QR and UV Sensor based Smart Car Parking System

Karthikeyan S.[1]
Assistant Professor
Department of CSE FET,
Jain (Deemed-to-be University) Bangalore-562112

Sathyajeeth Patil[2], Anshuman Goswami[3], Himanshu Kumar[4], Harichand Lalith Kumar[5], Shubham Singh[6], Charu C A[7]
Undergraduate-CSE-SE FET, Jain (Deemed-to-be University)Bangalore-562112

Abstract:- The primary objective of this project is to address the growing challenges of urban parking, which have led to frustration and congestion in metropolitan areas. The rapid surge in vehicle ownership and usage has made finding an available parking spot increasingly time-consuming and arduous. In response, this project introduces a cutting-edge QR code-based smart parking system designed to transform the urban parking experience.This groundbreaking solution offers users a seamless and convenient way to discover, reserve, and pay for parking spaces via a user-friendly mobile application. With this app, drivers can effortlessly locate vacant parking spots, make reservations, receive confirmation codes, and smoothly navigate parking facilities. Furthermore, the system enables flexible booking cancellations and provides real-time updates on parking charges.By incorporating online payment services, users can complete transactions through a virtualwallet, ensuring a hassle-free experience. This pioneering QR code-based smart parking system not only reduces the time spent hunting for parking but also mitigates traffic congestion caused by vehicles endlessly circling for spots.In other words, this system holds immense potential for enhancing urban mobility and improving the quality of life for city dwellers. It represents a promising step towards a more efficient and accessible parking solution for the challenges of modern urban living.

Keywords:-   urban,parking,reservation,QR-based,virtual wallet,quality,efficient,hassle-free.

I.   INTRODUCTION

The QR code-based smart parking system is designed to enhance the urban driving experience. This innovative solution prioritizes user convenience and efficiency, offering drivers, a streamlined approach to locating, reserving, and paying for parking spaces. The system leverages the ubiquity of smartphones and QR code scanning for seamless entry and exit, reducing the time spent searching for parking and alleviating traffic congestion.

At its core, this project centers on a user-friendly mobile application that empowers drivers to effortlessly discover available parking spots, make reservations, receive confirmation codes, and efficiently navigate parking facilities. Real-time updates on parking availability enable advanced planning, while the flexibility of booking cancellations caters to changing needs. Additionally, the integration of online payment services ensures convenient, cashless transactions through a virtual wallet.

By focusing on user-centric design and technology-driven solutions, this project not only addresses urban parking challenges but also promotes smoother traffic flow, reduced emissions, and an improved quality of life for city dwellers. The QR code-based smart parking system represents an innovative approach to urban mobility, promising a more efficient and sustainable parking solution.

By leveraging modern technology and user-centric design principles, it offers an elegant solution to the challenges of urban parking. Through this innovation, cities can anticipate reduced traffic congestion, enhanced environmental sustainability, and an overall improvement in the daily lives of urban residents. This project marks a significant step towards a more efficient and user-friendly urban mobility landscape, aligning with the evolving needs of today's urban communities.

II.   LITERATURE SURVEY

Abhirup Khanna and Rishi Anand [1] addressed the issue of ceasing and they presented an IOT based Cloud facilitated sharp halting structure. The service was characterized by its efficiency and real-time capabilities, offering prompt and up-to-the-minute assistance. However, it posed challenges due to its relatively high cost and the complexities associated with its implementation, particularly when considering larger-scale deployment.

Can Biyik, Zaheer Allam, Gabriele Pieri [4] and others analyzed smart parking solutions from a technical perspective to provide comprehensive insights into building them.They asserted the necessity for the adoption of a Smart Parking System, highlighting its significance in modern urban environments. The utilization of cutting-edge technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), and Machine Learning (ML) augments the potential and prospects of the Smart Parking System, painting a promising picture of its future role and impact.

AnujaSajeev, ShreyasVidwans, Chandradeep Mallick, and Yatin Jog [2]proposed an overview of prevailing smart parking technologies employed worldwide.They projected that Smart Parking Systems were poised to generate close to $360 million in annual revenue by the year 2020, underscoring the substantial economic potential within the smart parking industry. This optimistic forecast highlighted the immense growth prospects anticipated in the near future for smart parking technology, mainly – sensors, RFID, GSM, and QR-based smart parking systems.

Tanmay Satpalkar, Sagar Salian, Sagaya Stephen, and Shakila Shaikh[3] introduced a novel system designed to streamline the process of locating available parking spaces within a designated parking area. This innovative solution leverages the capabilities of a QR code-based Smart Parking System to provide invaluable assistance to drivers, simplifying their quest for vacant parking spots. By harnessing this technology, the proposed system aims to enhance user convenience and contribute to the efficient utilization of parking resources, ultimately improving the overall urban mobility experience.However, this system, while enhancing convenience, had certain security considerations that needed to be addressed to ensure the protection of user data and system integrity.

Chao-Tung Yang et al. proposed a paper on a smart parking system using IoT technologies, including RFID and cloud computing, to enhance parking efficiency and reduce congestion. The project improves parking efficiency, reduces traffic congestion, real-time parking information, optimizes space utilization, and enhances user experience. However theprojecthad high initial setup and infrastructure costs, potential privacy concerns with data collection, dependency on IoT connectivity, and reliability.

In their research titled [5] "Development of a QR-Code Based Smart Car Parking System," Enamul Hoq, Sajib Paul, and Md. Tarek Ur Rahman Erin addresses the growing need for efficient parking solutions in the face of increasing vehicle numbers. They recognize the prevalent issues in conventional parking systems, including car theft and driver inconvenience, and propose an innovative approach to enhance security and convenience. The authors introduce an automated parking system that leverages QR code technology to revolutionize the parking experience. Their study demonstrates the practicality of this concept by showcasing a prototype.

In their research paper [6] 'Research on parking lot management system based on parking space navigation technology', authors Ruixuan Chen, Xingyan Hu, and Wei Mu present a comprehensive parking lot management system aimed at addressing the challenges posed by the ever-increasing number of vehicles. This system enables administrators to efficiently monitor parking spaces and vehicle information, significantly reducing their workload. Furthermore, it offers drivers the capability to access real-time parking information for nearby parking facilities and even reserve parking spaces using keywords. The study explores various path guidance algorithms, taking into account the distinct real-time demands of in-lot and off-site navigation. Ultimately, the system implements the Dijkstra algorithm with heap optimization and the Floyd algorithm, substantially cutting down the time required for drivers to locate parking spaces. This research offers an effective solution to the complexities associated with modern parking management.

Akshay Kumar in his paper [7] 'Smart Parking System using Wireless Sensor Networks and IoT' proposes a smart parking system architecture based on wirelesssensor networks and IoT technologies. It discusses the design considerations, system components, and potential benefits of the proposed system. The project enhanced parking space utilization, reduced search time, real-time availability updates, improved revenue generation, and potential for integration with autonomous vehicles.However the costly sensor deployment and maintenance, potential interference and reliability issues in wireless sensor networks, and limited scalability in large parking.

III. PROPOSED METHODOLOGY

This application has been crafted to provide intelligent parking solutions that not only save time and fuel but also streamline and reduce the manual effort required to find the perfect parking spot.

Users are required to register for this app, and upon registration, they are provided with a unique user ID, serving as their login credentials. This user-friendly application allows users to conveniently locate and reserve a parking spot that best suits their vehicle. Moreover, it offers navigation assistance to guide the driver to their reserved parking spot and enables real-time vehicle tracking. Upon arrival at the parking facility, users cansecure a parking spot by scanning a QR code at the entrance. This action assigns a parking ID and initiates a timer for the duration of their stay. The vehicle can then be parked in the designated slot. When departing, the user scans the QR code again to settle the parking fee.Notably, this app not only simplifies the parking experience for users but also provides an efficient electronic tracking system for parking enforcement. This streamlined approach translates to significant cost, time, and energy savings, ensuring the parking facility operates with enhanced efficiency.

To introduce a dynamic parking management system that continuously monitors and updates the real-time availability of parking spaces. This can be accomplished by deploying sensors within each parking space to detect occupancy. The data collected by these sensors is then transmitted to a centralized control system.This system captures up-to-the-minute data from the sensors, including information regarding parking space availability, occupancy status, and the dimensions of the vehicles occupying each spot. Think of it as a reservation system that empowers users to pre-book parking spaces conveniently through a mobile app or website. Once a parking space is reserved, the system can furnish step-by-step navigation instructions to direct the driver to their designated parking spot.
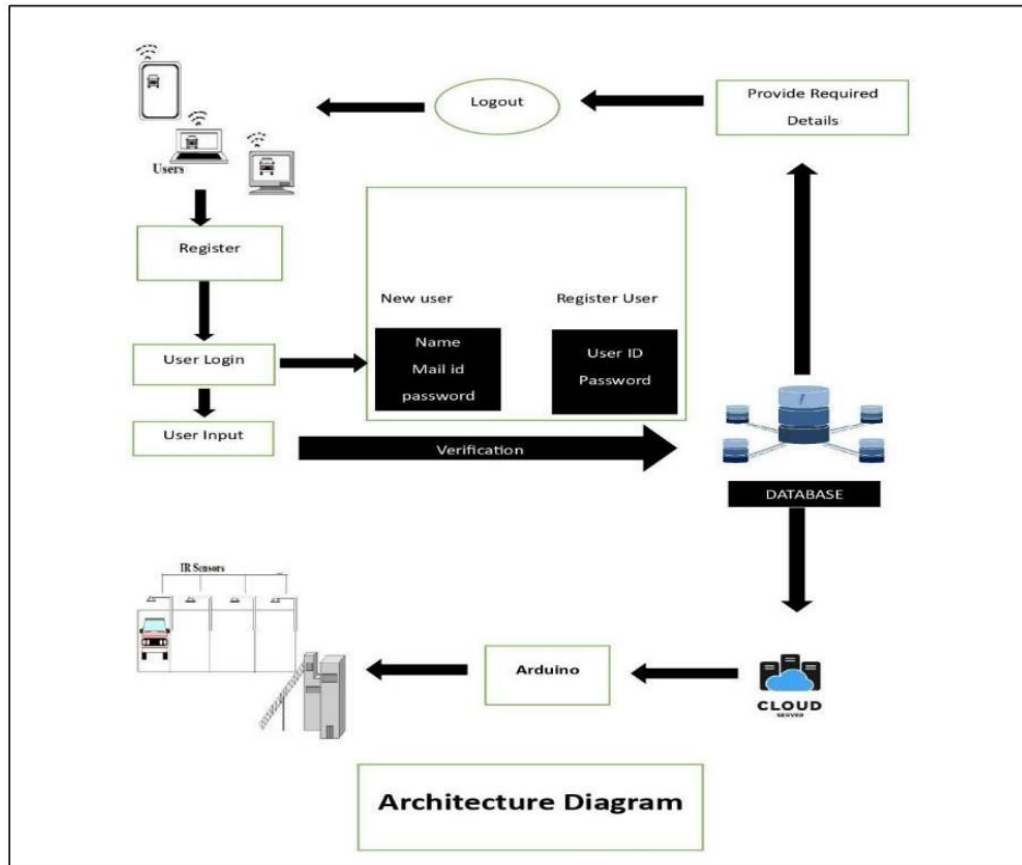
Fig. 1: Architecture Diagram

Let's delve deeper into the intricacies of how this mobile app augments the parking experience.Picture this: You're cruising through a busy city, searching for that elusive parking spot, and the minutes are ticking away. Frustration mounts as you navigate labyrinthine streets, hoping to stumble upon a vacant space. This is where the dedicated mobile app comes to your rescue. It becomes your parking concierge, simplifying the process and saving you precious time.

First and foremost, to unlock the potential of this smart parking system, users need to install the mobile app on their smartphones. This application, which has been meticulously designed for user-friendliness, serves as the central hub for all your parking needs.As you embark on your parking quest, the app becomes your trusty sidekick. You open the app and initiate a search for available parking spots within your vicinity. The magic happens in real time. The app swiftly communicates with the embedded sensors installed in each parking spot. These sensors detect occupancy and relay the data to the central control system. The result? You're presented with up-to-the-minute information about parking space availability right on your smartphone screen. This, in itself, is a game-changer, ensuring you have access to the latest data to make an informed decision.When you've identified a suitable parking spot, the next step is as simple as scanning a QR code.

With a quick scan, the app takes care of the rest. It confirms your reservation, and at the same time, it updates the system's database to reflect this newly reserved status. This action also marks the beginning of your parking reservation, and you can rest assured that your spot is secured for a specific duration, eliminating any uncertainty about finding a parking space when you arrive at your destination.But the convenience doesn't stop there. When it's time to leave the parking area, you don't have to fumble for cash or go through a cumbersome payment process. The app has you covered once again. By scanning the QR code at the exit, you validate your departure. The system, in its innate efficiency, verifies the QR code and promptly updates the database to free up the parking space, making it available for the next user.

The beauty of this entire process lies in its seamlessness. What used to be a stressful and time-consuming endeavor has been streamlined to perfection. You're no longer left circling blocks, worrying about parking fees or the availability of spots. This smart parking system, enabled by the mobile app, simplifies the entire journey, from locating a parking space to securing it, and finally, to your smooth exit.In addition to its user-centric features, this system also boasts broader advantages for parking management and urban planning. By facilitating efficient space allocation, it optimizes resource utilization and reduces traffic congestion. Parking enforcement benefits from an electronic tracking system, enhancing control and minimizing violations.

IV. IMPLEMENTATION

At the core of the smart parking system, the iOS application takes on a central role, acting as a critical component for facilitating a smooth and interactive experience between users and the system. To guarantee a secure and reliable environment, the application harnesses the formidable capabilities of Firebase Authentication. This service plays a dual role in providing both user registration and authentication processes. Through Firebase Authentication, user registration is not only streamlined but also fortified with security measures. It enables users to create accounts and offers a range of authentication options, from email and password combinations to social media logins, ensuring flexibility and convenience. Furthermore, the system utilizes this data to maintain the privacy of user information, upholding the integrity of the entire system. This comprehensive approach ensures that the iOS application is not just a gateway to the smart parking system but a guardian of user data, delivering a seamless and secure user experience.

Harnessing real-time data sourced directly from the Arduino control unit, the application serves as a beacon of convenience in the realm of parking management. By providing users with instantaneous updates on parking space availability, this innovative app reshapes the way we approach the perennial challenge of finding a parking spot. Let's take a closer look at the multifaceted functionalities that empower users and elevate their parking experience.

The app opens up a world of possibilities as it empowers users to effortlessly search for parking spaces that align with their specific needs. This is not just a run-of-the-mill search; it's a personalized exploration that takes into account location, time considerations, and individual preferences. Gone are the days of circling endless rows of parked cars, hoping for a vacant spot. Now, with a few taps on your mobile device, you can pinpoint the perfect parking space with ease.

When an available parking spot catches your eye, the app streamlines the booking process, making it both swift and straightforward. A booking request is swiftly transmitted to the Arduino control unit, which then undertakes the crucial task of verifying and confirming the reservation. If the selected space remains unoccupied, the confirmation is swiftly relayed to you. This means you no longer have to engage in the stressful and time-consuming ritual of hunting for a parking spot upon arrival. The confirmation not only ensures that your spot is reserved but also offers peace of mind, knowing that your parking needs are met.

What sets this app apart is its commitment to providing users with a comprehensive and tailored experience. It accomplishes this by integrating a versatile filtering mechanism. With this functionality at your disposal, you gain the power to fine-tune your parking space requirements. You can specify criteria such as the type of vehicle you're driving, the proximity to your desired destination, the duration of your stay, and other pertinent preferences. This feature is a true game-changer, as it ensures that you find a parking space that is not just available but ideally suited to your unique needs. The filtering feature turns the app into a personal parking concierge, working tirelessly to match your criteria with the perfect parking spot.

But what about finding your reserved parking space? The app has that covered too. It seamlessly incorporates mapping and navigation features, which are designed to guide you to your designated parking area. No more wandering around, trying to decipher complex parking layouts. This app simplifies the navigation process, ensuring that you reach your reserved parking spot without a hitch. It's like having an expert navigator right at your fingertips, making your overall parking experience smoother and more efficient.

Once you've reached your designated parking area and are ready to park, the app optimizes payment procedures. It takes away the hassle of fumbling for cash or dealing with credit cards. By simply scanning a designated QR code upon vehicle entry, the app initiates a timer to track the duration of your parking. This not only ensures accurate and hassle-free billing but also saves you time and effort. As you prepare to leave the parking area, a new QR code is generated. This code facilitates the automatic deduction of parking fees from your digital wallet, eliminating the need for additional payment methods. It's a touchless and streamlined approach that reduces transaction time and enhances user convenience. It's all about making the exit as smooth as the entry.

In conclusion, the app, powered by real-time data from the Arduino control unit, is a game-changer in the world of parking management. It goes beyond the basic functionality of finding a parking spot; it's a comprehensive tool that empowers users to customize their parking experience. With features like real-time availability updates, seamless booking, personalized filtering, and effortless navigation, it simplifies the entire process. By optimizing payment procedures, it further streamlines the user experience. This app is not just a convenience; it's a revolution in how we approach and interact with parking spaces. It's about making parking a stress-free, efficient, and personalized experience, one scan at a time.
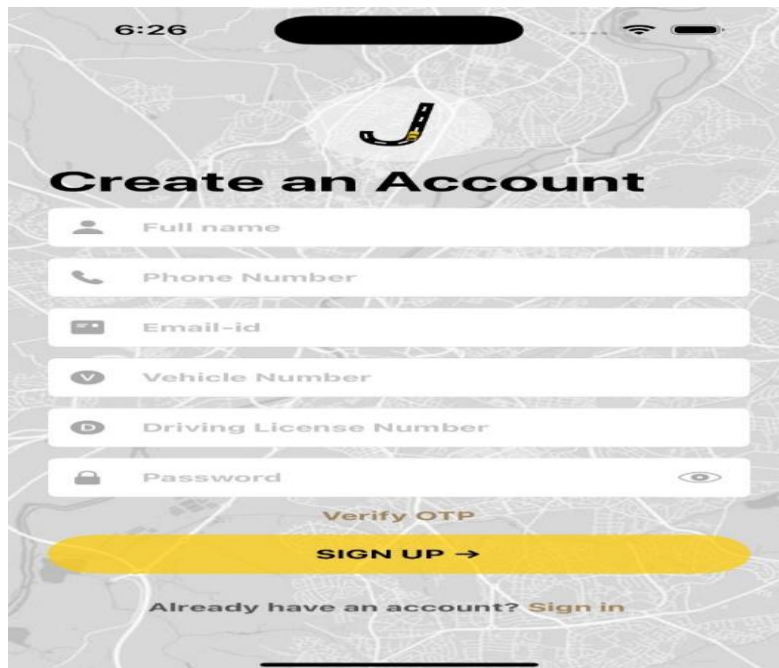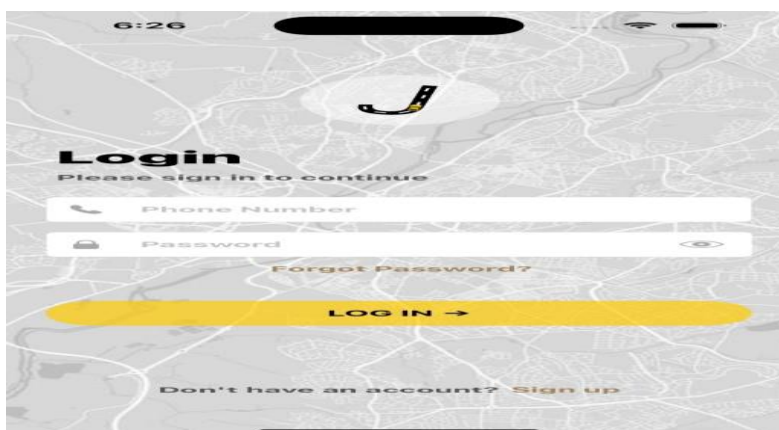
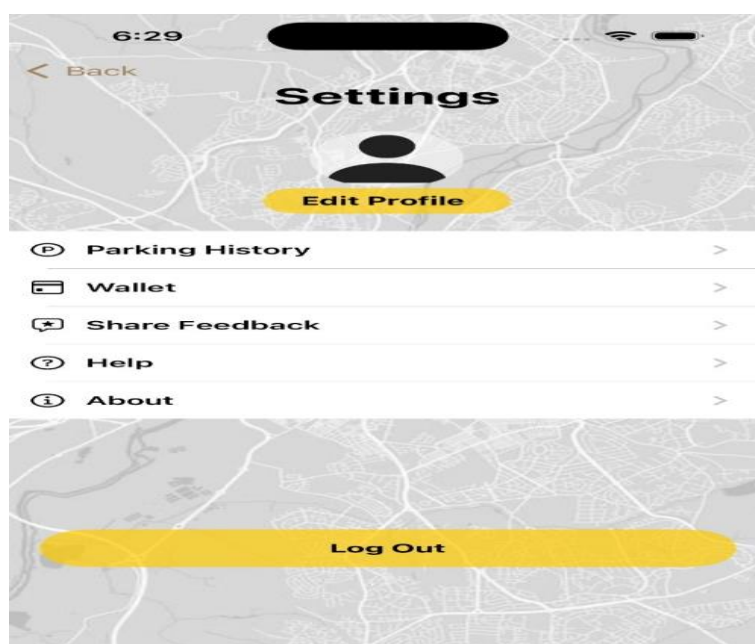Fig. 2: Registration Page

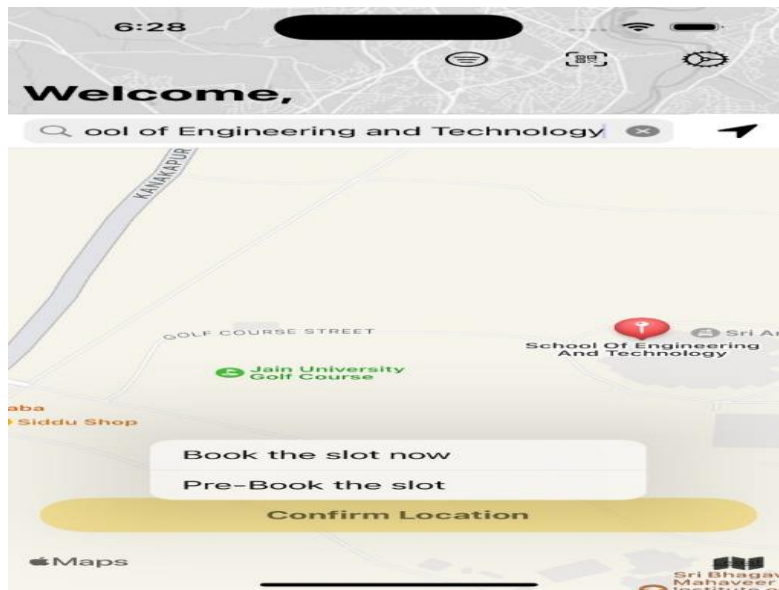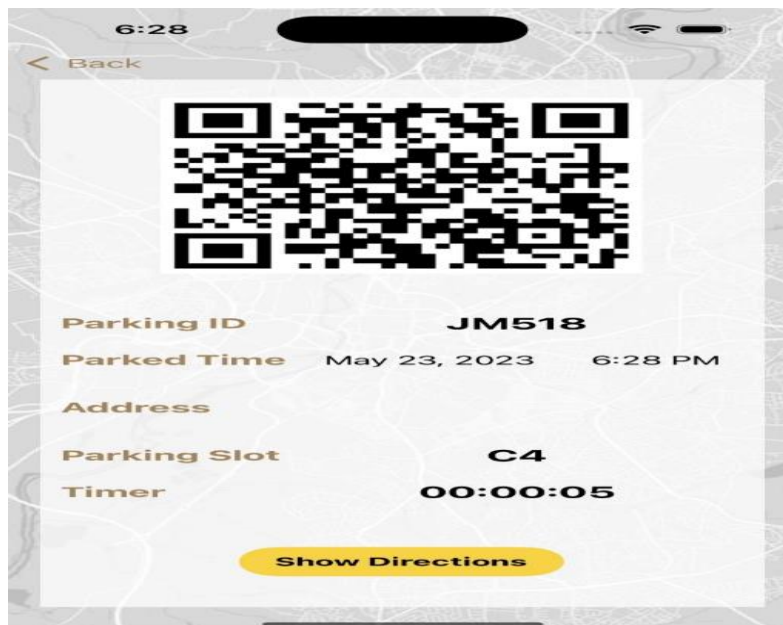Fig. 3: Login Page

Fig. 4: Profile Page

Fig. 5: Map

Fig.6: QR Generation

Fig. 7: Wallet

V. CONCLUSION

Smart Car Parking Systems project is not merely a mobile application but a transformative solution designed to revolutionize the way drivers experience parking. Through seamless integration of automated payment processes, digital reservations, and personalized parking guidance, we aim to enhance convenience while eliminating the hassles of manual ticketing and the perpetual search for change.The project will alleviate the challenges associated with urban traffic congestion and environmental pollution. By significantly reducing the time spent searching for parking spaces, our smart systems directly contribute to mitigating traffic congestion. The ripple effect of this efficiency is evident in the positive impact on carbon emissions, as vehicles spend less time idling in search of a parking spot.The real-time information about parking availability, accessible through our mobile applications, empowers drivers to plan their parking in advance. This proactive approach not only saves time but also alleviates the frustration often associated with the unpredictable nature of finding parking spaces. As a result, drivers can reach their destinations more efficiently, leading to fuel savings and a diminished environmental footprint.In essence, our project is not just about providing parking solutions; it's about making a meaningful difference in urban mobility and environmental sustainability. By optimizing the parking experience, we envision a future where cities are not only smarter but also cleaner and more livable. Our Smart Car Parking Systems pave the way for a more efficient, interconnected, and eco-conscious urban landscape, ultimately contributing to the well-being of both drivers and the environment at large.

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