REAL-TIME SMART PARKING MANAGEMENT SYSTEM

A Project Report

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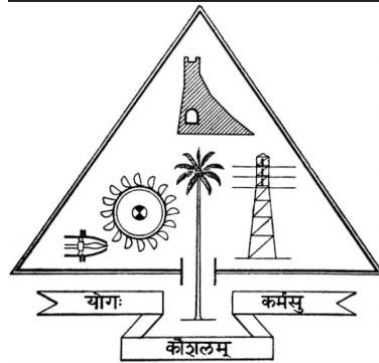
In

Computer Science and Engineering

By

MIMITHA M G(TCR21CS038)

RIDIN SHAJI(TCR21CS051)

SUSHMINI S (TCR21CS064)

URMILA T ANILAN(TCR21CS065)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

GOVERNMENT ENGINEERING COLLEGE, THRISSUR

KERALA

Abstract

In congested urban areas of India, finding parking spaces poses a challenge due to the lack of efficient real-time communication with drivers in traditional parking facilities. Our proposal aims to develop a comprehensive parking management solution that dynamically opens up parking spaces in real time and rewards drivers for good behavior. By leveraging real-time data, the system matches drivers with available spots based on their ratings, driving history, and behavior, offering better parking spots and favorable rates. This innovative approach addresses immediate parking challenges in urban settings while incentivizing positive driving and parking behavior.

Our goal is to address these challenges through the development of a real-time smart parking management system. The system utilizes appropriate technology to continuously monitor occupancy status thus dynamically opens up parking spaces in real time, updating an app that shows nearby open slots within a certain radius and also use sophisticated algorithms to analyze the information to predict parking availability based on the user's rating, preferences and real-time location. By considering factors such as historical usage patterns, time of day, and current traffic conditions, the system generates accurate predictions to guide drivers to available parking spaces in the vicinity. Furthermore, the system incorporates intelligent navigation algorithms that dynamically adjust routes based on parking availability and traffic conditions. Through integration with existing navigation applications, drivers receive personalized route recommendations that prioritize efficiency and minimize search time. Additionally, the system provides features such as parking space reservation and seamless payment integration, enhancing convenience for users.

To validate the effectiveness of the proposed system, extensive simulations and real-world deployments are conducted in urban environments. Results demonstrate significant improvements in parking efficiency, reduced congestion, and enhanced overall driving experience. Moreover, the system's adaptability and scalability make it suitable for deployment in diverse urban settings, contributing to the sustainable development of smart cities.

In summary, the real-time smart parking management system presented in our project offers a promising solution to the challenges of urban parking. By harnessing various technological fields, the system optimizes parking utilization, improves traffic flow, and enhances the driving experience for residents and visitors alike.

Introduction

India is one of the fastest-growing economies in the world, with a rapidly increasing population of around 1.4 billion people .The recent growth in economy and due to the availability of low price vehicles in the market, an every average middle-class individual can afford a private vehicle, which is good thing, however the consequences of heavy traffic jams, pollution, less availability of roads and spot to drive the motor car. One of the important concerns, which is to be taken in accounting, is the problem of parking those vehicles. Though, if there is space for parking the vehicle but so much time is squandered in finding that exact parking slot resulting in more fuel intake and not also environment friendly. Traditional parking facilities lack efficient real –time communication with drivers.

Thus, it becomes imperative to confront this challenge by developing a comprehensive parking management solution that not only dynamically opens up parking spaces in real-time but also rewards drivers with good behaviour, providing them with better parking spots and favorable rates based on their driving history. It will be a great deal if in some way we find out that the parking itself can provide the precise vacant position of a parking slot then it'll be helpful not limited to the drivers also for the environment. Initially when the user granted location access, map displays the user's current location and also the available parking spaces nearby. In addition, searching for a suitable parking space accounts for approximately 30% of traffic congestion in the city. It is clear that simply adding parking spaces will not solve the problem. Smart parking solutions, on the other hand, can provide a solution by increasing parking visibility. Intelligent parking systems help users quickly find adjacent parking spaces, which can be crucial in solving this problem. These technologies can reduce traffic congestion and improve the overall parking experience by reducing vehicle travel time.

The smart parking system aims to alleviate the challenges posed by the increasing number of vehicles on the road. By providing real-time information about available parking spots, it not only saves time and fuel for drivers but also contributes to reducing traffic congestion and pollution. With the integration of technologies like parking sensors and mobile apps, users can efficiently locate vacant parking slots, improving the overall parking experience and environmental sustainability.

Problem

In recent research in metropolitan cities the parking management problem can be viewed from various angles such as high vehicle density on roads. This results in annoying issues for the drivers to park their vehicles as it is very difficult to find a parking slot. Traditional parking management systems often rely on static signage, outdated information, and manual enforcement and improper communication within drivers, resulting in inefficiencies, congestion, and frustration for drivers. In worst case, people fail to find any parking space especially during peak hours and festive season. The drivers usually waste time and effort in finding parking space and end up parking their vehicles finding a space on the street which further leads to space congestion.

The problem can be formally defined as the optimization of parking utilization and management in urban environments to minimize congestion, reduce environmental impact, and enhance the overall driving experience. It involves the real-time monitoring of parking availability, efficient allocation of parking spaces, and the provision of accurate information and navigation assistance to drivers.

The system offers a user-centric approach to parking, benefiting commuters, visitors, businesses, municipalities, and transportation services alike .Commuters can enjoy a stress-free parking experience with accurate information about parking availability and personalized navigation assistance to nearby parking spaces. Tourists and visitors can explore urban areas without worrying about parking, enhancing their overall experience and satisfaction. Businesses can optimize parking utilization for employees and clients, improving accessibility and convenience. Municipalities can mitigate traffic congestion and environmental impact by implementing efficient parking management strategies. Transportation services can streamline operations with optimized parking solutions for their vehicles, reducing idle time and fuel consumption.

Overall, the proposed solution aims to transform the parking experience in urban environments, making it more convenient, efficient, and sustainable for all stakeholders involved.

Solution

The intuitive idea behind the proposed solution is to leverage technology to create a dynamic parking management system that enhances the overall experience for drivers. This system would utilize real-time communication to inform drivers of available parking spaces, allowing them to easily find convenient and secure spots. Additionally, the system would incorporate a reward mechanism based on drivers' behavior, such as safe driving practices or adherence to parking regulations, to offer them access to better parking spots and potentially discounted rates. By combining real-time updates with incentives for good behavior, the solution aims to optimize the parking experience for drivers while improving overall traffic flow and utilization of parking facilities.

Literature Review

Sensor-Based Systems: Many solutions utilize sensors embedded in parking spaces to detect occupancy. These sensors can communicate with a central management system to provide real-time data on parking availability.

Mobile Applications: Numerous studies explore the development of mobile apps that allow drivers to locate nearby parking spots, reserve spaces in advance, and receive real-time updates on availability and pricing.

Data Analytics: Some research focuses on using data analytics techniques to predict parking demand, optimize parking space allocation, and identify patterns in drivers' behavior to improve the overall efficiency of parking management systems.

IoT and Connectivity: Integration of Internet of Things (IoT) devices and connectivity technologies enables seamless communication between parking infrastructure, vehicles, and drivers, facilitating efficient management and utilization of parking spaces.

Incentive-Based Approaches: Similar to your proposed solution, some literature explores the implementation of incentive-based schemes to encourage desirable behavior among drivers, such as rewarding those who carpool or use designated eco-friendly parking spaces.

Smart Pricing Models: Research often investigates dynamic pricing models based on factors like demand, location, time of day, and driver behavior, aiming to optimize revenue for parking operators while providing fair pricing for drivers.

[1] Developing a Smart Parking Management System Using the Internet of Things Searching for parking wastes significant amounts of time and effort and leads to substantial financial costs. This is particularly the case for people who are always pressured to be on time. Smart cities employ all kinds of modern technologies to manage and enhance resources effectively. Urban parking facilities are one of the essential assets that must be managed. We developed a smart parking management system (SPMS) as a modern solution to manage parking and save users time, effort and cost. In the context of today's modern life, it has become necessary to improve search methods for available parking and minimize the congestion that occurs at the parking entrance. Searching or booking available parking online earlier is a better substitute than searching at a parking lot where there is a possibility of not being able to find parking. Our smart parking management system was developed to: • Manage parking and solve problems efficiently using technology • Apply technical solutions to improve the smart cities concept The proposed system uses a variety of technologies that help manage parking. It provides essential services for users, including searching for parking, reservations and payment. It is extended to cover more advanced services such as receiving notifications, statistics and monitoring the parking state. The system is connected to sensors to detect occupancy and an automatic number plate recognition (ANPR) camera to control access. The remainder of the paper is organized as follows

 [2] An IoT-based E-Parking System for Smart Cities The huge proliferation in the number of vehicles on the road along with mismanagement of the available parking space has created parking related problems as well as increased the traffic congestion in urban areas. Thus, it is required to develop an

automated smart parking management system that would not only help a driver to locate a suitable parking space for his/her vehicle, but also it would reduce fuel consumption as well as air pollution. It has been found that a drivers search for a suitable parking facility takes almost 15 minutes which increases the fuel consumption by the vehicle, traffic congestion and air pollution. A significant amount of research works exist in the area of design and development of smart parking system. Various features of smart parking system are listed below. • Inquiry on availability of parking space and reservation of parking lot • Real-time parking navigation and route guidance • Vehicle occupancy detection and management of parking lots . Most of the smart parking systems (SPS) proposed in literature over the past few years provides solution to the design of parking availability information system, parking reservation system, occupancy detection and management of parking lot, real-time navigation within the parking facility etc. However, very few works have paid attention to the real time detection of improper parking and automatic collection of parking charges. Thus, this paper presents an internet-of thing (IoT) based E-parking system that employs an integrated component called parking meter (PM) to address the following issues. • Real-time detection of improper parking • Estimation of each vehicles duration of parking lot usage • Automatic collection of parking charges The E-parking system proposed in this paper also provides city-wide smart parking management solution via providing parking facility availability information and parking lot reservation system and it is named as parking meter (PM) based E-parking (PM-EP).

 [3] Smart Parking based System for smarter cities India is getting motorized i.e. the rate of private vehicles is more as compared to public transports. As the rate of people owning their vehicles increases ,the need of parking slots to park vehicles also increases. But currently the scenario is that there are not sufficient parking slots available or there is also possibility that people are not now aware about the legal parking slots available in their locality. This situation leads to the unnecessary crowding of vehicles on the road and also results in inconveniency of people walking on the road. To overcome above problems, We are proposing the solution in the form of a multilingual android application which will be helpful for the people to find their parking slots digitally. By digitally we mean that this particular system will assign the parking slot based on the current location of the user and the parking slot which the user wants according to his/her ease. Ease in terms of finding the exact slot. The payments can be done digitally or through vending machines. The end user can register and login with his/her account which will help the system to find the location and displaying the nearest parking area and nearest parking slot ,whether it is available or not. If not then it will direct user to the next nearest slot and so on. The existing system comprises of both traditional and application based approach for parking. If we talk about the traditional approach it utilizes manual method of parking i.e user has to find the spot for parking by traveling to far distances and paying extra money. An application based approach consist of the applications which provides the parking slots for the particular locality for example .The application named 'Parking Panda ' provides the parking slots to the areas like stadium, sports leagues etc.

[4] SMART PARKING SYSTEM TO REDUCE TRAFFIC CONGESTION Transportation is the key-success for any of the country. Now a day, many people have options to use their own vehicle for travelling. This will surely increase the demand in trading but one of the problems created by road traffic is "parking". To park all these vehicles in the major metro cities is quite tedious and difficult task and it became problematic to park vehicles. Lot of research and development is being done all over the world to implement better and smarter parking management mechanisms. The current smart parking systems or Wireless Sensors Network Parking requires the combination of wireless sensor networks module, Embedded web-server, Central WebServer. Sensor networks make use of Infrared (IR) Sensor nodes to check the parking slot state and send this information to embedded web-server. It thereby displays the information on a LED screen with which the user can check for empty vehicle
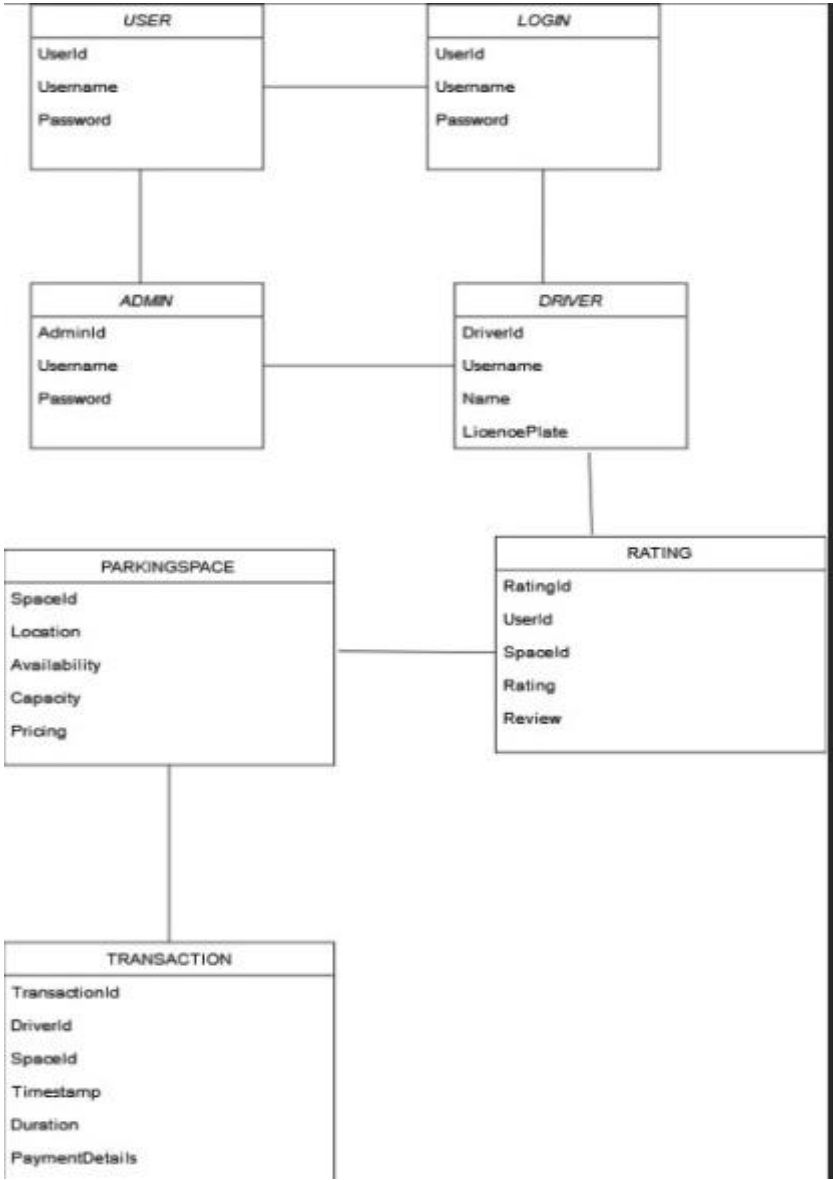
slots. These systems not guide the users to reach to the parking lot. If the slot is not available at that time than drivers will start searching for another parking zone so that this process is time consuming and will increase the traffic congestion. This paper proposes a Reservation-based Smart Parking System for avoiding the traffic problems that provides the pre- booking of slots through the use of the mobile application. This application is expected to provide an efficient and cost- effective solution to the vehicle parking problems. Application must be installed in the user's mobile. Unlike the existing system, our idea is to use client-server architecture where client request for the reservation of slots and server responds with the slots which are available at that time. Our system is that the user has an option to go for the parking area according to his/her convenience. The advantage of this will greatly reduce the time taken by the vehicle to search for a parking area. Advanced payment modules are also included like e- wallet, debit card, credit card from which the user can pay. Penalty will be added on late exit as well as an over use of the slot after user specified entry and exit time .The refund will be given on cancelation of parking slot and early exit. The supervisor is required to monitor the area. Many of the vehicles parking facilities are unable to cope with the influx of vehicles on roads and parking area. The current smart parking systems or Wireless Sensors Network Parking requires the combination of wireless sensor networks module, Embedded web-server, Central Web-Server. Sensor networks make use of Infrared (IR) Sensor nodes to check the parking slot state and send this information to embedded web-server. It thereby displays the information on a LED screen with which the user can check for empty vehicle slots . Also image capturing devices are used for continuously clicking pictures of parking area to ensure empty slots which results in high power consumption and also high maintenance cost is required . There are some systems in the market like the smart parking services which are based on the wireless sensor networks which uses wireless sensors to effectively find the available parking space. But to use this system, additional hardware needs to be installed in the car which is not feasible . Finding a parking slot in a congested city is very hard. In many cases people go to a parking station and they find it full and there is no space available for parking. Then in search of parking space they have to again roam with their vehicle to find available parking.

[5] An IoT-Based Intelligent System for Real-Time Parking Monitoring and Automatic Billing Today, the parking industry is being transformed by new technologies that are allowing cities to reduce rates of congestion significantly. Sensor networks that sense vehicle occupancy are providing the basic intelligence behind smart parking systems. Thanks to the Smart Parking technology, it is now possible to know in real-time the location of free parking spaces and to help drivers to get to their ultimate destination. A variety type of vehicle detectors has been used in parking information acquisition. These vehicle detectors mainly include the inductive loop , acoustic sensor , infrared sensor , or ultrasonic sensor . System using video camera sensor technologies have been proposed to collect the information in vehicle parking field. However, a video camera sensor is vulnerable to bad weather and night time operation. Furthermore, it is expensive, and can generate a large amount of data that can be difficult to transmit in a wireless network. The magneto-resistive based detection systems combined with a wireless area network are the most popular technique due to their high accuracy. Yet, this type of sensor is facing different issues, i.e. it can be bedeviled by electromagnetic interference, which affects the accuracy , the reading from sensor needs to be collected constantly which will result in wearing out the battery . To extend the battery lifetime and increase the vehicle detection accuracy, a parking sensor system has been proposed. While power management technique has been implemented to optimize energy consumption, high occupancy monitoring accuracy is achieved using two-fold sensing approach. It is a sequence of darkness and Signal Strength Indicator (RSSI) measurement based techniques. The wireless sensors are still intrusive, they are embedded in the pavement, or taped to the surface of each individual parking lot. Existing

sensors, such as ground based parking sensors costs up to $200 per parking lot . As consequence, smart-parking technology using wireless sensors for outdoor parking is costly due to the large number of sensors units required to cover the entire parking lot . Although, parking occupancy monitoring systems have made a significant progress, smart parking payment is rarely studied in smart parking research . Yet, there are companies working on the patents of parking systems for payments. A first approach consists in using a camera or an RFID transceiver for vehicle detection and identification . A limitation of this solution lies in that the system is complex and its implementation is expensive when a detection device is installed on each parking lot. Furthermore, when only RFID transceiver is used for vehicle detection and identification, the system can be bedeviled by electromagnetic interference, which affects the accuracy. Moreover, this system is designed to detect a vehicle when entering a parking and seek payment, whereas information on vacant parking lots is not provided. A technique for monitoring vehicle parking using one camera to record the entrance of a vehicle and a second camera to record the vehicle leaving the parking has been proposed . Moreover, in a system and method for obtaining and displaying information on vacant parking space is described. When a user occupies a parking space designated with an individual ID, he enters this ID into a parking meter or via a smart phone mobile app., and pays the parking fees. The database processes the received data and changes the status of the parking space with its ID from unpaid to paid. These data are used as information on the occupation of a parking space. In this paper, we propose a smart sensor system allowing outdoor parking monitoring and payment without requiring any user/driver interaction. It will be deployed without having to install new components on each parking lot. The proposed sensor has benefits in terms of detection and payment reliability, and reduced expense by reducing the system complexity and installation, and extending batteries lifetime through the reduction of the system power consumpdrivers.

By reviewing these themes and approaches in the literature,we gained insights into existing solutions, identify gaps in research and refine our proposal efficiently.

Database Diagram

USER
- UserId
- Username
- Password

LOGIN
- UserId
- Username
- Password

ADMIN
- AdminId
- Username
- Password

DRIVER
- DriverId
- Username
- Name
- LicencePlate

PARKINGSPACE
- SpaceId
- Location
- Availability
- Capacity
- Pricing

RATING
- RatingId
- UserId
- SpaceId
- Rating
- Review

TRANSACTION
- TransactionId
- DriverId
- SpaceId
- Timestamp
- Duration
- PaymentDetails

ER diagram