, including the date, time, location, and total cost. Users then make a payment through the OPBS platform using their preferred payment method, such as credit/debit card or mobile wallet. capable of emotion detection, such as CNN's, Support Vector Machines, Gaussian mixture models, random forests, Recurrent Neural Networks (RNN's), etc.

E. Confirmation

Once the payment is processed successfully, the system generates a booking confirmation for the user. This confirmation includes details such as the booking reference number, parking location, date, and time. Users may receive this confirmation via email or within the app.

F. Navigating to the Parking Spot

On the day of the booking, users can use the OPBS app to navigate to the selected parking spot. The app may provide directions using GPS, helping users reach the location efficiently.

G. Accessing the Parking

At the parking location, users can typically access the designated spot using various methods. This may include scanning a QR code provided in the booking confirmation, using a digital pass within the app, or even automatic recognition through license plate readers in some advanced systems.

H. Parking and Departure

Users park their vehicles in the reserved spot and can enjoy their activities knowing they have a guaranteed parking space. When it's time to leave, users can simply exit the parking area, with the OPBS system automatically registering their departure.

I. Feedback and Reviews

Following theconvolutional and pooling layers, CNNs often include one or more fully connected layers. These layers connect every neuron in one layer to every neuron in the next layer, enabling high-level feature representation and classification.

Training:

- **User Authentication**:
  - Users are authenticated using JWT tokens.
  - Training involves setting up authentication routes and middleware to protect endpoints.

- **Booking Process:**
  - Training includes implementing booking logic, such as checking for available spaces, handling conflicts, and generating booking confirmations.

- **Payment Processing:**
  - Integration with the Stripe API for payment processing.
  - Training involves setting up payment routes and handling successful and failed transactions.

- **Frontend-Backend Integration:**
  - Training includes establishing communication between the frontend and backend using RESTful APIs.
  - Redux is used for managing application state, and Axios is used for making HTTP requests.

- **Data Modeling:**
  - Training includes defining schemas using Mongoose for storing parking space and user data.
  - Ensures data consistency and integrity within the MongoDB database.

IV. ACTUAL WORK

In this section, we will learn about the actual implementations which we carried out in this research.

1. LIBRARIES USED

a. Frontend

- React.js
- Material UI and UI Components
- Redux for state management
- React Rounder for Navigation

b. Backend

- Node.js
- Express.js
- MongoDB for the database
- JWT for authentication

2. DATASETS

a. Parking Spaces Dataset

- This dataset includes information about available parking spaces in urban areas, such as location coordinates, pricing, availability status (occupied or vacant), and any specific restrictions.
- Source: OpenStreetMap API for geographical data, supplemented with manual updates from city parking authorities.

b. User Dataset:

- This dataset stores user information, including names, email addresses, hashed passwords, vehicle details (e.g., license plate numbers), and payment methods.
- Source: User registrations through the OPBS platform.

3. FEATURE EXTRACTION.

Feature extraction is a critical step in designing the Online Parking Booking System (OPBS), encompassing a range of attributes from various sources. During user registration, features such as user demographics (name, email), vehicle details (license plate number, vehicle type), and preferred payment methods are extracted, facilitating personalized user profiles. Real-time parking space availability features, derived from IoT sensors in parking lots, provide updates on vacant spots, location coordinates, pricing, and restrictions, enhancing user convenience. Booking and payment features include details like booking timestamps, selected parking space ID, and chosen payment methods, ensuring accurate reservations and secure transactions. Feedback and ratings features capture user comments, ratings, and timestamps post-parking, aiding in user satisfaction analysis. IoT sensor data features encompass real-time occupancy status, sensor IDs, and timestamps, optimizing data accuracy.

User interaction features, such as login/logout timestamps, search queries, and booking history, contribute to personalized recommendations and improved search functionality. These extracted features collectively form the backbone of the OPBS, enabling efficient parking management, personalized user experiences, and continuous system enhancement through user feedback analysis and real-time updates.

4. MODEL SELECTION

a) Recommendation System:

- If the OPBS wants to provide personalized parking spot recommendations to users based on their past preferences, a recommendation system could be implemented.
- Model: Collaborative Filtering (e.g., Matrix Factorization, Singular Value Decomposition) or Content-Based Filtering.
- Purpose: To suggest parking spots that users are likely to prefer based on their historical bookings or specified preferences.

***b)* Predictive Analytics for Parking Availability:**

- Improve the accuracy of predicting parking spot availability in real-time, machine learning models can be trained on historical parking data.
- Model: Time Series Forecasting (e.g., ARIMA, Prophet) or Machine Learning Regression (e.g., Linear Regression, Random Forest).
- Purpose: Predict the likelihood of a parking spot being occupied at a given time, helping users make informed decisions when booking.

c) Demand Prediction:

- Predicting future demand for parking in specific areas can help in proactive management and resource allocation.
- Model: Time Series Forecasting, Machine Learning Regression, or Deep Learning models.
- Purpose: Forecast the expected demand for parking in different urban areas or time slots, aiding in efficient planning and pricing.

5. TRAINING

The training process for the Online Parking Booking System (OPBS) is comprehensive, ensuring the system's functionality, security, and efficiency. User authentication training involves setting up secure routes using JWT tokens and middleware for sensitive endpoints. Booking process training covers logic for checking available spaces, handling conflicts, and generating confirmations with accurate timestamps. Payment processing training integrates the Stripe API securely for transactions. Frontend-backend integration training establishes communication using RESTful APIs, Redux for state management, Axios for HTTP requests, and React Router for navigation. IoT sensor integration training includes setting up communication and updating parking availability in real-time.

6. SIMULATION SETUP

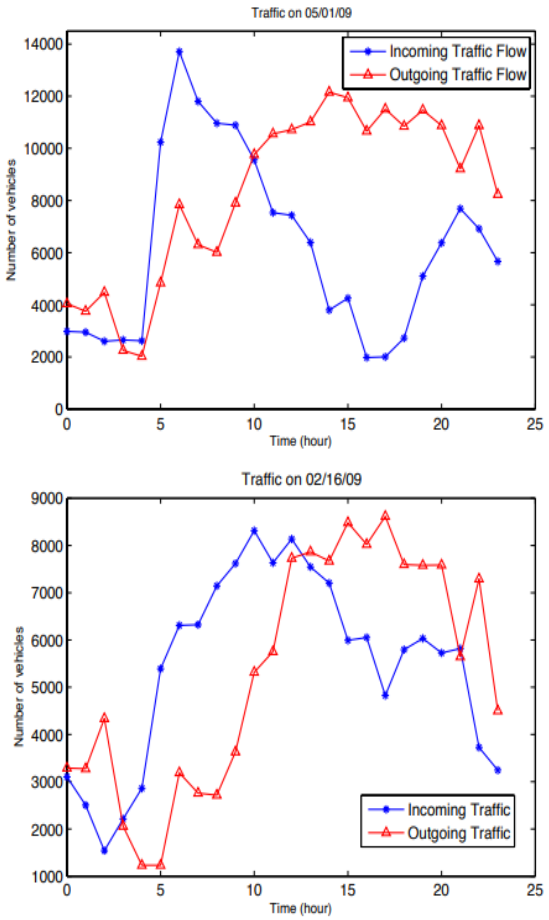

Fig.1.1 Incoming and Outgoing Traffic Flows

Furthermore, **Fig. 5.2** illustrates the incoming and outgoing traffic in two different days. As we see, the peak time of incoming traffic is from 6am to 10am, and the rush hour of outgoing traffic is during 5pm to 8pm. It matches people's regular schedule, in the morning most people drive to work and go back home after 5pm. Therefore, the traffic trace is reasonable to generate the parking demand in the simulation. Furthermore, we assume that the users' budget distribution follows the Gaussian distribution at a certain range from 1 to 10. If the budget is less than 1, we force it to be 1, and if it is larger than 10, we set it to 10.

7. EXPERIMENTAL RESULTS

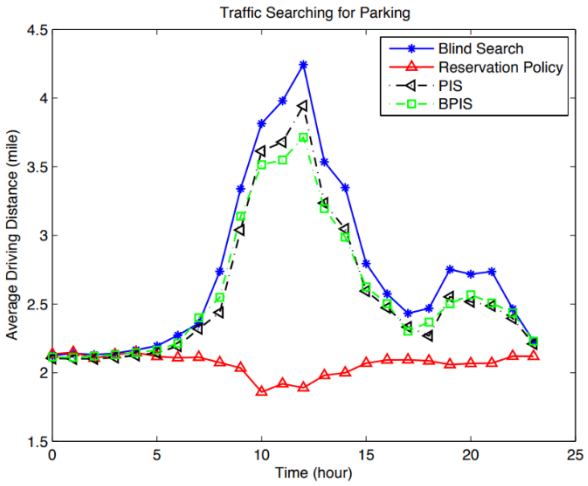

Fig 1.2 Traffic Searching for Parking Comparison under Different Parking Guidance Strategies

As we discuss in Chapter 1**, Fig. 1.2** shows that the driving distance under blind search is the worst, especially during the peak hours; PIS and BPIS are better than blind search when traffic flows increase; and the reservation policy is the best 41 compared with others. Note that, in this simulation, there is no pricing scheme implemented in reservation policy

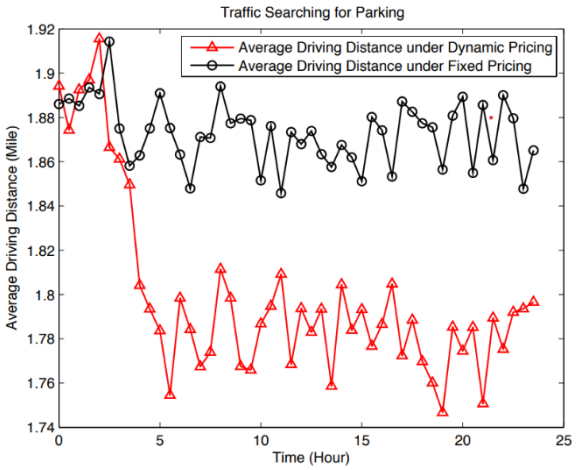

Fig. 1.3 Traffic Searching for Parking under Different Pricing Schemes

As shown in **Fig. 1.3**, by implementing the dynamic pricing scheme, the average driving distance of all users for parking searching can be reduced. In general, a user under dynamic parking price will select a parking lot that can provide the highest benefit. In contrast, under fixed pricing, each user cannot learn the related parking information from the price and is only concerned about the walking distance.

V. REFERENCES

Various sources which were used while conducting this study are listed below. These include research papers and journals from other authors and other available articles over the web.

[1] Research Paper on **"A Reservation-based Smart Parking System"** by Hongwei Wang ,University of Nebraska-lincoln.

[2] A Research Paper on **"Parking lot management system based on space navigation technology"** by Ruixuan chen, Xingyan Hu, Wei Mu.

[3] A Research paper on **"Smart Parking-An integrated solution for urban setting"** Naman Dhariwal, Sri Chander Akunuri, Shivama, And K. Sharmila Banu.

[4] A paper on **" Web based framework for smart parking system"** by Awad Alharbi, George Halikias, Mohammad Yamin, Adnan Ahmed Abi Sen.

[5] Web Source: Wikipedia, Google Search