JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Smart Parking Reservation and Navigation Application using Deep Learning

[1]Shrikant Shinde, [2] Yash Ingle, [3]Abhijit Lavhale, [4]Vedant Hedau, [5]Ayush Bendale

[1]Assistant Professor, [2,3,4,5]Student
[1,2,3,4,5]Department of Computer Engineering,
[1,2,3,4,5]Sinhgad Institute of Technology and Science, Narhe, Pune, 411041, India

Abstract: Urbanization has led to an increasing demand for efficient parking solutions, prompting the development of various parking reservation and navigation systems. However, existing solutions often suffer from drawbacks such as limited accuracy in predicting parking availability and lack of user-friendly interfaces. Previous parking prediction solutions often faced challenges with accuracy and usability, limiting their effectiveness and adoption. Our project, employees LSTM deep learning, our system significantly improves real-time forecasting by analyzing historical data. The integration with Google Maps API further enhances user experience by providing seamless navigation system to navigate through reserved spots. Moreover, the user-friendly interface ensures accessibility and ease of use for all users, regardless of their technical proficiency. Our project aims to optimize parking utilization, offering a transformative solution to the complexities of urban mobility.

KeyWords - **Long Short-Term Memory (LSTM), Parking Reservation, Navigation system, Deep Learning, Google Maps API**

1. INTRODUCTION

In our ever-expanding urban landscape, competition for parking has become a daily ordeal for countless people. Problems such as the growth of cities, the growth of traffic and related traffic and environmental problems require new solutions to improve parking management. Traditional parking lots cannot meet the needs of modern urban areas due to inefficiency, user frustration and waste of resources. This project tries to solve these complex problems by introducing smart parking and navigation systems that use the power of deep learning. Deep learning, a subfield of artificial intelligence, has demonstrated its benefits to many businesses with its potential for transformational change, and its application in parking lot management is promising. By combining real-time data from sensors and cameras with deep learning models, we aim to create systems that both facilitate stations and provide navigation services within the station to users. Our vision is to transform parking to be more efficient, convenient and environmentally friendly. This paper outlines the complexity of our business, outlines the background and motivation behind the initiative, defines the problem statement, outlines the mission, settings, and constraints. In a detailed paper, we will examine the process, data collection, deep learning model training, user interface development, integration, impact of results and evaluation, and discuss the importance of the project and its future prospects. Our journey begins with a better understanding of the challenges posed by traditional parking and the ability of deep learning to update our parking spaces in today's cities.

The Smart Parking Reservation and Navigation Application utilizes deep learning technology to revolutionize parking management. By employing advanced algorithms, the application predicts parking availability in real-time, allowing users to reserve parking spots beforehand. Through seamless integration with navigation systems, it provides users with optimal routes to their reserved spots, minimizing time and fuel consumption. This innovative solution aims to alleviate the frustration of finding parking in congested urban areas while promoting efficient resource utilization and reducing environmental impact.

2. RELATED WORK

This literature review provides a foundation for understanding the relevant methodologies, technologies, and best practices for developing your Android application for parking and navigation using deep learning. It's important to explore each of these areas further through academic papers, case studies, and documentation to gather more specific insights and guidance for your project. [1] The paper introduces a novel architecture and mobile app leveraging deep learning and cloud computing to predict parking space occupancy in Istanbul, Turkey. Utilizing LSTM networks, the app provides real-time and future parking availability. Comparing LSTM with SVM, Random Forest, and ARIMA, LSTM demonstrates superior accuracy and reliability in modeling multivariate and multi-time series parking data. [2] The author addresses urban parking challenges, presenting a system with hardware (sensors, controllers) and software (cloud database, RFID, Android app) components. Methodology, data analysis, and results demonstrate the system's efficacy in aiding users to find, book, and pay for parking efficiently. Future enhancements include navigation, accident alerts, and AI camera integration. [3] The paper presents a vehicle management system offering features like parking slot booking, vehicle renting, and mechanic services. Utilizing Google Maps API, Firebase, and blockchain, the mobile app aims for efficiency. The design and development are detailed with diagrams, and experimental results and user feedback are discussed. The system aims to simplify driving and mitigate disputes. [4] The paper details the system architecture, software design, and technology stack of VehiPark, employing Android Studio, Firebase, Java, Github, and Visual Studio Code. Evaluation based on functionality, usability, and efficiency demonstrates VehiPark's user friendly nature. Main contributions include effective vehicle parking management. Future enhancements suggested include vehicle number detection, park statistics, and support for multiple parks.[5] The authors introduce a smart parking management system employing IoT, image processing, and a mobile app. It detects parking slot availability, captures vehicle number plates, alerts security for unauthorized vehicles, and generates user bills. Components include Raspberry Pi, camera module, IR proximity sensors, and THINGSPEAK cloud platform. Python controls sensor and camera data, while MIT App Inventor II develops the mobile app. Testing confirms successful functionality. The system aims to save time, fuel, and money, reduce pollution and traffic issues, and enhance parking space utilization. Future enhancements may involve AI integration and user parking pattern analysis.[6] The authors have developed an Android app for parking slot booking, enabling users to reserve spaces in advance and view availability on a graphical interface. QR code authentication is utilized for slot allocation. Claiming to address parking space scarcity, reduce traffic congestion, and air pollution, they cite relevant previous works and detail their methodology and design. Acknowledgments are extended to their project guide and principal for their support and guidance. [7] The paper addresses parking difficulties and vehicle management complexities by offering online booking, parking information query, and route guidance modules. It analyzes various path guidance algorithms and selects the most suitable for parking lot and off-site scenarios. Claiming to reduce time and energy wastage, enhance efficiency, and safety, the paper presents methodology, tests, and results. Future work directions are outlined for further improvements. [8] The authors propose a system that consists of custom-made sensor units, Arduino microcontrollers, a central controller, a database, and a mobile application. The system aims to address the parking problems in malls by allowing users to locate free parking spaces, check the parking fees, locate their cars, and pay using the mobile application. The authors describe the design and development of the system, and present a prototype and some test results. They claim that their system can reduce traffic jams, save time, and enhance the user's experience. They also suggest some possible improvements and extensions for their system. [9] The authors propose a parking management system for malls utilizing a mobile app. It comprises custom-made sensor units for space occupancy detection and a mobile app running on Android. The app connects to a central controller's database, allowing users to find free spaces, check fees, locate their cars, and make payments. The system's design, development, prototype, and test results are presented. Claiming to reduce traffic jams, save time, and enhance user experience, the system aims to address parking issues in malls. [10] The authors address parking issues in urban areas and college campuses by employing a high-resolution camera and convolutional neural network (CNN) to detect and classify cars and empty spaces. They develop a mobile app for real-time parking information display. Utilizing two CNN-based models, they compare performance on a public dataset. Claiming cost effectiveness, scalability, user-friendliness, and accuracy, their system aims to alleviate parking challenges.[11] LoRa WAN sensors detect the parking occupancy status, they transmit this data wirelessly to a LoRa WAN gateway. The gateway serves as a bridge between the sensors and the wider network infrastructure. It collects the data from the sensors and forwards it to the next stage of processing. [12] Users can reserve parking spaces in advance through a digital platform and are charged according to the time they spend parked. This system offers convenience and flexibility for drivers, making parking management more efficient and hassle-free. The above survey of various researchers of different

algorithms of parking managements techniques. The chapter reviews the relevant literature, methodologies, technologies, and best practices for developing an Android application for parking and navigation using deep learning1. It cites four papers that present different aspects and applications of smart parking systems, such as parking prediction, parking reservation, parking management, and vehicle management.[13] This study provides an in-depth exploration of various smart parking solutions and their applications. It evaluates existing techniques and technologies for parking guidance, reservation, detection, and prediction, while also examining their advantages and challenges. Furthermore, it emphasizes the pivotal role of deep learning in improving the performance and scalability of smart parking systems. The above survey uses deep learning algorithm and LSTM for parking management more efficient.

3. PROBLEM STATEMENT

To develop an application that allows users to reserve parking slots in a designated area and navigate them towards their reserved space using a deep learning algorithm. The application should provide a seamless experience for users who struggle to find parking spaces in crowded areas, thereby reducing stress and optimizing the use of available parking resources.

4. PROPOSED METHODOLOGY

➢ SYSTEM ARCHITECTURE

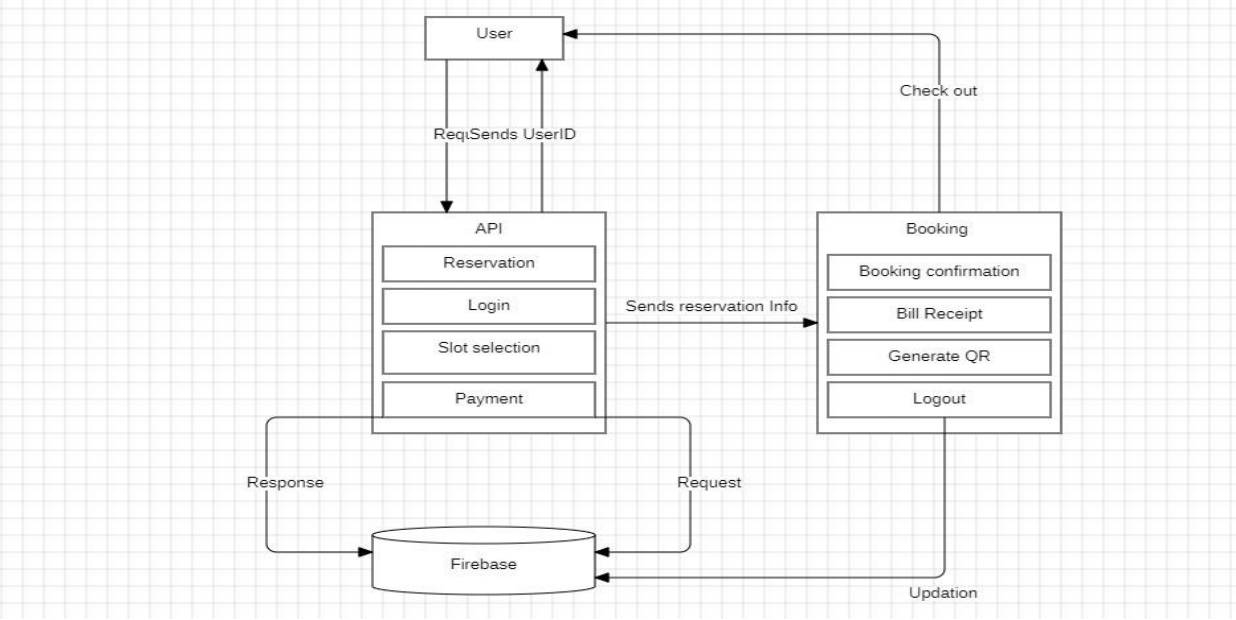

Fig 1. System Architecture

The block diagram in Fig.1 gives an overview of the approach towards building a basic version of the intended features for slot booking system. The workflow for parking slot booking works in following manner:

1. User Interface: This is where the user interacts with the app. It's the first point of contact between the user and the application.
2. Authentication: This process verifies the user's identity. It typically involves entering a username and password.
3. User Profile: This component stores the user's account information. It may include details like name, email, phone number, etc.
4. Payment Gateway: This is used for transactions within the app, such as paying for parking.

5. Database: This is where all the data related to the app is stored. It includes user profiles, transaction details, and other relevant information.

- **Algorithm:**

Long Short-Term Memory (LSTM) is a type of recurrent neural network (RNN) architecture that is designed to overcome the limitations of traditional RNNs in capturing long-term dependencies and handling vanishing gradient problems.

Here's a breakdown of the components and functionality of LSTM:

1. Cell State (Ct): LSTM networks maintain a cell state, which serves as a memory unit that carries information across time steps. The cell state allows LSTMs to retain information over long sequences, facilitating the capture of long-term dependencies.
2. Hidden State (ht): LSTMs also have a hidden state, which acts as the output of the LSTM cell and carries information to subsequent time steps. The hidden state is influenced by both the current input and the previous hidden state.
3. Gates: LSTMs utilize specialized gates to control the flow of information into and out of the cell state.
4. Activation Functions: LSTMs use activation functions, such as the sigmoid and hyperbolic tangent (tanh) functions, to compute the outputs of the gates and update the cell state and hidden state.
5. Training: LSTMs are trained using backpropagation through time (BPTT), a variant of backpropagation that unfolds the network across time steps. Gradient descent algorithms, such as stochastic gradient descent (SGD) or Adam, are commonly used to optimize the network's parameters.

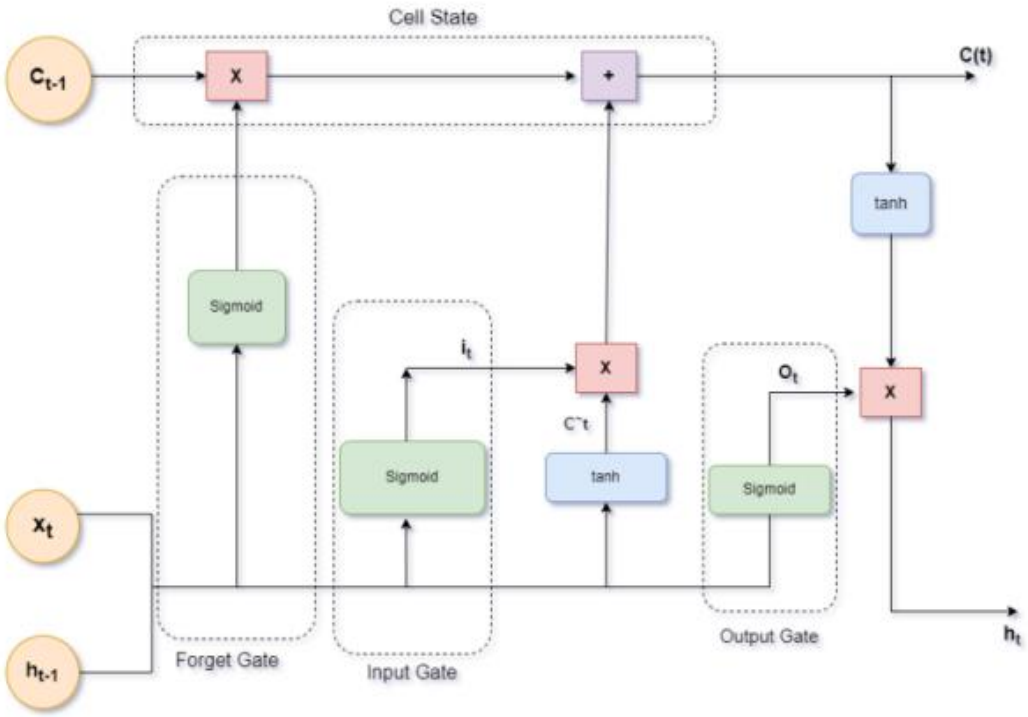

Fig 2. Long Short-Term Memory (LSTM) architecture

Figure 2 shows an LSTM cell, the core of an LSTM network. Information flows through forget, input, and output gates. The forget gate decides what past info to forget, while the input gate picks what new info to remember. These are combined to create a new cell state. Finally, the output gate controls what info from the cell is sent as output for the next cell in the network.

5. RESULTS AND DISCUSSIONS:

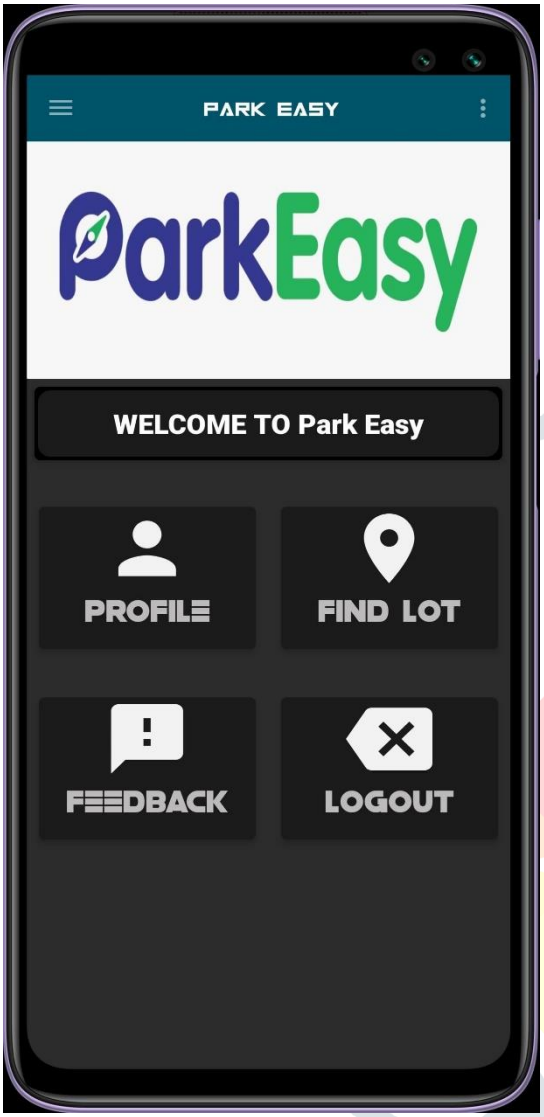

Fig 3. Home Page

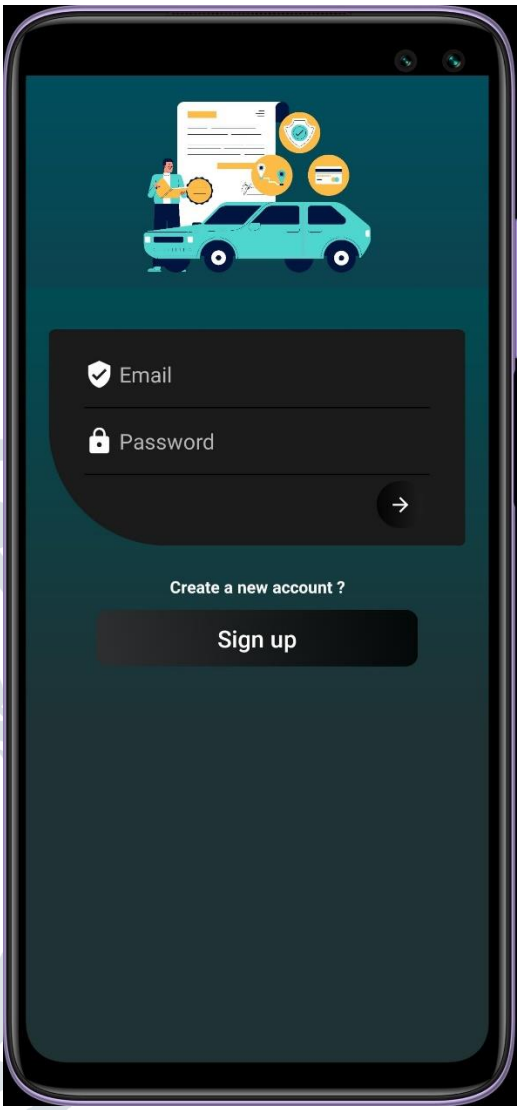

Fig 4. Login page

Figure 3- The Park Easy app home screen offers a user-friendly interface with two prominent features: Park and Profile. Park, allows users to find and reserve parking nearby, while the Profile section provides quick access to user account details. A logout button is available in the top right corner, and a feedback button sits at the bottom left, possibly to enable users to provide suggestions or report issues with the app.

Figure 4- This is a login page for a smart parking app. It prompts users to enter their registered email address and password to access their account. If they haven't signed up yet, a "Create a new account?" link is usually available to direct them to the registration page. This login process allows users to swiftly access the app's features and find parking efficiently.

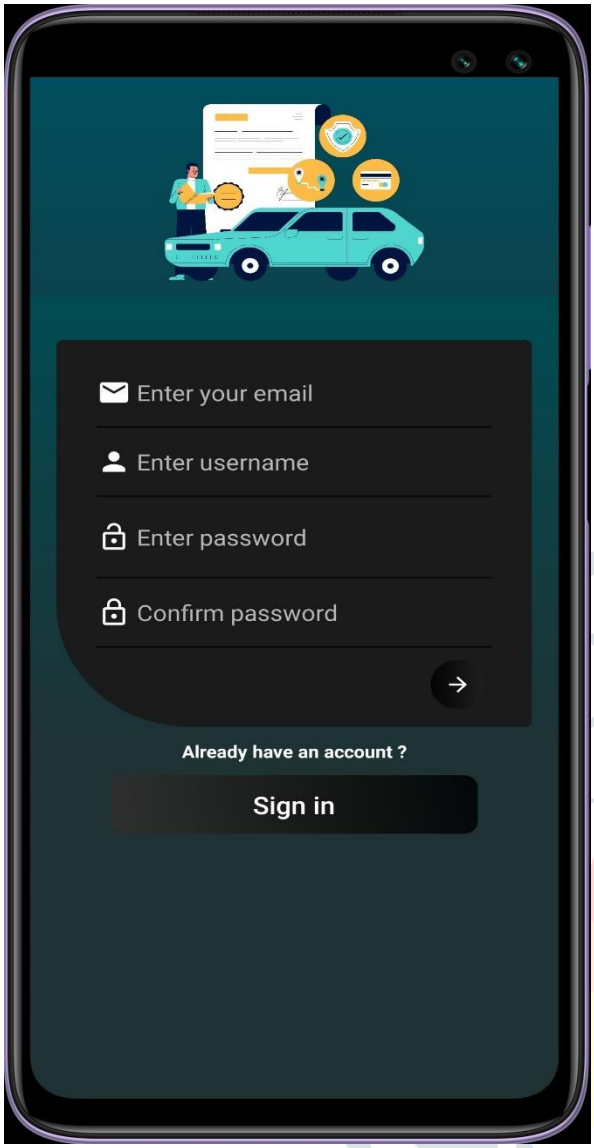

Fig 5. User Registration page

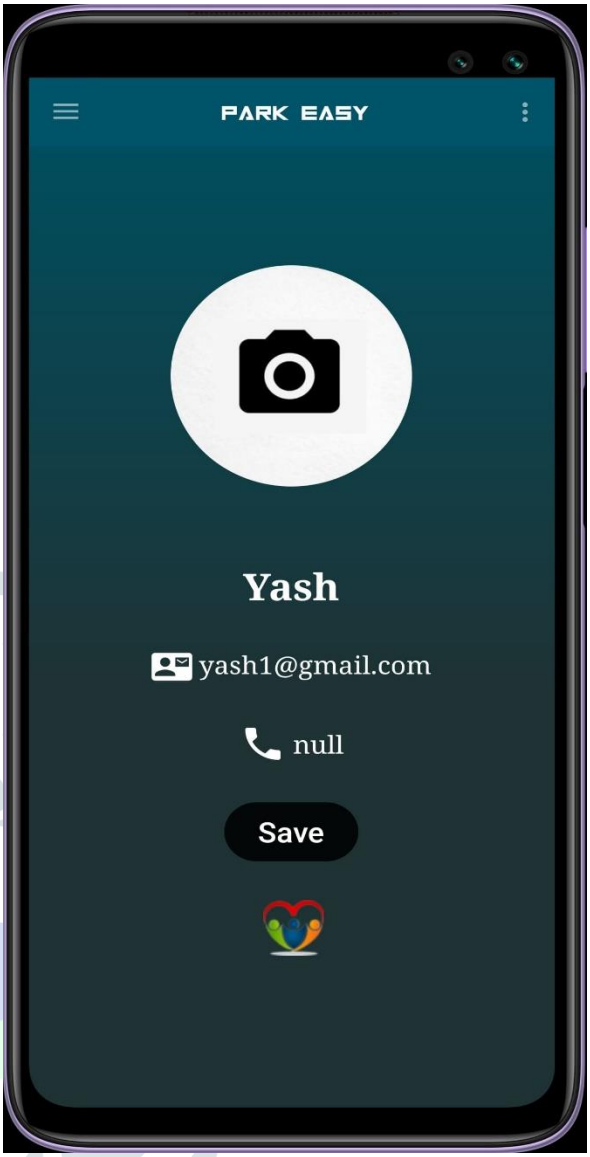

Fig 6. User Info page

Figure 5- This screenshot showcases the user registration for a smart parking app. It allows you to sign up with your email, create a username and password, and confirm the password for secure access. Already have an account? A ”Sign in” link lets you access the app directly if you’re a returning user, saving you time to find and reserve parking on the go.

Figure 6- The Park Easy user details page allows users to manage their account information. Here, users can view their registered email address and edit their phone number for better communication. After making any edits, users can confirm the changes by selecting the ”Save” button. It’s important to note that usernames cannot be modified on this page.

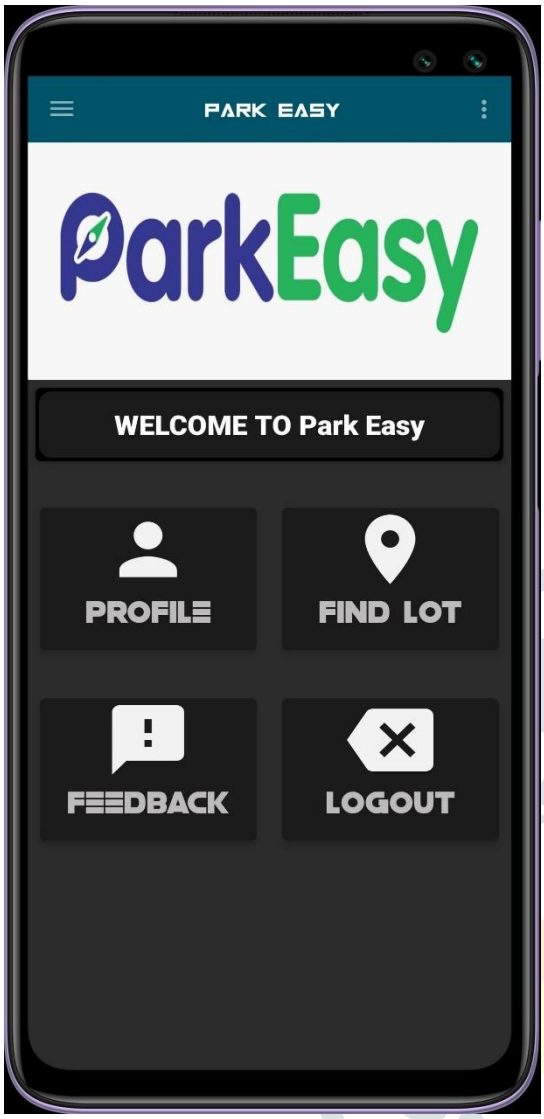

Fig 7. GUI Main page

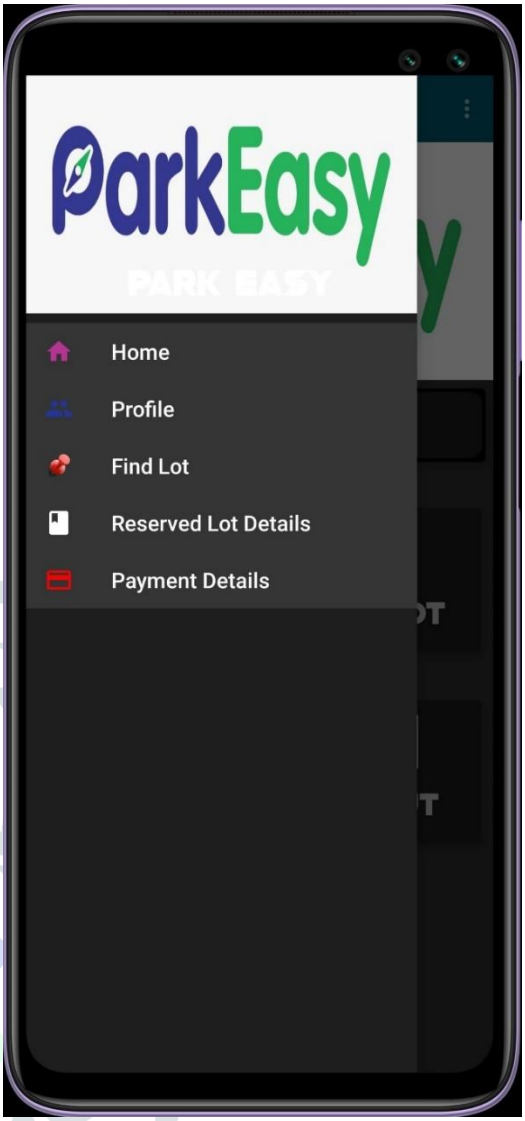

Fig 8. GUI Master page

Figure 7- The Park Easy app home screen offers a user-friendly interface with two prominent features: Park and Profile. Park, allows users to find and reserve parking nearby, while the Profile section provides quick access to user account details. A logout button is available in the top right corner, and a feedback button sits at the bottom left, possibly to enable users to provide suggestions or report issues with the app.

Figure 8- The ParkEasy app's main menu, showcased in this Figure 7, provides one tap access to key functionalities through a bottom navigation bar. From finding parking to managing reservations and profiles, users can navigate the app seamlessly with these essential features at their fingertips.

Fig 9. Output and Payment Page

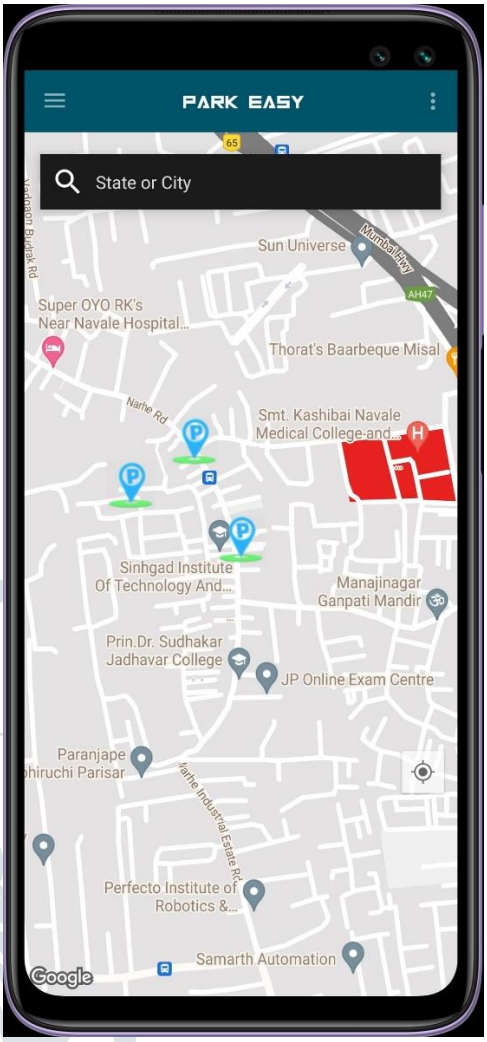

Figure 10: Navigation Page

Figure 9- The ParkEasy app's payment page lets you confirm the duration of your reserved parking slot and select a payment method. In the Figure 8.7, the reserved slot starts at 9:55 AM and ends at 11:57 AM, for a total cost of Rs.50 per hour. You can choose to pay with Google Pay or PhonePe. There's also a button labeled 'Set Time' which allows you to adjust the duration of your reservation before proceeding to payment.

Figure 10- The parking navigation page within a smart parking reservation app offers users step-by-step guidance to their reserved parking spot. This functionality integrates seamlessly with mapping applications, Google Maps, to visually guide users through their route. The information displayed on this page guides and showcase reserved parking location of user.

6. CONCLUSION

Therefore, our analysis indicates that the Smart Parking Reservation and Navigation Application represents a pioneering solution to urban mobility challenges. Despite encountering various obstacles, such as technical complexities and user adoption hurdles, we successfully overcame these challenges through rigorous testing, iterative development, and user feedback incorporation. By leveraging Deep Learning technology, the application now offers users convenience, reduces congestion, and contributes to sustainability, thereby enhancing efficiency and environmental friendliness in urban living. Through continuous refinement and updates, the application has become increasingly user-friendly, with intuitive interfaces and seamless functionalities. As a result of our efforts, the application has garnered widespread acclaim from both users and experts in urban planning and technology sectors.

7. FUTURE SCOPE

Future work for the Smart Parking Reservation and Navigation Application involves refining prediction models, integrating IoT devices for real-time data collection, and implementing dynamic pricing strategies. Additionally, expanding navigation capabilities, fostering community engagement, and conducting environmental impact analyses are crucial. Furthermore, exploring features like augmented reality overlays and gamification elements will enhance user experience. Ultimately, the application aims to evolve into a comprehensive urban mobility platform, offering services beyond parking reservation and navigation. Embracing emerging technologies and continually evolving to meet user needs will ensure the application remains at the forefront of urban transportation innovation.

REFERENCES

[1] H. Canli and S. Toklu, "Deep Learning-Based Mobile Application Design for Smart Parking," in IEEE Access, vol. 9, 2021.
[2] N. B. A. Warif, M. I. S. S. Azman, N. -S. N. Ismail and M. A. Remli, "IoT-based Smart Parking System using Android Application" in IEEE, Bangladesh, 2020.
[3] Jayesh Suryawanshi, Nitish Giri, Vedant Gulhane, Manthan Tayade, Rushikesh Ghonse, "Intelligent Vehicle Management: Harnessing Emerging Technologies for Efficiency and Sustainability" in IJFMR Volume 5, Issue 5, September-October 2023.
[4] Herath, Jinuka & Kasthuriarachchi, Bihansa & Sandamini, Chamali & deshan, Chamath & Pemarathne, Punsisi. "VehiPark-Online Vehicle Parking Management System", in ResearchGate, conference 2022.
[5] M. Venkata Sudhakar, A.V. Anoora Reddy, K. Mounika, M.V. Sai Kumar, T. Bharani, "Development of smart parking management system", in ScienceDirect, Volume 80, Part 3, 2023.
[6] Jugneet Singh Chat- tawal , Navin Shrirao , Harsha Kadwe And Krutika Lagad "Design and Development of Parking Slot booking System", in Nagpur International Journal of Innovations in Engineering and Science, Vol 4 No.8, 2019.
[7]R. Chen, X. Hu and W. Mu, "Research on parking lot management system based on parking space navigation technology," in IEEE International Conference on Power, Intelligent Computing and Systems (ICPICS), Shenyang, China, 2020.
[8] M. Owayjan, B. Sleem, E. Saad and A. Maroun, "Parking management system using mobile application," in Sensors Networks Smart and Emerging Technologies (SENSET), Beiriut, Lebanon, 2017.
[9] J. Lewis, R. Abbas, S. Reisenfeld and S. Maric, "Little Locator, "A Smartphone Parking-Location Application," in International Conference on Computing, Power and Communication Technologies (GUCON), Greater Noida, India, 2018.
[10] S. N. R. Mettupally and V. Menon, "A Smart Eco-System for Parking Detection Using Deep Learning and Big Data Analytics," in SoutheastCon, Huntsville, AL, USA, 2019.
[11] Jemmali, Mahdi & Bani Melhim, Loai & Alharbi, Mafawez & Bajahzar, Abdullah & Omri, Mohamed Nazih, "Smart-parking management algorithms in smart city" in Scientific Reports, Vol.:(0123456789),2022.
[12] LingeshS, Singaravel, Jayashree, Devi Priya, Ramkumar," Parking allotment management system", in IRJETS, Volume:03,Issue:05,May-2021.
[13] Shrikant Shinde, Yash Ingle, Abhijit Lavhale, Vedant Hedau, Ayush Bendale, "A Survey on Deep Learning Algorithm used for Smart Parking Reservation and Navigation", in JETIR, Vol.11, Issue 3, March-2024.