**QR Code-based Smart Vehicle Parking Management System**

**ABSTRACT:**

Traffic congestion and the scarcity of parking spaces have become pressing issues in our daily lives, often causing frustration and inconvenience. Traditional parking management systems often lead to congestion, long wait times, and inefficient space utilization. To address these challenges, our project leverages the power of QR codes and database technology to create a user-friendly, real-time parking management system. This study presents a software-based solution to address these challenges by offering a secure and time-efficient parking system. The "QR Code-based Smart Vehicle Parking Management System" is a cutting-edge solution designed to revolutionize the way we manage vehicle parking in urban environments. Developed using Java and MySQL, this system offers a seamless and efficient approach to parking management, enhancing user convenience and optimizing parking space utilization. Our proposed application allows users to reserve parking slots in advance at any location, eliminating the need to search for parking spaces on-site. The primary objective of this research is to develop and implement an automatic parking system that enhances the convenience of public parking zones while automating the collection of parking fees, reducing human intervention. Users can easily locate and reserve vacant slots through a user-friendly web-based application, reducing the hassle of searching for parking spots. Furthermore, this study introduces a novel approach to alleviate parking woes, offering insights into various solutions to address these issues. The web application provides users with the flexibility to select parking locations at their convenience, eliminating the need for last-minute searches and offering instant parking solutions. By presenting this innovative software solution, we aim to provide an alternative approach to mitigate parking challenges, improving the overall urban mobility experience. This research contributes to the ongoing efforts to enhance the efficiency and accessibility of parking facilities, making urban living more convenient and stress-free for all. This project represents a significant step towards smart, sustainable urban development by optimizing parking resources, reducing traffic congestion, and enhancing the overall quality of life in urban areas.

**EXISTING SYSTEM:**

* The existing system for managing vehicle parking primarily relied on a manual approach and hardware-based solutions to oversee parking operations. This established system had been in place for an extended period and utilized the following key components and methods:
* Manual Ticketing: The primary method of parking validation in the existing system was manual ticketing. When a vehicle entered the parking facility, attendants issued physical parking tickets to the drivers. These tickets served as proof of entry and were later required for exit validation.
* Parking Attendants: Human attendants played a crucial role in the earlier system. They were stationed at entry and exit points of the parking facility to manage the flow of vehicles. Attendants were responsible for issuing tickets, collecting parking fees, and ensuring the orderly movement of vehicles within the parking area.
* Hardware-based Entry/Exit Barriers: Hardware-based solutions, such as entry and exit barriers, were commonly employed. These barriers were operated manually by attendants or electronically through ticket validation. They controlled access to the parking facility, allowing entry once a valid ticket was presented and opening the exit barrier upon fee payment.
* Limited Automation: The earlier system had limited automation capabilities. It relied heavily on human intervention to manage the parking process, which could lead to inefficiencies, particularly during peak traffic hours.
* Parking Fee Collection: Payment for parking was typically handled by parking attendants who accepted cash payments and provided change when necessary. In some instances, card-based payment systems were integrated into the hardware.
* Parking Space Allocation: Parking space allocation was primarily based on a first-come, first-served basis. Vehicles were directed to available parking spots as they entered the facility, without advanced reservation or optimization of space allocation.
* Security Measures: Security in the earlier system depended on the integrity of physical parking tickets and the vigilance of attendants. Unauthorized access or use of replicated tickets was a potential concern.
* Limited Data Collection: Data collection in the earlier system was minimal. The focus was on transactional data related to ticket issuance, fee collection, and vehicle movement, with limited capability for in-depth data analysis.
* In conclusion, the earlier vehicle parking management system relied on manual procedures and hardware-based solutions to manage parking operations. While it served its purpose, it had limitations in terms of automation, real-time information, and user convenience. The introduction of modern solutions, such as the QR Code-based Smart Vehicle Parking Management System, represents a significant advancement in addressing these limitations and improving overall parking efficiency.

**DISADVANTAGES OF EXISTING SYSTEM:**

* Inefficiency: The manual system is inherently less efficient compared to automated systems. Human intervention for issuing tickets, collecting fees, and managing entry and exit can lead to delays, especially during peak hours.
* Limited Parking Information: Users often have limited access to real-time parking information. They may have to circle the parking area searching for an available spot, resulting in congestion and frustration.
* Human Errors: The reliance on human attendants increases the likelihood of errors in ticket validation, fee collection, and directing vehicles to parking spaces. These errors can lead to disputes and inefficiencies.
* Cash Handling: Handling cash payments poses security risks for both attendants and users. It can also lead to difficulties in providing change and reconciling transactions accurately.
* Space Underutilization: First-come, first-served allocation of parking spaces may lead to inefficient space utilization. Some areas of the parking facility may be overcrowded while others remain underutilized.
* Lack of Pre-Booking: In the existing system, users do not have the option to pre-book parking spaces in advance, which can be inconvenient, especially during peak hours or for special events.
* Security Vulnerabilities: Physical parking tickets can be easily replicated or tampered with, leading to security vulnerabilities and potential misuse.
* Limited Data Insights: The manual system lacks robust data collection and analysis capabilities, making it difficult to gather insights into parking patterns, peak hours, or trends. This hampers effective planning and optimization.
* Manual Maintenance: Maintenance and upkeep of the hardware-based entry and exit barriers can be costly and require regular human intervention for repairs and adjustments.
* Scalability Challenges: Expanding or modifying the existing system to accommodate more parking spaces or locations can be complex and costly due to its hardware-centric nature.
* User Inconvenience: Users may find it inconvenient to search for parking spaces manually, especially in crowded areas or during adverse weather conditions.
* Environmental Impact: The manual system contributes to increased vehicle emissions and fuel consumption due to prolonged search times for parking spaces.
* In summary, the existing manual and hardware-based parking management system suffers from several disadvantages, including inefficiency, limited user convenience, security vulnerabilities, and a lack of data-driven decision-making capabilities. These shortcomings highlight the need for modern, automated solutions to improve the overall parking experience.

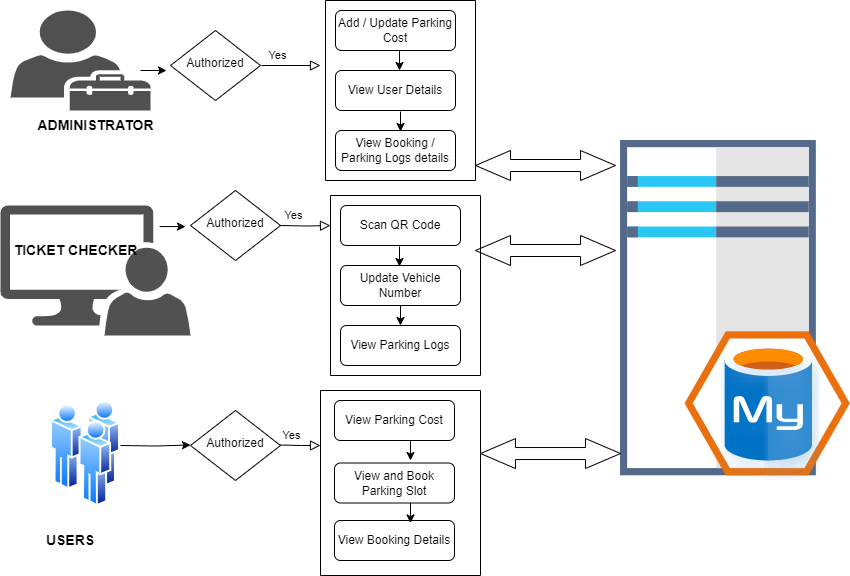
**PROPOSED SYSTEM:**

* The "QR Code-based Smart Vehicle Parking Management System" is a technologically advanced solution designed to enhance the efficiency, convenience, and security of vehicle parking in urban environments. This proposed system leverages modern software, hardware, and data-driven approaches to overcome the limitations of the existing manual parking management systems.
* The heart of the proposed system is QR code technology. Users can generate unique QR codes through the system's web application. These QR codes are associated with their vehicle's information and parking reservation, effectively serving as digital parking permits.
* The proposed system maintains a dynamic and continuously updated database of parking space availability. This real-time information is accessible to users through the application, allowing them to check parking availability before even reaching the parking facility.
* In the proposed system, Users can make cashless payments for parking fees through the application, ensuring secure and convenient transactions. Multiple payment options, such as cash, UPI, credit card/ debit card are supported as prototype model is developed.
* In the proposed system, the admin has access to an intuitive administrative dashboard. This dashboard enables them to monitor real-time occupancy, manage parking cost details, view user details, see booking details and oversee the overall functioning of the parking facility efficiently.
* The system enhances security by maintaining a comprehensive record of all vehicles entering and exiting the parking facility. This data can be easily retrieved and analyzed in case of discrepancies or incidents. Both administrators and vehicle owners benefit from a user-friendly interface. The application is intuitive and easy to navigate, ensuring a seamless experience for all users.
* The proposed system is highly scalable, capable of adapting to a wide range of parking facilities, from small lots to large multi-level parking structures, making it suitable for diverse urban environments. Users can pre-book parking slots in advance through the application, eliminating the need for last-minute searches and ensuring that a parking spot is available upon arrival.
* In addition to on-the-spot availability, the system offers a pre-booking infrastructure. Users can access the application and reserve parking slots prior to their visit, further enhancing convenience and planning. The primary focus of the proposed system is to provide an improved parking experience for users, reducing the time spent searching for parking spaces and ensuring a hassle-free and secure parking process. By optimizing parking resources, reducing traffic congestion, and promoting efficient space utilization, the proposed system contributes to smart and sustainable urban development.
* In conclusion, the "QR Code-based Smart Vehicle Parking Management System" represents a forward-thinking solution that addresses the shortcomings of traditional parking management systems. Its incorporation of QR code technology, real-time data, automation, and user convenience promises to revolutionize the way parking is managed in urban environments, improving efficiency and the overall quality of life for residents and visitors alike.

**ADVANTAGES OF PROPOSED SYSTEM:**

* Efficiency and Time-saving: Users can check real-time parking availability, reducing the time spent searching for parking spaces.
* Convenience for Users: Pre-booking options allow users to reserve parking slots in advance, ensuring they have a guaranteed spot upon arrival. Cashless payment methods offer added convenience, eliminating the need for physical currency.
* Enhanced Security: The system maintains a detailed record of all vehicles entering and exiting the parking facility, enhancing security and accountability. QR codes are difficult to replicate, reducing the risk of unauthorized access.
* Reduced Human Intervention: Automation reduces the reliance on parking attendants, leading to cost savings for facility operators.
* Optimized Space Utilization: The system's real-time data on parking space availability allows for better allocation of parking spaces, reducing underutilization or overcrowding. Advanced booking options contribute to efficient space management.
* Payment Flexibility: Users have multiple payment options, including credit cards, mobile wallets, and prepaid accounts, increasing flexibility and user satisfaction.
* Administrative Efficiency: Facility operators benefit from an intuitive administrative dashboard, simplifying the management of parking facilities. Real-time occupancy data aids in decision-making and resource allocation.
* Scalability: The system is highly scalable and can adapt to various parking facility sizes and types, making it suitable for a wide range of urban environments.
* Improved User Experience: Users experience a hassle-free and convenient parking process, which can lead to higher customer satisfaction and loyalty. Reduced wait times and efficient entry/exit processes contribute to a positive experience.
* Data Insights: The system collects comprehensive data on parking patterns and trends, allowing facility operators to make data-driven decisions. Insights into peak hours and occupancy rates can inform pricing strategies and resource allocation.
* Environmental Benefits: Reduced idling and circling in search of parking spaces contribute to decreased vehicle emissions and improved air quality. The system aligns with sustainability goals by promoting efficient space utilization and reducing urban congestion.
* Smart Urban Development: The proposed system supports the development of smart cities by optimizing parking resources and reducing traffic congestion. Efficient parking management enhances overall urban mobility and quality of life.
* In conclusion, the "QR Code-based Smart Vehicle Parking Management System" offers numerous advantages, including enhanced efficiency, user convenience, security, and scalability. Its data-driven approach and automation not only benefit users but also contribute to the development of smarter and more sustainable urban environments.

**SYSTEM ARCHITECTURE:**



**MODULES:**

* User Module
* Parking Reservation Module
* QR Code Generation Module
* Admin Module
* Ticket Checker Module
* QR Code Verification Module

**MODULES DESCSRIPTION:**

**User Module**

* The "User Module" is the first module of the QR Code-based Smart Vehicle Parking Management System, responsible for managing user interactions within the system. This module enables users to register, authenticate, view parking costs, book parking slots, and access their booking history.
* The Users access the registration page and fill in their name, email address, contact number, and vehicle details. The system validates and stores this information securely. Users enter their registered email and password to log in securely. The system verifies the credentials and grants access upon successful authentication. Once logged in, users can view the parking costs associated with the parking facility they select.
* Users have the option to book parking slots in advance for their chosen date and time. Users select their desired parking location, date, and time slot. The system checks availability and allows users to confirm the booking. Users can access their booking history to review past and upcoming reservations.

**Parking Reservation Module**

* The "Parking Reservation Module" is a core component of the QR Code-based Smart Vehicle Parking Management System, designed to facilitate the seamless booking of parking slots by users. This module ensures that users can reserve parking spaces efficiently and provides them with the necessary information to make informed decisions regarding their parking needs.
* Users can choose the date and time for which they want to reserve a parking slot. The users are prompted to choose the desired reservation date and time. The system provides a calendar and time picker interface to facilitate easy selection. Users can view available time slots and their associated costs.
* This module also checks whether the selected date and time is already reserved to any other users. If it is already reserved to any other users, then they cannot reserve the particular slot. For better user experience, the available and unavailable slots are marked with different colors so the users can easily identify and book quickly to avoid confusions and same more time.
* The "Parking Reservation Module" ensures a user-friendly and efficient process for reserving parking slots, offering users flexibility, transparency, and convenience in securing their parking needs. It enhances the overall parking experience and contributes to the optimized utilization of parking resources within the system.

**QR Code Generation Module**

* The "QR Code Generation Module" is a critical component of the QR Code-based Smart Vehicle Parking Management System. This module is responsible for creating unique QR codes associated with each parking reservation. These QR codes serve as digital parking permits and are crucial for validating user entry and ensuring a smooth parking experience.
* The primary function of this module is to generate a unique QR code for each parking reservation made by users. When a user successfully books a parking slot, the system triggers the generation of a unique QR code. The QR code is dynamically created and linked to specific reservation details, including the location, date, time, and user information.
* The module ensures the security and integrity of generated QR codes to prevent unauthorized access. Users must present a valid, unexpired QR code for entry, enhancing security at parking facilities. The module is equipped with error handling mechanisms to address issues such as invalid or expired QR codes.
* The "QR Code Generation Module" ensures a secure and efficient parking experience by generating and managing unique QR codes associated with each parking reservation. These QR codes play a pivotal role in entry and exit validation, enhancing security and streamlining the overall parking process.

**Admin Module**

* The "Admin Module" is a crucial component of the QR Code-based Smart Vehicle Parking Management System, providing administrators with the tools and functionalities needed to manage parking facilities efficiently and ensure a smooth user experience. This module empowers administrators to perform essential tasks such as updating parking costs, viewing user details, accessing booking information, and reviewing parking logs.
* Administrator has the ability to set and update parking costs. Admin access the "Manage Parking Costs" section of the system. They can add new pricing profiles and Updates to pricing profiles are reflected in real-time for users during the booking process.
* Admin has the option of "View User Details" section. User information, including name, contact number, email etc., are displayed.
* Admin has the capability to access and review booking details, including current and past reservations. Admin also has the option of viewing the Parking Logs.

**Ticket Checker Module**

* The "Ticket Checker Module" is an essential component of the QR Code-based Smart Vehicle Parking Management System, designed to streamline the process of verifying and registering valid parking tickets. This module equips ticket checkers with the necessary tools to validate QR codes using a webcam, record vehicle information, and access parking logs.
* Ticket checkers use the module to scan QR codes presented by users for entry validation. The system captures the QR code image, decodes it, and verifies its validity. If the QR code is valid and within its expiration period, the system allows the ticket checker to proceed. After validating the QR code, ticket checkers record the vehicle information and register the entry in the system.
* Ticket checkers have the option to view parking logs. The module allows ticket checkers to access the "Parking Logs" section, similar to administrators.

**QR Code Verification Module**

* The "QR Code Verification Module" is a fundamental component of the QR Code-based Smart Vehicle Parking Management System, responsible for ensuring the authenticity and validity of QR codes presented by users. This module plays a critical role in the entry and exit processes, verifying parking permits and providing a seamless experience for both users and parking facility operators.
* This module allows the system to capture and decode QR codes presented by users using a web camera. Users or ticket checkers can position the QR code within the scanner's viewfinder. The system captures the QR code's image and decodes the encoded data.
* The primary function of this module is to validate the QR code, ensuring it is genuine and whether it is already used or not. The module checks the decoded data against the system's database to verify its authenticity. It confirms that the QR code corresponds to an existing and valid parking reservation. To handle issues such as invalid or expired QR codes, the module provides appropriate error handling mechanisms. If the QR code is invalid or expired, the system generates error messages for users or ticket checker. Security measures are in place to protect the QR code data and prevent unauthorized access.
* The "QR Code Verification Module" is a critical component that ensures the integrity of the parking system by verifying the authenticity of QR codes and enforcing access control. It plays a pivotal role in providing a secure and efficient parking experience for users and parking facility operators.

**SYSTEM REQUIREMENTS:**

**HARDWARE REQUIREMENTS:**

* System : Pentium i3 Processor.
* Hard Disk : 500 GB.
* Monitor : 15’’ LED.
* Input Devices : Keyboard, Mouse.
* Ram : 4 GB.

**SOFTWARE REQUIREMENTS:**

* Operating system : Windows 10/11.
* Coding Language : JAVA.
* Frontend : JSP, HTML, CSS, JavaScript.
* IDE Tool : Apache Netbeans IDE 16.
* Database : MYSQL.