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Analysis of Smart Parking System Using IOT Environment

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Abstract
The typical parking experience has been transformed by smart parking systems that use the Internet of Things (IoT) environment to integrate technology to improve efficiency, convenience, and sustainability. In order to monitor and manage parking spaces in real-time, this unique technique makes use of IoT devices, such as sensors, cameras, and networking technologies. As a result of the system's reliable information on parking availability, drivers may find and book parking spaces in advance, which eases traffic and reduces aggravation. Additionally, parking systems with IoT capabilities optimize resource use, lowering carbon emissions and fostering sustainability. The adoption of IoT in parking systems is a crucial step towards building smarter, more connected cities that will enhance both drivers' and parking operators' experiences with parking. There are numerous crucial elements in the process for developing a smart parking system in an IoT context. First, sensors are placed in parking places to gather up-to-the-minute occupancy information. Then, using wireless communication protocols, this data is sent to a central server or cloud computing platform. After that, a data processing and analysis module interprets the gathered data using algorithms and machine learning techniques and presents parking availability information to users via a mobile application or other user interfaces. For effective management and monitoring of parking spaces, the system also includes automated payment methods and interacts with existing infrastructure. Taken as Alternative parameters is Park Smart, Street line, Park Whiz, ParkMobile, Spot Hero. Taken as evaluation parameters is Light Sensor, CCTV coins, SMS, Cost-effectiveness, Timestamp. This demonstrates the rank of the data set Park Smart is on 1st Rank, ParkMobile is on 2nd Rank, Park Whiz is on 3rd Rank, Street line is on 4th Rank and Spot Hero is on 5th Rank. To sum up, implementing a smart parking system employing IoT technology has shown to be a potential way to deal with the problems associated with urban parking. The system increases parking efficiency, lessens traffic congestion, and enhances user experience by utilising IoT sensors, data analytics, and real-time communication. The parking scene in smart cities has the potential to change dramatically, enhancing ease and sustainability.
Keywords: WPM (Weighted Product Method), Smart parking system, Internet of things (IoT), Interoperability, Edge Computing.

1. INTRODUCTION

Technology has evolved into a crucial instrument for addressing the issues that metropolitan regions face in the current day. Particularly, the parking situation has been a major worry. Smart digital solutions, such as the adoption of smart parking systems, have emerged with the rise of the Smart City paradigm. According to Naphade et al. [11], these methods have the power to improve parking lots' efficiency and order. Smart parking systems can maximise the use of finite resources, such as fuel, time, and space, by fusing technical developments with novel ideas. According to Babic et al. [12], this optimisation can lead to quicker, simpler, and denser parking of vehicles, assuring the effective utilisation of every parking space. The ultimate goal of the smart parking system is to support urban management in cutting parking management costs, reducing traffic congestion, and ensuring more efficient resource utilisation in urban settings.In conclusion, the introduction of smart parking systems is anticipated to have a number of positive effects on metropolitan areas, including better traffic control, cost savings, and increased parking space utilisation. Smart parking technologies help achieve the overarching objective of building smarter, more sustainable cities by combining technology and human ingenuity.[13] Khaoula et al. [2] conducted a survey on smart parking systems as part of their study and gave a general overview of the idea, categories, functionality, and related technology. A theoretical comparison of current smart parking systems was also provided, highlighting the benefits and drawbacks of the suggested paradigm. They proposed that multi-agent systems (MAS) and expert systems might one day be the best options for smart parking systems. The integration of wireless sensor networks (WSN) with RFID technology in a car parking framework was the focus of a different

study by Karbab et al. [4]. They suggested using RFID rather than conventional techniques to find licence plates, and they used a network of linked sensors controlled by a mote to effectively find parking space availability. These studies open the door for more investigation into this area by providing insightful information and providing complex solutions to the problems associated with smart parking.[1]The rapid advancement of internet, communication, and information technology has made it easier to adopt smart parking systems (SPS), which are effective and economical. The authors of [18] reviewed several SPS systems created by researchers and provided details of their cutting-edge features. The essential sensors and networking tools were also discussed, along with a comparison of the benefits and drawbacks of these options. However, it offered little detail regarding the precise techniques or strategies used by these systems to provide services to users. Similar to this, Nene et al. [19] discussed vehicle parking systems based on contemporary smart parking technologies. They provided a quick overview of the SPSs and highlighted their advantages and disadvantages.[2]This study suggests an Internet of Things-based smart parking system that does more than just list available parking spaces. It attempts to make it easier for cars to find available parking spaces, reducing parking lot traffic. Drivers are informed of the location of their parked car by the system, which also uses vehicle plate number detection to provide increased security surveillance. The IoT-based architecture of the smart parking system includes a mobile application, along with both hardware and software components. By utilising this technology, drivers can simply obtain parking data, pay for parking fees using their mobile devices, and eventually cut down on the amount of time it takes to park their cars.[3]

Due to the scarce supply of parking spaces in cities and the substantial traffic that is caused by people looking for parking spaces, we explore the specific field of smart parking management systems in this work. Numerous smart parking systems have been developed, some of which emphasise directing users to available parking spaces while others place a stronger emphasis on automation of management and operations. Many of these technologies have made the leap from being tested in labs to being sold as products. However, the introduction of smart parking systems raises crucial questions about data confidentiality and citizen privacy. These systems rely largely on users providing their location data, which is transferred over numerous infrastructure components and saved in central databases. Additionally, parking policies in certain cities and localities specify that particular parking spaces must be shared by locals of a certain neighbourhood or saved for those with special needs. As a result, protecting such sensitive information becomes crucial because sharing specific locations might cause humiliation or unwanted conclusions about people, such as their closeness to important businesses or rivals.[4]The performance of several sensors frequently used in smart parking systems, such as photodiodes, Light-dependent resistors (LDRs), Infrared LEDs, Ultrasonic sensors, LiDAR, and magnetic sensors, is the main emphasis of this article. The evaluation criteria take into account factors including vehicle presence, accuracy, and power usage and offer useful data for incorporating these sensors into smart parking systems. The study also investigates the availability and power consumption of Low Power Wide Area (LPWA) radio communication technologies, such as LoRa, NB-IoT, and Sigfox, which are commonly utilised in smart parking detection systems. In order to get insight into the power needs and protocol of contemporary smart parking devices, the article presents a case study of a commercial LoRaWAN smart parking system. The research suggests two optimisation methodologies to overcome problems with power consumption. The first approach involves exploiting the decrease in signal strength that occurs when a vehicle is present above the sensor to use the received signal strength of the LPWA device as an occupancy indicator. In the second approach, a brand-new device architecture is introduced, which captures ambient energy to power the circuitry and lessens dependency on pricy and power-guzzling battery-operated LPWA-based sensors.[5]

An Android app is being created to give users access to a user-friendly smart parking booking system. Customers can reserve parking spaces using the app by choosing the desired space and time. Customers also have the freedom to cancel their reservations at any time. For users, this programme improves parking's effectiveness and ease. An IR sensor is used as an input device together with Raspberry Pi as the microcontroller. The Raspberry Pi receives data from the IR sensor, which is in charge of determining the presence of cars. When a parking place is open, a green LED indication lights up, and when a car is detected by the sensor, a red LED comes on. An Android application is used to give real-time updates on parking space availability. The management and monitoring of parking places is made possible by the integration of hardware and software components.[6]A reporting tool that can process and visualise the unprocessed data held in the IoT middleware is crucial for ensuring the usability of a smart parking system. This reporting tool enables the creation of educative reports that offer perceptions on parking availability and usage. The system's front-end layer can be created as a desktop dashboard or a mobile application. The user interface for this front-end application enables users to quickly look for available parking spaces and make judgements. The smart parking system would not significantly outperform traditional parking options without the front-end application. Consequently, the terms "front-end application" and "front-end dashboard" are used interchangeably in this study. highlighting the significance of an intuitive user interface for efficient operation of the smart parking system.[7]In summary, the various works reviewed in the study have their

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own unique advantages and disadvantages. For example, the system proposed by Kianpisheh et al. [8] has a comprehensive parking detection method but is expensive and lacks strong interaction with drivers. None of the works examined provided a solution to identify the driver or check their eligibility to park in a reserved space. Furthermore, the described systems are not scalable as they require the allocation of new sensors for monitoring additional parking spots. These limitations indicate that the existing works do not fully support the requirements of a smart parking system as part of a larger smart city application.[8]Cars looking for parking places frequently contribute to traffic congestion and delays in highly populated urban areas. Drivers cannot find desired parking places with current smart parking systems that only offer real-time parking information, and sometimes these systems make the issue worse. This study suggests an Internet of Things (IoT)-based Smart Parking with Reservation System (SPRS) to address these problems. The system uses ultrasonic sensors to identify vehicles, and it communicates the information it has gathered to an Arduino board via an Ethernet card. The Relational Database Service (RDS) of the Amazon Web Service (AWS) receives the information next. Drivers can request parking through a smartphone app, and when it becomes available, it notifies them and illuminates the parking space with LED lights. In order to reduce traffic congestion and enhance the parking experience overall, this IoT-based strategy promises to deliver more precise and effective parking recommendations.[9]

The planned smart parking infrastructure in [8] makes use of a smartphone application that is connected to the cloud. Users can book parking spaces and make advance payments using this system, which provides real-time parking information. Other systems already in place use GPS and wireless connectivity to recommend the closest parking spots that are open [5]. Every two minutes, these systems send information on parking space availability. If every parking place is occupied, nothing further happens. Users can reserve a site within a 2-kilometer radius of their location, though, if there are open spots. Users can access the GPS coordinates on their smartphones, and they can message for directions. It's crucial to remember that the app needs a WiFi connection. Even if all available parking spaces are taken, no bookings are issued.[10]A smart parking system's implementation involves a number of technological levels, any of which may be vulnerable. This is relevant to other IoT-based systems as well, such as smart home systems [15] and traffic management systems [11], and is not just restricted to smart parking systems. Before these systems are made available to the public, it is essential to detect and comprehend any potential vulnerabilities in order to guarantee their integrity and security. Since it identifies the system's weakest link, threat modelling can be a useful method for assessing the security of smart parking systems [12]. System designers can improve the overall security and dependability of the smart parking infrastructure by proactively addressing these issues.[11]Carbon emissions have increased as a result of more vehicles on the road. Due to a lack of parking, traffic congestion and car idling are the main contributors to this problem. In reality, traffic congestion during parking search is responsible for almost 30% of all carbon emissions. It is predicted that carbon emissions can be decreased by 20% by introducing smart parking systems and infrastructure [18]. Smart parking system deployment, however, necessitates a sizable time and financial commitment. This article additionally takes into account three more transformative variables that are in line with the Sustainable Development Goals (SDGs) for 2030 in addition to the aforementioned factors. It specifically addresses the objectives of Sustainable Cities and Communities (goal 11) and Affordable and Clean Energy (goal 7) [19]. These objectives are centred on facilitating sustainable urban growth and ensuring access to inexpensive, dependable, and environmentally friendly energy sources. To help achieve these goals of sustainable development, the study in this paper takes into account a variety of smart parking-related factors, such as security and energy efficiency.[12]

2. MATERIALS & METHODS

We discuss Alternative parameters are Park Smart, Streetline, Park Whiz, ParkMobile,SpotHero for following.

Park Smart: Efficient Space Utilization: Park Smart, a smart parking system, optimizes parking space utilization by providing real-time information on available parking spots. This helps drivers quickly find vacant spaces, reducing the time spent searching for parking and minimizing traffic congestion. Enhanced User Experience: ParkSmart offers convenient features such as mobile app integration, online reservation, and cashless payment options, improving the overall user experience. By simplifying the parking process and eliminating the need for physical tickets or cash transactions, Park Smart enhances convenience and customer satisfaction.

Streetline: Real-time Parking Availability: Streetline, a smart parking solution, provides real-time information on parking availability in city streets. By using sensor technology and data analytics, Streetline helps drivers locate vacant parking spaces, reducing the time and frustration associated with finding parking. Parking Management Optimization: Streetline enables parking authorities to optimize parking management through data-driven insights. By collecting and analyzing parking data, such as

occupancy rates and parking patterns, Streetline helps cities make informed decisions regarding parking policies, pricing, and infrastructure improvements, leading to more efficient use of parking spaces and improved traffic flow.

ParkWhiz: Reservation and Pre-booking: Park Whiz offers a convenient solution for drivers to reserve and pre-book parking spaces in advance. By accessing the ParkWhiz platform or app, users can browse available parking options, compare prices, and secure a parking spot ahead of time, saving them the hassle of searching for parking upon arrival. Digital Parking Passes: ParkWhiz provides digital parking passes that eliminate the need for physical tickets or paper receipts. Users can simply display their digital pass on their mobile devices, allowing for quick and seamless entry and exit from parking facilities. This digital approach enhances convenience and reduces the risk of misplaced or lost parking passes.

ParkMobile: Mobile Parking Payments: ParkMobile allows users to conveniently pay for parking directly from their mobile devices. By using the ParkMobile app, users can easily enter their parking space number, select the desired parking duration, and complete the payment using various payment methods. This eliminates the need for coins or physical payment at parking meters, making the parking experience more efficient and user-friendly. Parking Reminders and Extensions: ParkMobile offers features that help users manage their parking time effectively. The app allows users to set parking reminders, sending notifications when their parking time is about to expire. Additionally, if additional parking time is needed, users can extend their parking sessions remotely through the app without needing to return to their vehicle. This helps users avoid parking citations and provides added flexibility in managing their parking needs.

SpotHero: Advanced Reservation System: Spot Hero provides an advanced reservation system that allows users to book parking spots in advance. Users can search for available parking spaces, compare prices, and reserve a spot at their desired location and time. This feature is especially useful in busy urban areas where parking can be limited, as it ensures users have a guaranteed parking spot upon arrival, saving time and reducing stress.Real-Time Availability and Pricing: SpotHero offers real-time information on parking spot availability and pricing. Users can check the app to see which parking spots are currently available, allowing them to plan their parking ahead of time. The app also displays the current pricing for each parking spot, helping users find the most cost-effective option. This transparency in availability and pricing enhances the user experience and helps users make informed decisions when choosing parking options.

We discuss Evaluation parameters are Light Sensor, CCTV coins,SMS,Cost-effectiveness,Timestamp for following.

Light Sensor: Automatic Lighting Control: Light sensors are used in various applications, including automatic lighting control systems. These sensors can detect the ambient light levels and adjust the artificial lighting accordingly. For example, in outdoor lighting systems, light sensors can detect the amount of natural light available and automatically turn on or dim the lights to maintain optimal illumination levels. This not only ensures energy efficiency but also enhances user comfort by providing appropriate lighting in different environmental conditions.Daylight Harvesting: Light sensors play a crucial role in daylight harvesting systems, which aim to maximize the use of natural light in indoor spaces. By measuring the amount of natural light entering a building, light sensors can dynamically adjust the artificial lighting to complement the available daylight. This helps reduce energy consumption by utilizing natural light sources effectively. Light sensors in daylight harvesting systems can also provide feedback to building management systems, allowing for better energy management and optimization of lighting conditions throughout the day.

SMS:SMS (Short Message Service) is a widely used communication technology that allows the exchange of short text messages between mobile devices. It provides a quick and convenient way to send and receive information, notifications, and alerts, making it a popular choice for businesses, organizations, and individuals.SMS offers several advantages, including high reliability, broad compatibility across different mobile networks and devices, and widespread accessibility. It is a cost-effective communication solution, especially for reaching a large audience, as SMS messages can be sent to multiple recipients simultaneously. Additionally, SMS is often used for two-factor authentication, allowing an extra layer of security for various online services and transactions.

Cost-effectiveness: Cost-effectiveness refers to the efficiency and value derived from a particular investment or action in relation to its cost. It is an important consideration in decision-making processes, as it helps assess the feasibility and economic viability of different options.When evaluating cost-effectiveness, it is essential to analyze both the upfront costs and the long-term benefits or savings. This involves considering factors such as initial investment, operational expenses, maintenance costs, and potential return on investment. By comparing the cost-effectiveness of various alternatives, organizations can make informed decisions that maximize value and optimize resource allocation.

Timestamp:A timestamp is a chronological record that indicates the date and time when a specific event occurred or when data was recorded. It provides a precise reference point and helps establish the sequence of events or the order in which actions took place.Timestamps are commonly used in various applications, such as data logging, transaction processing, and event tracking. They serve as essential metadata, enabling data analysis, auditing, and troubleshooting. Timestamps are often generated using standardized formats, such as the ISO 8601 format, to ensure consistency and compatibility across different systems and platforms.

WEIGHTED PRODUCT MODEL(WPM)

The employee performance index appraisal decision support system (DSS) is intended to help decision-makers evaluate the work of staff members at the Pringsewu district revenue department. This DSS's objectives include making decisions regarding human resources, assessing employee performance in relation to achieved goals, and enhancing employee performance going forward.The two fundamental issues that this DSS seeks to solve are. Its primary goal is to transform the manual evaluation process into a computerised one, doing away with the drawbacks of the manual method. Second, it seeks to efficiently implement and assimilate changes by utilising cutting-edge technology. The Weighted Product (WP) weighting approach was selected for this DSS. The WP approach includes dividing attribute weights by attribute ratings. This approach enables objective evaluations based on predetermined standards. The WP technique is used by the DSS to determine employee performance appraisal scores, which can range from a maximum of 0.250 to a minimum of 0.133. The score with the highest value denotes the best employee performance, while the score with the lowest value denotes the worst performance.By using this DSS, the system may provide employee performance appraisal reports quickly and clearly, resulting in decision-making processes that are more effective and efficient. The system's goal is to give a thorough and trustworthy evaluation of employee performance based on predetermined standards, enabling better human resource management at the revenue-generating level.[1]

The remaining sections of the article are described as follows:Introduces the fundamental concept in Section 2 and suggests a new scoring scheme based on the weighted product approach.Section 3 examines the bidders' equilibrium bidding tactics based on predicted profit.In order to balance the winning probability and profit while choosing the most desired bid, Section 4 applies the Cobb-Douglas utility function. We review the equilibrium bidding tactics.Compares the procurer's revenues in Section 5.Determines the best auctions in Section 6.Section 7: Shows how the suggested models are reliable.Section 8: Offers a conclusion in light of the research and arguments discussed in the essay.[3]

A modelling technique called multi-attribute decision making (MADM) is used to choose the best option from a group of options based on predetermined criteria. Each attribute is given a weight value, and the alternatives are then ranked in accordance.The Simple Additive Weighting (SAW) method and the Weighted Product (WP) approach are two methods that are frequently employed in MADM. Both approaches have been widely used to solve MADM problems, thus it is crucial to compare them in order to comprehend their differences.The SAW approach multiplies the attribute values by their associated weights and adds them together to get a weighted sum for each choice. The option with the highest weighted sum is regarded as the ideal option. The WP technique, on the other hand, weighs the attribute values for each alternative. The product of these values is derived by raising the attribute values to the power of their respective weights. The option with the highest product weight is regarded as the most advantageous.Researchers want to comprehend the advantages, disadvantages, and applicability of both approaches for various MADM scenarios. This analysis aids in choosing the best approach based on the particular needs and characteristics of the current decision-making challenge.[4]

In the context in question, there are difficulties in expressing the need for an objective solution to the kelayakanpenerimaRastra. System Pendukung Keputusan (SPK) can be used as a solution in this situation. Based on an assessment and ranking of the available alternatives as well as the criteria for selection, SPK in this will provide recommendations.In this study, the Multi-attribute Decision Making (MADM) method was employed as the sole tool within the SPK to resolve the issue at hand. MADM will offer recommendations based on evaluations and rankings of potential alternatives as well as previously established penilaian criteria. There are two methods used in MADM: Simple Additive Weighting (SAW) and Weighted Product (WP). Both of these methods can be used to implement the permasalahan recommendations made to the Rastra'spenerima.The purpose of this study is to develop and improve a pendukungkeputusan application using the SAW and WP models in order to recommend Rastra as a penerima. With this application, it should be possible to offer recommendations that are more objective and sincere when discussing the kelayakan of Rastra's defenders.[5]

A popular methodology for assessing digital library services is the CSE-UCLA model. When assessing the degree of optimisation or efficiency of programmes or services, it does have some limitations. It specifically lacks a methodical strategy for rating the

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programmes or services using numerical calculations.A fresh idea known as the weighted product based on the CSE-UCLA evaluation model was put forth to alleviate these restrictions. The CSE-UCLA model's evaluation features are carried over into the new one, which also uses the weighted product method for quantitative computations.The weighted product technique enables a quantitative and systematic evaluation of the programmes or services, giving a more precise indication of how effective they are.The new methodology intends to address the drawbacks of the original model and provide a more robust and thorough evaluation framework for digital library services by including the weighted product method into the CSE-UCLA evaluation model.[8]

To solve various decision difficulties, multiple Multi-Attribute Decision Making (MADM) techniques have been created. The Simple Additive Weighting (SAW) approach is one MADM technique that is frequently employed. A weighted linear combination or scoring method is another name for SAW. It is an easy method that is regularly used in multi-attribute decision analysis.The weighted average is computed using the arithmetic mean in the SAW method. Every property is given a scaled value, which is then multiplied by the weights chosen by the decision-makers for each choice. An assessment score is calculated for each alternative based on the sum of the products for all criteria.The SAW approach has the benefit of maintaining the relative order of magnitude of the standardised scores, guaranteeing the preservation of the relative significance of the choices.The Weighted Product (WP) method is another MADM approach that has been suggested. Due to its computational simplicity, the WP technique is thought to be more effective than others for solving MADM problems. The WP method offers a practical method for solving choice problems and is especially helpful in situations when there is a high degree of subjectivity.In conclusion, the WP approach is renowned for its efficacy and efficiency in solving MADM problems, whereas the SAW method is a widely used MADM method that determines an assessment score for each alternative based on weighted averages. For decision-makers across a range of industries, both approaches provide useful resources.[9]

In the analysis of the credit application you mentioned, the method Fuzzy MADM with the Simple Additive Weighting (SAW) model was used to determine the conclusion. But for this study, you want to use the Weighted Product (WP) method as a backup.Weighted Product (WP) is a method used in the Fuzzy-Multi Attribute Decision Making (F-MADM) method. Comparing this method to similar ones, it has a more favourable hit rate, which reduces the amount of time needed to generate a conclusion.Another feature of the weighted product model is its capacity to provide cost and benefit estimates for each attribute. However, the method has drawbacks when applied to attributes with rentangnilai.According to the research mentioned, the F-MADM method with the Weighted Product model will be used in the research on the handling of credit requests. Using this method, you can adjust the amount of credit you receive based on indicators like jaminan, penghasilan, SIUP, and PBB that have already been determined.In this study, the Weighted Product method's use is hoped to provide more accurate and objective insight into how to evaluate credit application risk. However, it's important to understand that the methodology and model used must be compatible with the research needs and the characteristics of the data that are being used.[11]

RESULT AND DISCUSSION

Table 1:smart parking system using iot environment

	Light Sensor	CCTV coins	SMS	Cost-effectiveness	Timestamp
ParkSmart	2	8	8	9	1
Streetline	7	1	5	6	7
ParkWhiz	6	9	4	6	4
ParkMobile	7	9	5	3	9
SpotHero	6	6	1	7	9

Table 1 shows the Smart parking system using iot environment using the analysis method Alternative parameters for ParkSmart,Streetline,ParkWhiz,ParkMobile,SpotHero and Evaluation parameters for Light Sensor,CCTV coins,SMS,Cost-effectiveness,Timestamp

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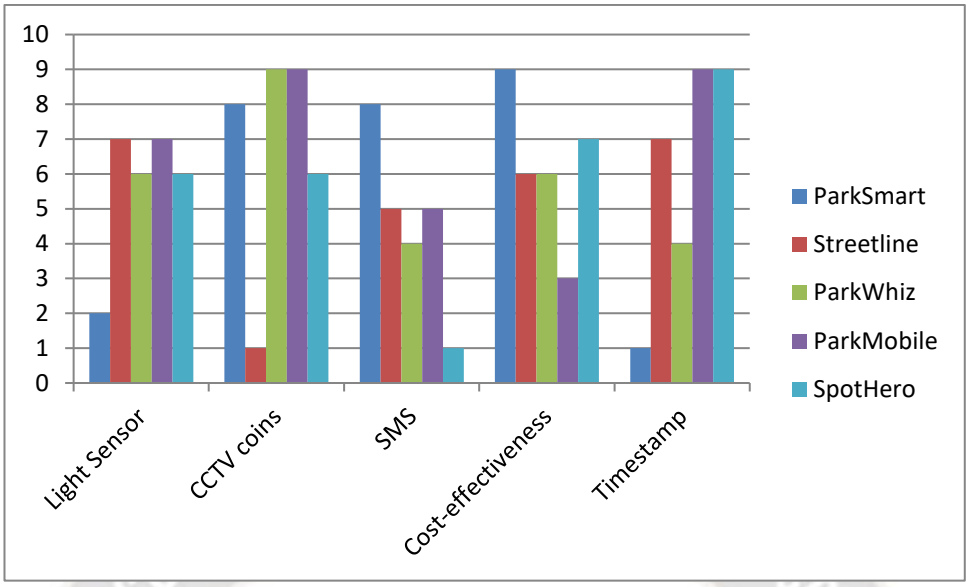

Figure 1: Smart parking system using IOT environment

Figure 1 shows the data set of smart parking system using IOT environment like Alternative parameters for ParkSmart,Streetline,ParkWhiz,ParkMobile,SpotHero and Evaluation parameters for Light Sensor,CCTV coins,SMS,Cost-effectiveness,Timestamp

Table 2: Performance value

Performance value				
0.28571	0.88889	1.00000	0.33333	1.00000
1.00000	0.11111	0.62500	0.50000	0.14286
0.85714	1.00000	0.50000	0.50000	0.25000
1.00000	1.00000	0.62500	1.00000	0.11111
0.85714	0.66667	0.12500	0.42857	0.11111

Table 2 shows performance value of Alternative and Evaluation parameters.

Table 3: Weight

Weight				
0.20	0.20	0.20	0.20	0.20
0.20	0.20	0.20	0.20	0.20
0.20	0.20	0.20	0.20	0.20
0.20	0.20	0.20	0.20	0.20
0.20	0.20	0.20	0.20	0.20

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Table 3. Shows Each technology or solution is represented by a row in the table, and the values in each row (0.20 for each category) seem to indicate equal weight or importance assigned to each criterion. However, without further context or information, it is difficult to determine the specific meaning or interpretation of these values..

Table 4: WeightedNormalised Decision Matrix

Weighted normalized decision matrix				
0.77837	0.97672	1.00000	0.80274	1.00000
1.00000	0.64439	0.91028	0.87055	0.67761
0.96964	1.00000	0.87055	0.87055	0.75786
1.00000	1.00000	0.91028	1.00000	0.64439
0.96964	0.92211	0.65975	0.84412	0.64439

Table 4 shows the normalised decision matrix with weights of alternative and evaluation parameters.

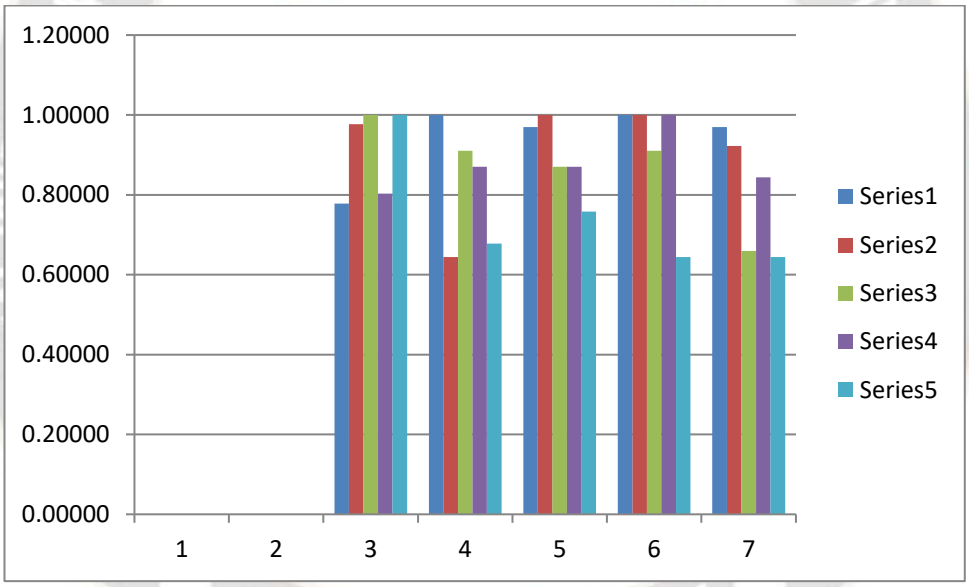

Figure 3 shows the Normalized decision matrix with weights of Alternative parameters for ParkSmart,Streetline,ParkWhiz,ParkMobile,SpotHero and Evaluation parameters for Light Sensor,CCTVcoins,SMS,Cost-effectiveness,Timestamp

Table 5:Preference Score & Rank

	Preference Score	Rank
ParkSmart	0.61028	1
Streetline	0.34602	4
ParkWhiz	0.55691	3
ParkMobile	0.58658	2
SpotHero	0.32087	5

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Table 5 gives ParkSmart Preference Score values is 0.61028,Streetline Preference Score values is0.34602, ParkWhizPreference Score values is 0.55691, ParkMobile Score values is 0.58658, and SpotHero Preference Score values is 0.32087. and ParkSmart is on 1st Rank,ParkMobile is on 2nd Rank,ParkWhiz is on 3rd Rank,Streetline is on 4th Rank and SpotHero is on 5thRank.

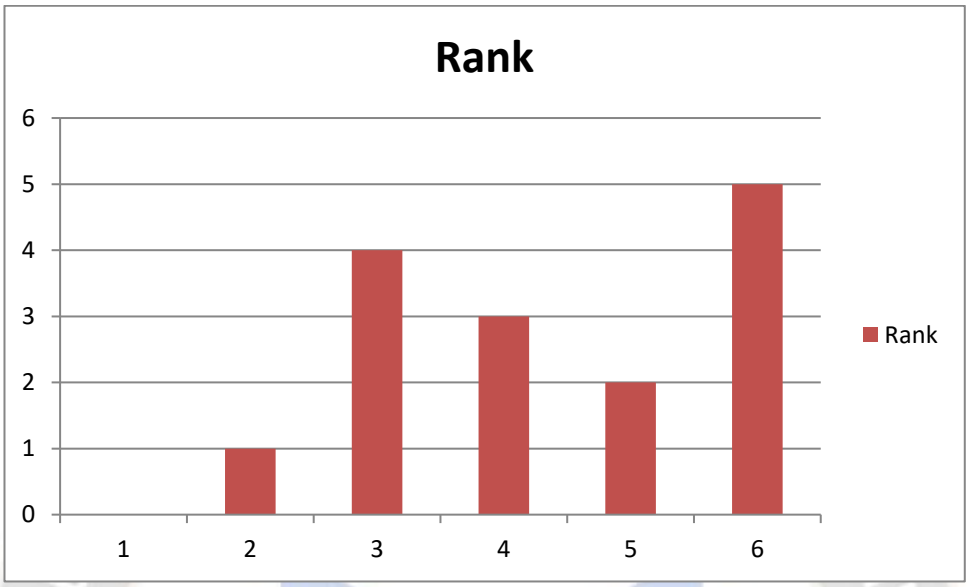

Figure 4: Preference Score & Rank

Figure 4shows the rank of the data set(ParkSmart is on 1st Rank,ParkMobile is on 2nd Rank,ParkWhiz is on 3rd Rank,Streetline is on 4th Rank and SpotHero is on 5thRank).

CONCLUSION

In conclusion, the implementation of a smart parking system using an IoT environment offers numerous benefits and improvements to traditional parking management. This technology harnesses the power of connected devices and data analytics to optimize parking space utilization, enhance user experience, and contribute to efficient urban mobility.Firstly, the utilization of IoT devices, such as sensors and actuators, enables real-time monitoring of parking spaces, providing accurate information on availability and occupancy. This data can be seamlessly integrated into mobile applications or digital signage, allowing users to easily locate and navigate to vacant parking spots. By reducing the time spent searching for parking, the smart parking system improves traffic flow and reduces congestion in urban areas.Secondly, the IoT environment enables effective management and optimization of parking resources. The collected data on parking occupancy can be analyzed to identify usage patterns, peak hours, and high-demand areas. This information empowers parking administrators to make data-driven decisions, such as adjusting pricing, optimizing parrking lot layouts, and implementing dynamic pricing strategies to incentivize efficient parking utilization.Moreover, the integration of IoT with payment systems and mobile applications allows for convenient and cashless transactions. Users can make payments using mobile wallets or pre-registered accounts, eliminating the need for physical tickets or cash. This streamlines the payment process, improves security, and enhances the overall user experience.Furthermore, the IoT environment enables remote monitoring and maintenance of parking infrastructure. By utilizing sensors to detect malfunctions or anomalies, parking administrators can proactively address issues and minimize downtime, ensuring a seamless and reliable parking experience for users.In conclusion, the implementation of a smart parking system using an IoT environment revolutionizes the traditional parking management paradigm. It improves parking space utilization, enhances user convenience, optimizes resource allocation, and contributes to efficient urban mobility, making it a vital solution for addressing the challenges of parking in today's urban environments.

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