

A Web-Based Community Parking System for Efficient Utilization of Private Parking Spaces

Naveen M Kumar¹, Shashwath S², Disha S³, Diya S Naik⁴, Prof Shruthi⁵

^{1,2,3,4,5}*Department of Computer Science and Engineering, Shree Devi Institute of Technology Mangaluru, Karnataka, India*

Abstract—Parking difficulties are increasing due to the growing number of vehicles and limited availability of parking spaces. Drivers often spend considerable time searching for suitable parking, while many privately owned parking spaces remain unused. This paper presents a web-based community parking system that connects parking-space owners with drivers. The proposed system allows property owners to list and manage available parking spaces, while drivers can search for nearby spaces using location-based services, view availability, and make parking reservations. The system is developed using HTML5, CSS3, JavaScript, Bootstrap, Python Flask, MySQL, and Jinja2. The proposed approach aims to improve the utilization of existing private parking spaces and provide a convenient mechanism for drivers to find and reserve suitable parking spaces.

Index Terms—community parking, parking reservation, private parking spaces, location-based services, web application, parking space utilization

I INTRODUCTION

The rapid increase in the number of vehicles has created significant challenges in finding and managing parking spaces, particularly in areas where parking availability is limited. Drivers may spend considerable time searching for suitable parking spaces, which can contribute to traffic congestion, unnecessary fuel consumption, and increased carbon dioxide emissions. Illegal roadside parking can further create inconvenience and safety concerns for other road users. In addition, privately owned parking spaces may remain unused for significant periods of time.

Existing smart parking research has explored several approaches to address parking-related problems, including realtime parking-space detection,

occupancy prediction, online parking reservation, Internet of Things (IoT) based systems, navigation, privacy protection, and web-based parking applications. These approaches demonstrate the potential of digital technologies to improve parking management. However, within the set of studies reviewed in this work, comparatively less emphasis is placed on connecting unused private parking spaces with drivers who require parking.

To address this issue, this paper presents a web-based community parking system that connects parking-space owners with drivers. The proposed system allows property owners to list and manage unused parking spaces, while drivers can search for nearby parking spaces using location-based services, view their availability, and make parking reservations. The system is designed to improve the utilization of existing private parking resources while helping drivers find suitable parking spaces.

The proposed system uses HTML5, CSS3, JavaScript, Bootstrap, Python Flask, MySQL, and Jinja2. It provides functionality for user registration and login, parking-space management, location-based parking search, booking, and cancellation.

II RELATED WORK

Research in smart parking systems has explored different approaches for detecting parking availability, predicting occupancy, enabling reservations, and improving the management of parking resources.

Sanghvi et al. [1] proposed a camera-based approach for detecting parking space availability. The study demonstrates how image-based techniques can be used to identify whether parking spaces are occupied or vacant. Such approaches provide an

automated method for monitoring parking occupancy. Canli and Toklu [2] investigated parking occupancy prediction using historical parking information. Their work focuses on estimating parking availability based on previously observed parking conditions. Predictive approaches can assist users and parking managers in understanding expected parking availability.

Chong Chen How et al. [3] developed a mobile-based parking reservation application. The system focuses on enabling users to locate and reserve parking spaces through a digital platform. This demonstrates the usefulness of digital reservation mechanisms for improving the parking experience. Abdul Khaliq et al. [4] examined security and privacy considerations in parking systems. Their work highlights the importance of protecting user information and system data when parking services are provided through connected digital platforms.

Attarbashi et al. [5] investigated an IoT-based approach for detecting parking-space availability. The approach uses sensing technologies to obtain information about the occupancy status of parking spaces. This demonstrates the application of IoT technologies for automated parking monitoring.

Pham et al. [6] presented an approach combining parking search, reservation, and navigation. The integration of these functions provides users with a more comprehensive parking service by connecting parking discovery with reservation and navigation.

Lyu and Fan [7] focused on the design and modeling of an intelligent parking system. Their work demonstrates the importance of systematic analysis and design in the development of intelligent parking-management applications.

Qumsiyeh and Ishaq [8] investigated real-time parking detection using camera-based techniques. Such approaches provide parking-availability information by processing visual information from parking areas.

Labayne et al. [9] developed an online parking reservation system and evaluated its functionality using a structured software-development approach. Their work demonstrates the applicability of web-based reservation systems for managing parking spaces.

Anggraini et al. [10] explored the use of computer

vision together with a progressive web application for parking management. The approach combines automated parking detection with web-based access, demonstrating how computer-vision techniques can be integrated with modern web applications.

The reviewed studies demonstrate that existing parking research has addressed several important aspects, including automated vacancy detection, occupancy prediction, reservation, security, navigation, and IoT-based monitoring. However, within the set of studies reviewed in this work, less emphasis is placed on a community-based model in which owners of unused private parking spaces can make those spaces available to nearby drivers. Therefore, the proposed system focuses on connecting parking-space owners and drivers through a web-based platform that supports parking-space listing, location-based search, availability information, and parking reservation.

III RESEARCH GAP

The literature review indicates that existing parking systems commonly concentrate on automated parking detection, occupancy prediction, IoT-based monitoring, reservation, navigation, and security. These approaches address important aspects of parking management, but the reviewed studies provide comparatively limited emphasis on utilizing unused privately owned parking spaces through a community-based sharing model.

The proposed work addresses this gap by providing a web-based platform in which property owners can list unused parking spaces and drivers can search for and reserve available spaces. Rather than requiring dedicated parking sensors or camera infrastructure for the core parking-space listing and reservation process, the proposed system focuses on digitally connecting existing private parking resources with users who need them.

IV PROBLEM STATEMENT AND OBJECTIVES

IV-A Problem Statement

The increasing number of vehicles and limited availability of parking spaces make it difficult for drivers to find suitable parking, particularly in busy areas. At the same time, many privately owned

parking spaces may remain unused for significant periods. The absence of a platform connecting these unused parking spaces with drivers creates an opportunity to improve the utilization of existing parking resources.

Therefore, the problem addressed in this work is the lack of a convenient web-based mechanism through which property owners can list unused private parking spaces and drivers can discover, view availability, and reserve suitable spaces.

IV-B Objectives

The main objectives of the proposed system are:

- To develop a web-based platform for community-based parking management.
- To enable drivers to search for nearby available parking spaces using location-based information.
- To allow property owners to list and manage their unused parking spaces.
- To provide parking availability information and reservation functionality.
- To support recurring parking reservations for users who require parking at regular intervals.
- To provide cancellation functionality for parking reservations.
- To monitor the allocated parking duration and apply an appropriate fine when a vehicle remains parked beyond the reserved time.
- To evaluate the functionality of the proposed parking system through functional testing.

V PROPOSED SYSTEM

The proposed system is a web-based community parking platform designed to connect property owners who have unused parking spaces with drivers who need parking. The system provides a centralized platform through which parking-space owners can list and manage their available spaces, while drivers can search for suitable parking spaces, view availability, and make reservations.

The proposed system consists of three primary user roles: administrator, parking-space owners, and drivers. All users can register and log in to the system according to their respective roles. The administrator is responsible for monitoring and managing the platform. Parking-space owners can add and manage available parking spaces, while drivers can search for nearby spaces, view parking information, and make reservations.

The system also supports location-based parking search, recurring reservations, booking cancellation, and overstay fine management. Recurring reservations allow users to schedule parking according to their repeated requirements. The overstay mechanism helps manage situations in which a vehicle remains parked beyond the allocated reservation period.

The proposed system is intended to improve the utilization of existing private parking resources rather than depending entirely on the construction of new parking facilities. By connecting unused parking spaces with drivers through a digital platform, the system provides a mechanism for sharing available parking resources within a community.

V-A System Users

The proposed system consists of three primary user roles: administrator, parking-space owners, and drivers. Each role has specific functions for managing and using the community parking platform.

1) Administrator

The administrator is responsible for managing and monitoring the overall parking platform. The administrator can oversee registered users, parking-space information, and booking-related information through the administrative interface. The administrator role supports the management and monitoring of the system.

2) Parking-Space Owner

A parking-space owner can register and log in to the system, add information about an available parking space, and manage the listed parking space. This allows owners to make unused parking resources available to potential users.

3) Driver

A driver can register and log in to the system, search for available parking spaces using location-based information, view relevant parking details, and reserve a suitable space. The driver can also manage or cancel reservations and use recurring booking functionality according to the functions provided by the system.

V-B System Workflow

The general workflow of the proposed system is as follows:

- 1) A user registers and logs in to the system.
- 2) A parking-space owner adds an available parking

space to the platform.

- 3) The parking-space information is stored in the database.
- 4) A driver searches for available parking spaces using the location-based functionality.
- 5) The system displays suitable parking-space information.
- 6) The driver selects an appropriate parking space.
- 7) The driver makes a reservation or schedules a recurring reservation.
- 8) The booking information is stored and the parking-space status is updated.
- 9) The driver can cancel the reservation when required.
- 10) The system monitors the allocated parking duration and applies an appropriate fine when the vehicle exceeds the permitted reservation period.

V-C Technology Stack

The proposed system is implemented using a web-based technology stack. HTML5, CSS3, JavaScript, and Bootstrap are used to develop the front-end interface. Python with the Flask framework is used for back-end development. MySQL is used for database management, while Jinja2 is used for dynamic HTML templating. Git and GitHub are used for version control and project management.

VI METHODOLOGY

The development of the proposed community parking system follows a structured software-development process consisting of requirements analysis, system design, database design, implementation, and testing. The methodology focuses on identifying the requirements of different users, designing the system architecture and database, implementing the web application, and evaluating its functionality through testing.

VI-A Requirements Analysis

The functional requirements of the system were identified based on the needs of drivers, parking-space owners, and administrators. The system requires user registration and login, parking-space management, availability information, parking search, booking, and cancellation functionalities.

VI-B System Design

The system is designed using separate frontend,

backend, and database components. The frontend provides the user interface, the backend handles application logic and requests, and the database stores system information.

VI-C Database Design

The database is designed to store information related to users, parking spaces, availability, and bookings. The backend communicates with the database to store, retrieve, and update the required information.

VI-D Development and Testing

The system is developed using web technologies and tested to verify the functionality of its major components, including authentication, parking-space management, search, reservation, cancellation, and database operations.

VII SYSTEM ARCHITECTURE

The architecture of the proposed community parking system consists of a web-based user interface, an application layer, and a database layer. The system supports three categories of users: administrators, parking-space owners, and drivers. Users interact with the system through the web interface, while the Flask-based backend processes requests and communicates with the MySQL database.

The overall architecture is organized into three main layers. The presentation layer provides the user interface using HTML5, CSS3, JavaScript, and Bootstrap. The application layer is implemented using Python Flask and handles application logic, user requests, parking operations, and communication between the interface and database. The data layer uses MySQL to store and retrieve information related to users, parking spaces, availability, reservations, recurring bookings, and booking-related information.

As shown in Fig. 1, administrators, parking-space owners, and drivers access the system through the web interface. User requests are processed by the Flask application layer, which communicates with the MySQL database for storing and retrieving system information. The application layer manages operations such as parking-space listing, location-based

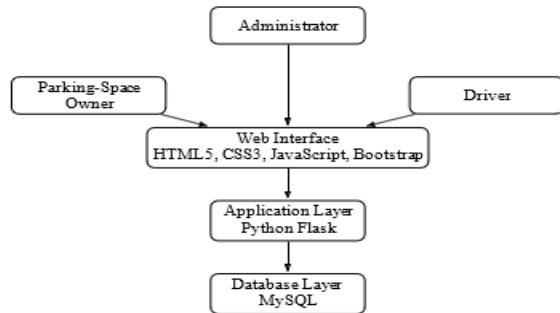


Fig. 1. Architecture of the proposed community parking system.

search, reservations, recurring bookings, cancellations, and booking-related fine management. The architecture separates the user interface, application logic, and data storage components, providing a structured approach to system development.

VIII RESULTS AND DISCUSSION

The implemented community parking system was tested to verify the operation of its major functional components. The testing focused on user registration, authentication, parking-space management, location-based parking search, parking reservation, recurring booking, booking cancellation, overstay and fine management, and administrative functionality. The tested functions operated successfully during functional testing.

VIII-A Functional Testing

Functional testing was performed by executing the major operations of the system and comparing the observed behavior with the expected behavior. Table I presents the functional testing results.

VIII-B Results

The results indicate that the core functional requirements of the proposed system were successfully implemented. User registration and login provide access to the platform, while parking-space management enables owners to make available spaces accessible through the system. The parking-search and location-based search functions assist drivers in identifying suitable parking spaces. The booking and recurring-booking functions support both individual and repeated parking requirements.

The cancellation function supports management of existing reservations. The overstay and fine management functionality addresses situations in which a vehicle remains parked beyond the allocated reservation period. The administrative module provides system-level management functionality.

TABLE I FUNCTIONAL TESTING RESULTS

Test Case	Expected Result	Result
User Registration	User account is created successfully	Pass
User Login	Registered user can log in successfully	Pass
Add Parking Space	Owner can add a parking space	Pass
Parking Search	Driver can search for available parking	Pass
Location-Based Search	Nearby parking spaces are displayed	Pass
Parking Booking	Driver can reserve an available parking space	Pass
Recurring Booking	Recurring reservation is created successfully	Pass
Booking Cancellation	Driver can cancel an existing booking	Pass
Overstay Detection	Parking beyond the allocated time is identified	Pass
Fine Management	Applicable fine is generated for an overstay	Pass
Admin Module	Administrative functions operate successfully	Pass

IX IMPLEMENTATION

The proposed community parking system is

implemented as a web application using a client-server architecture. The implementation consists of frontend development, backend development, database management, user authentication, parking-space management, location-based parking search, reservation management, recurring booking, cancellation, overstay and fine management, and administrative functionality.

IX-A Frontend Implementation

The frontend of the system is developed using HTML5, CSS3, JavaScript, and Bootstrap. HTML5 is used to structure the web pages, while CSS3 is used for styling and layout. JavaScript provides client-side interaction, and Bootstrap is used to support a responsive and consistent user interface.

The web interface provides users with access to the functions required by their respective roles. Separate interfaces are provided for administrators, parking-space owners, and drivers to perform their respective operations.

IX-B Backend Implementation

The backend is implemented using Python and the Flask web framework. Flask handles requests received from the frontend and implements the application logic. It manages communication between the web interface and the MySQL database and processes operations related to users, parking spaces, reservations, and booking management.

Jinja2 is used as the template engine for generating dynamic HTML content. This allows information retrieved by the backend to be displayed dynamically within the web pages.

IX-C Database Implementation

MySQL is used as the database management system. The database provides persistent storage for information required by the application, including user information, parking-space information, availability, reservations, recurring bookings, and booking-related information.

The backend communicates with the database to store new information, retrieve existing records, and update information when parking spaces or reservations are modified.

IX-D User Authentication

The system provides user registration and login functionality. Registered users can authenticate themselves before accessing the functions available to their respective roles. Authentication helps restrict access to system functions and provides a mechanism

for associating parking spaces and reservations with the appropriate users.

IX-E Parking-Space Management

The parking-space management functionality allows parking-space owners to add and manage available parking spaces. Relevant information about a parking space is stored in the MySQL database and can subsequently be retrieved by the application when drivers search for available spaces.

IX-F Location-Based Parking Search

The system provides location-based parking search functionality to help drivers identify suitable nearby parking spaces. Location information is used to assist in displaying parking spaces according to the driver's location and the available parking information.

IX-G Parking Reservation

After selecting a suitable parking space, a driver can make a reservation through the system. The reservation information is stored in the database and associated with the relevant user and parking space. The system updates the availability information according to the reservation status.

IX-H Recurring Booking

The system supports recurring parking reservations for users who require parking at regular intervals. This functionality allows users to schedule repeated parking reservations according to their requirements instead of creating individual reservations repeatedly.

IX-I Booking Cancellation

The system provides a booking cancellation function. When a driver cancels a reservation, the corresponding booking information is updated according to the implemented application logic, allowing the parking space to become available for subsequent reservations when applicable.

IX-J Overstay and Fine Management

The system monitors the allocated parking duration associated with a reservation. If a vehicle remains parked beyond the permitted reservation period, the system identifies the overstay and applies the corresponding fine according to the configured system rules.

IX-K Payment Integration

The system supports online payment functionality for parking-related transactions. The payment component provides a mechanism for processing payments associated with parking reservations through the integrated payment service.

IX-L Administrative Module

The system includes an administrative module for managing and monitoring the platform. The administrator can oversee users, parking-space information, and booking-related information through the administrative interface.

X CONCLUSION

This paper presented a web-based community parking system designed to improve the utilization of privately available parking spaces by connecting parking-space owners with drivers. The proposed system provides a common platform through which parking owners can make available parking spaces accessible to potential users, while drivers can search for suitable spaces and make parking reservations.

The system was developed using HTML5, CSS3, JavaScript, Bootstrap, Python Flask, MySQL, and Jinja2. The implementation includes user registration and authentication, parking-space management, location-based parking search, parking reservation, recurring booking, booking cancellation, overstay and fine management, payment functionality, and administrative functionality.

Functional testing was conducted for the major system operations. The tested functions covered user registration, login, parking-space management, parking search, location-based search, reservation, recurring booking, cancellation, overstay and fine management, payment functionality, and administrative operations. The tested functions operated successfully during the conducted functional tests.

The proposed system demonstrates the feasibility of using a web-based platform to facilitate the sharing and management of privately available parking spaces. The system provides a digital mechanism for connecting parking-space owners with drivers while supporting convenient parking search, reservation, and parking management. Further evaluation involving larger numbers of users, performance measurements, scalability testing, and usability studies can provide additional evidence of the system's effectiveness.

XI FUTURE WORK

Future development of the proposed system can focus on extending its functionality and evaluating its

performance under larger-scale usage. Possible extensions include realtime parking availability, improved map-based navigation, notification services, mobile application support, and enhanced parking analytics.

The system can also be evaluated using larger datasets and a greater number of users to study scalability, response time, and reliability. A structured usability study could further evaluate the user experience of drivers, parking-space owners, and administrators. Additional security mechanisms and access controls can also be investigated to strengthen the protection of user and booking information.

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REFERENCES

- [1] K. Sanghvi, A. Shah, P. Shah, P. Shah, and S. S. Rathod, "Smart Parking Solutions for On-Street and Off-Street Parking," in *2021 International Conference on Communication, Information and Computing Technology (ICCICT)*, Mumbai, India, 2021, pp. 1–6, doi: 10.1109/ICCICT50803.2021.9510099.
- [2] H. Canli and S. Toklu, "Deep Learning-Based Mobile Application Design for Smart Parking," *IEEE Access*, vol. 9, pp. 61171–61183, 2021, doi: 10.1109/ACCESS.2021.3074887.
- [3] C. C. How, I. F. Kamsin, N. K. Zainal, and H. Aysa, "Smart Parking Reservation Mobile Application," in *2022 IEEE International Conference on Distributed Computing and Electrical Circuits and Electronics (ICDCECE)*, 2022, pp. 1–5, doi: 10.1109/ICDCECE53908.2022.9792684.
- [4] A. Abdul Khaliq, A. Anjum, A. B. Ajmal, J. L. Webber, A. Mehbodniya, and S. Khan, "A

- Secure and Privacy Preserved Parking Recommender System Using Elliptic Curve Cryptography and Local Differential Privacy,” *IEEE Access*, vol. 10, pp. 56410–56426, 2022, doi: 10.1109/AC-CESS.2022.3175829.
- [5] Z. S. Attarbashi, T. A.-L. Thamodharan, M. A. Abuzaraida, S. Iftikhar, N. A. Alansari, A. B. B. Basri, and D. O. D. Handayani, “Us-ing IoT-Based Mobile Application to Build Smart Parking System,” in *2023 IEEE 9th International Conference on Computing, Engineering and Design (ICCED)*, Kuala Lumpur, Malaysia, 2023, doi: 10.1109/ICCED60214.2023.10425326.
- [6] T.-N. Pham, D.-T. Mai, and X.-K. Pham, “Smart Parking Services: An Overall Solution Based on Internet of Things and Fog Computing,” *IEEE Access*, vol. 11, pp. 112929–112939, 2023, doi: 10.1109/AC-CESS.2023.3323861.
- [7] L. Lyu and N. Fan, “Research and Design of Intelligent Parking Management System Based on UML Technology,” in *2022 IEEE Conference on Telecommunications, Optics and Computer Science (TOCS)*, 2022, doi: 10.1109/TOCS56154.2022.10016081.
- [8] E. Qumsiyeh and I. Ishaq, “Smart Parking Navigator: An IoT Fog-Based System for Realtime Car Parking Detection,” in *2023 IEEE World AI IoT Congress (AIIoT)*, Seattle, WA, USA, 2023, pp. 487–492, doi: 10.1109/AIIoT58121.2023.10174475.
- [9] J. J. Labayne, L. S. Echalar, and A. V. Matute Jr., “Efficiency Improvement in Parking: A Waterfall Model-Based Approach for Testing Online-Based Parking Slot Reservation Sys-tem,” in *2023 IEEE 15th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment, and Management (HNICEM)*, 2023, pp. 1–6, doi: 10.1109/HNICEM60674.2023.10589132.
- [10] N. Anggraini, A. F. Zein, L. K. Wardhani, and K. Fadhilah, “Smart Parking System With Background Subtraction Algorithm Using Progressive Web Apps (PWAs) Technology on Raspberry Pi 4,” in *2023 11th International Conference on Cyber and IT Service Management (CITSM)*, 2023, doi: 10.1109/CITSM60085.2023.10455254.