ARTIFICIAL INTELLIGENCE
REPORT
ON
PARKING MANAGEMENT SYSTEM

Computer Science and Engineering.

Under The Guidance of

Mrs.Ankita Wadhawan

Submitted By

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SMART - AI
ON PARKING MANAGEMENT SYSTEM

INTRODUCTION:

Parking management system is a crucial element of urban infrastructure. The rapid increase in the number of vehicles on roads has led to a significant challenge of finding parking spaces. In addition, the traditional methods of parking management have become outdated and inefficient. The integration of smart AI technology in parking management systems has revolutionized the way parking spaces are managed. The objective of this report is to explore the benefits of using smart AI in parking management systems and the challenges associated with its implementation.

Objectives:

The objectives of this project are as follows:

Develop a parking management system using AI technology to optimize parking space usage, reduce congestion and improve the user experience.

Implement a parking guidance system that provides real-time parking availability information to drivers.

Develop automated payment systems that are convenient and secure for users.

Integrate the parking management system with other transportation systems to provide a seamless travel experience for users.

Methodology:

The proposed AI parking management system will be developed using a combination of hardware and software components. The hardware components will include sensors and cameras installed at parking

locations to detect the presence of vehicles and collect data on parking usage. The software components will include machine learning algorithms to analyse the data collected from sensors and cameras and predict parking demand.

The system will also feature a parking guidance system that provides real-time information to drivers on parking availability at specific locations. Additionally, automated payment systems will be implemented, which will allow users to make payments using their mobile devices, eliminating the need for cash payments.

The system will also be integrated with other transportation systems, such as public transit, to provide a seamless travel experience for users.

How Artificial intelligence is used in parking management system?

Artificial Intelligence (AI) is being increasingly used in parking management systems to improve efficiency and reduce traffic congestion.

Here are some ways AI is used in parking management systems:

Parking guidance: AI-powered parking management systems use sensors, cameras, and other technologies to detect available parking spots and guide drivers to them. These systems can provide real-time information on parking availability, which can help reduce the time drivers spend looking for parking spots, leading to less congestion and emissions.

Predictive analysis: AI algorithms can analyse historical data on parking occupancy and usage patterns to predict future demand for parking spots. This can help parking managers make informed decisions about how many spots to allocate and where to locate them.

Automated payment systems: AI can automate the payment process by using license plate recognition technology to identify vehicles and charge drivers for the time they spent parked. This eliminates the need for physical payment stations and reduces the risk of human error.

Enforcement: AI-powered parking management systems can also help enforce parking rules and regulations. For example, they can detect when a vehicle has overstayed its allotted time or parked in a

restricted area, and issue automated citations or alerts to enforcement personnel.

Benefits of Smart AI in Parking Management System:

1. Real-time Data Analysis: Smart AI in parking management systems can collect data in real-time and analyse it to provide valuable insights into parking patterns. This information can be used to optimize the use of parking spaces, reduce congestion and minimize the time spent searching for parking spaces.
2. Automatic Payment and Ticketing: Smart AI in parking management systems can automate the payment and ticketing process. Drivers can pay for their parking using their mobile devices or through automatic license plate recognition systems. This reduces the need for physical tickets and cash transactions, which in turn reduces waiting times and improves the overall customer experience.
3. Efficient Parking Guidance: Smart AI in parking management systems can guide drivers to available parking spaces in real-time. This is done

through the use of sensors that detect the presence of parked vehicles. Drivers can be directed to available parking spaces through mobile apps or digital displays, thus reducing the time spent searching for parking spaces.

4. Reduced Maintenance Costs: Smart AI in parking management systems can monitor parking facilities for any maintenance issues such as broken equipment or lighting failures. This ensures that issues are identified and resolved quickly, reducing maintenance costs and improving the overall safety of the parking facility.

Challenges of Smart AI in Parking Management System:

1. High Implementation Costs: Implementing smart AI technology in parking management systems can be expensive. The costs associated with installing sensors, cameras, and other infrastructure can be prohibitive for smaller parking facilities.

2. Cybersecurity Risks: Smart AI in parking management systems involve the collection of sensitive data such as license plate numbers, payment information, and personal details. This data can be vulnerable to cyber-attacks, and it is important to have robust cybersecurity measures in place to protect the data.
3. Lack of Standardization: There is currently no standardization in the implementation of smart AI in parking management systems. This can lead to compatibility issues between different systems and devices, making it difficult for users to switch between different parking facilities.

Automatic Parking System Based on Improved Neural Network Algorithm and Intelligent Image Analysis:

Link:

click on the button or link

https://www.hindawi.com/journals/cin/2021/4391864/

1. Introduction

With the rapid development of national economy, the living standard of Chinese residents has been greatly improved, the travel conditions are more diverse and fast, and the number of private cars is increasing year by year. At the same time, due to the relative lag of urban planning and construction, there is a huge gap in the demand for parking space, and the problems of parking and finding a car are becoming increasingly prominent, which increases the efficiency of private car travel. In addition, the problems such as imperfect parking system and irregular parking have a significant impact on the overall travel, parking, and pick-up of residents. The design and promotion of intelligent parking system which can solve these problems has become an urgent demand.

Parking management services need to achieve a variety of functions, mainly including parking information query, map route navigation, display and guidance of spare parking spaces, intelligent payment, and car locating system, involving multidisciplinary technology, including edge computing, image processing technology, smartphone application development technology, and deep learning algorithm [1–3]. At present, there are some parking management service products in the market, but their functions are not perfect. The existing technical problems are mainly divided into three categories: inaccurate positioning, limited scope of use, inaccurate vehicle information identification and feedback, and some problems in promotion and cost. This research mainly aims at the technical level and carries out a series of design and improvement. In terms of positioning technology, due to the weak and inaccurate positioning signals of traditional positioning systems such as Global Positioning System (GPS) and Beidou, the

widely used positioning technologies include ultrasonic positioning, infrared positioning, Radio Frequency Identification (RFID) positioning, Wireless Fidelity (WiFi) Positioning, ZigBee positioning, and Bluetooth positioning [4]. The positioning principle is to cover the field by building a wireless signal and then receive the signal and locate the object. The existing indoor positioning models include BP neural network positioning model, WLAN positioning model, support vector machine model, ZigBee fuzzy clustering positioning model, etc. [5]. In this study, WiFi coverage is used to identify and locate the free parking spaces.

Many achievements have been made in the research of vehicle navigation function. The navigation system is usually divided into three parts: parking lot end, cloud end, and user end. The parking lot information is transmitted to the cloud end and read at the user end after calculation and processing [6]. The system types include navigation system based on path planning, auxiliary navigation system using tags for mobile robots, and guidance system based on neural network algorithm for vehicle trajectory prediction [7]. This study uses the improved neural network algorithm for path navigation. The research of auxiliary parking system is relatively early, from the intelligent auxiliary parking system based on optical projection, to the 3D reconstruction automatic detection parking system, and the parking space monitoring system based on filter and local binary mode; now it can basically meet the needs of users [8]. Image recognition technology has also been greatly developed in recent years, such as parking space occupancy recognition technology based on C4.5 algorithm, Open Source Computer Vision Library (OpenCV) graphics processing technology, etc. [9]. This topic studies some image recognition technology and positioning technology, explores its existing application results, and

optimizes its application mechanism. In view of the lack of accuracy and real time of current recognition technology, this study uses You Only Look Once (YOLO) improved model for image feature extraction and recognition, in order to improve its recognition efficiency and accuracy.

2. Establishment of Parking Space Recognition System Based on Improved Neural Network Algorithm

2.1. Overall Framework Design of Parking System

The parking system designed in this study is mainly divided into two parts: server part and data analysis part, including service application layer, perception layer, data analysis layer, and management layer [10]. The function of the service layer is that users can obtain some relevant information such as the number of cars in the parking lot, the entrance and exit of the parking lot, the estimated parking time, and so on, through the handheld terminal. At the same time, it also has the distance navigation function, which can plan the optimal path to the entrance of the parking lot and record the location information and parking time of the parking lot. The main function of the front-end perception layer is information transmission. The specific working principle is to obtain the recognition image of the parking space through the shooting function, recognize the coordinate information of the target parking space, and upload the information to the intelligent terminal. Combined with the positioning and navigation system of the intelligent terminal, the information is judged and analyzed, and the path is calculated. Cloud service layer, also known as data analysis

layer, analyzes and calculates the obtained data by building a distributed cluster. In this study, the improved neural network algorithm and image recognition technology convolution neural network algorithm are used to analyze and process the data [11].

AI-based smart parking is an innovative parking solution that leverages data from different devices like sensors and cameras to form an AI-driven parking management system. These devices are either embedded into the parking lot or placed in close proximity to the parking lot to **detect the availability of parking spots.**

The system **provides details of the vacant parking slots in the vicinity and reduces the traffic issues due to illegal parking in the vicinity**. It is designed with an objective to meet the requirements of controlled parking that offers effortless parking tactics to the authorities.

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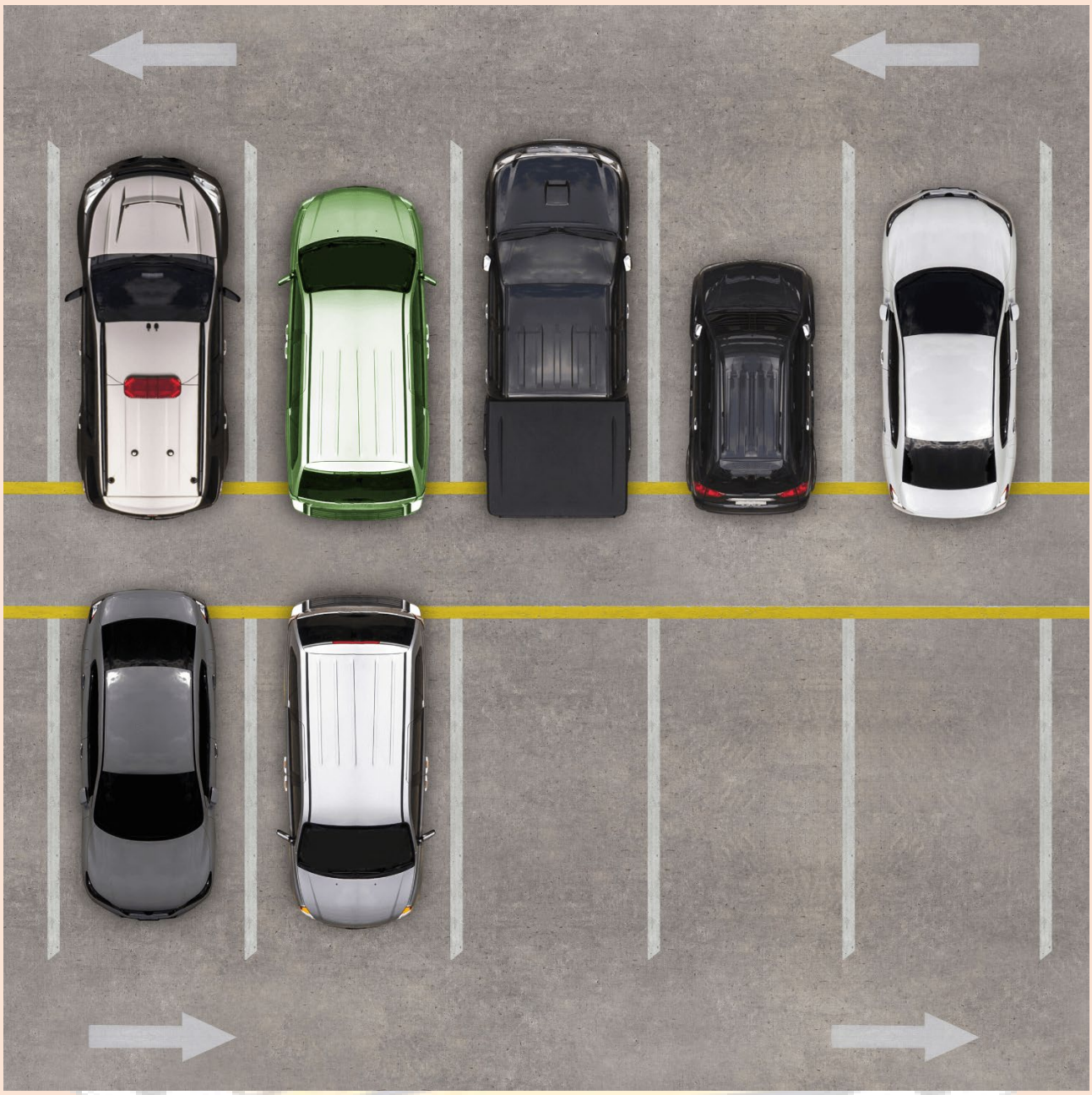


This image is related to parking management system.

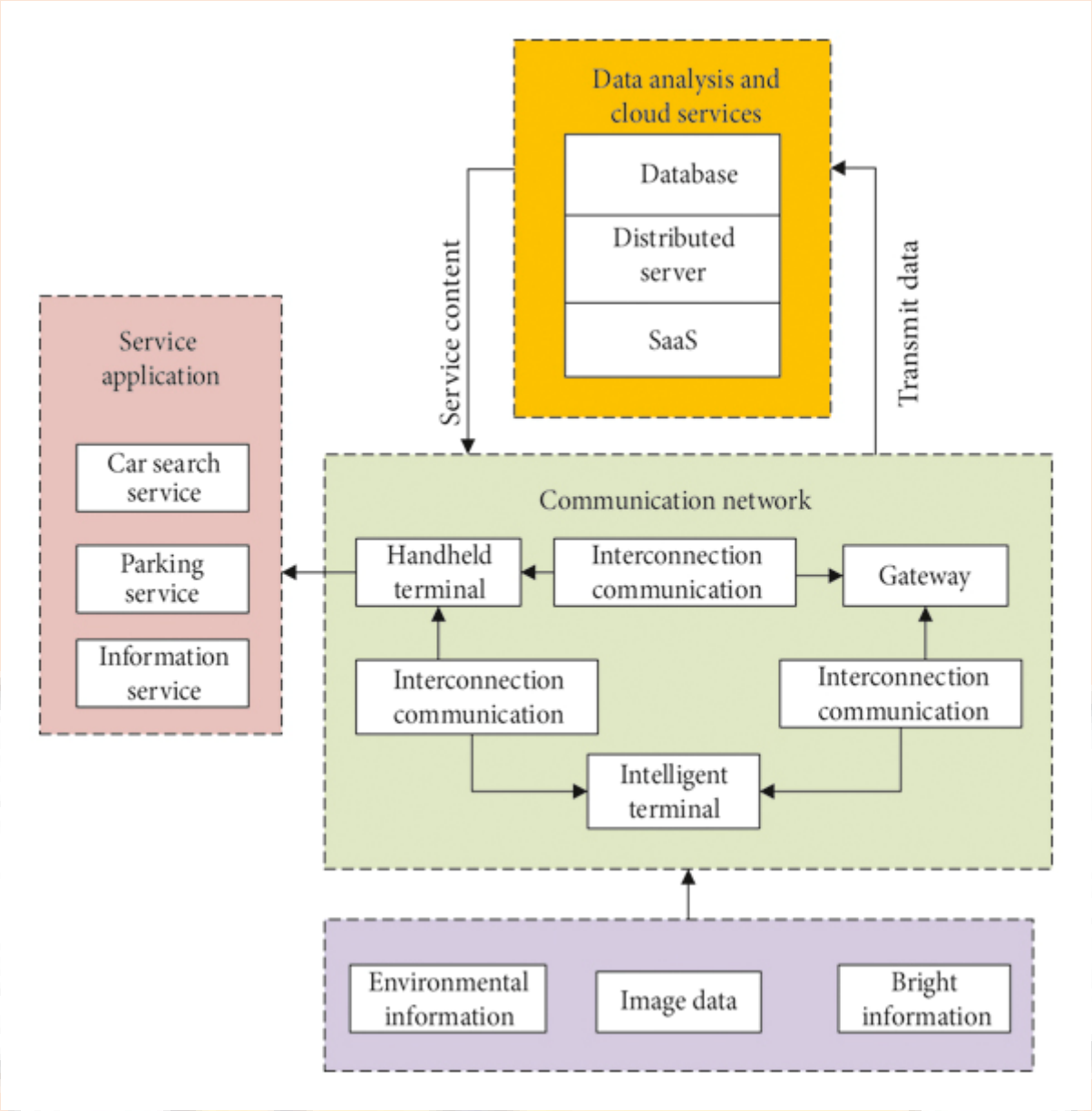
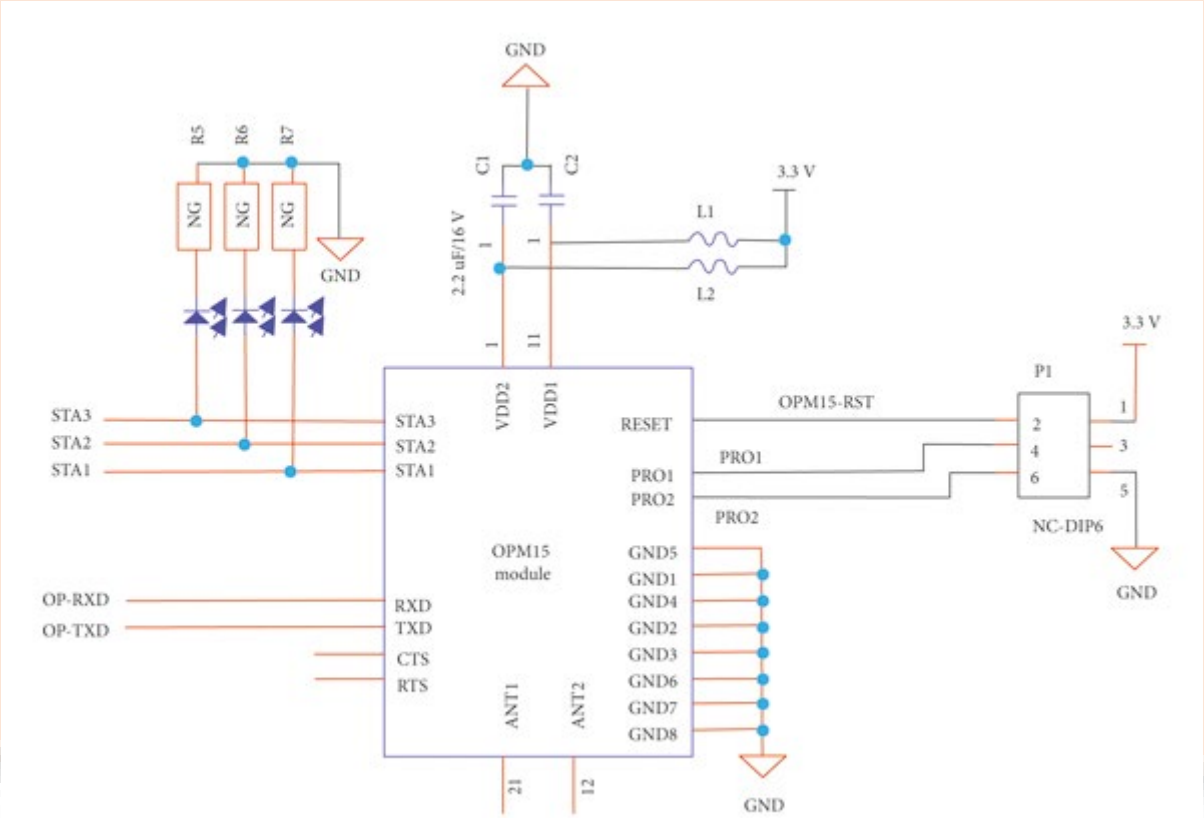


Figure 1: Overall System Framework Design:

The network system of parking system is opm15 system, which is composed of multiple network intelligent terminals with sensing ability, processing ability, and wireless communication performance, and can realize the interconnection communication between objects and between objects and networks [12]. Nodes in omp15 network can also be used as relay signals of other base stations to dynamically use network resources.

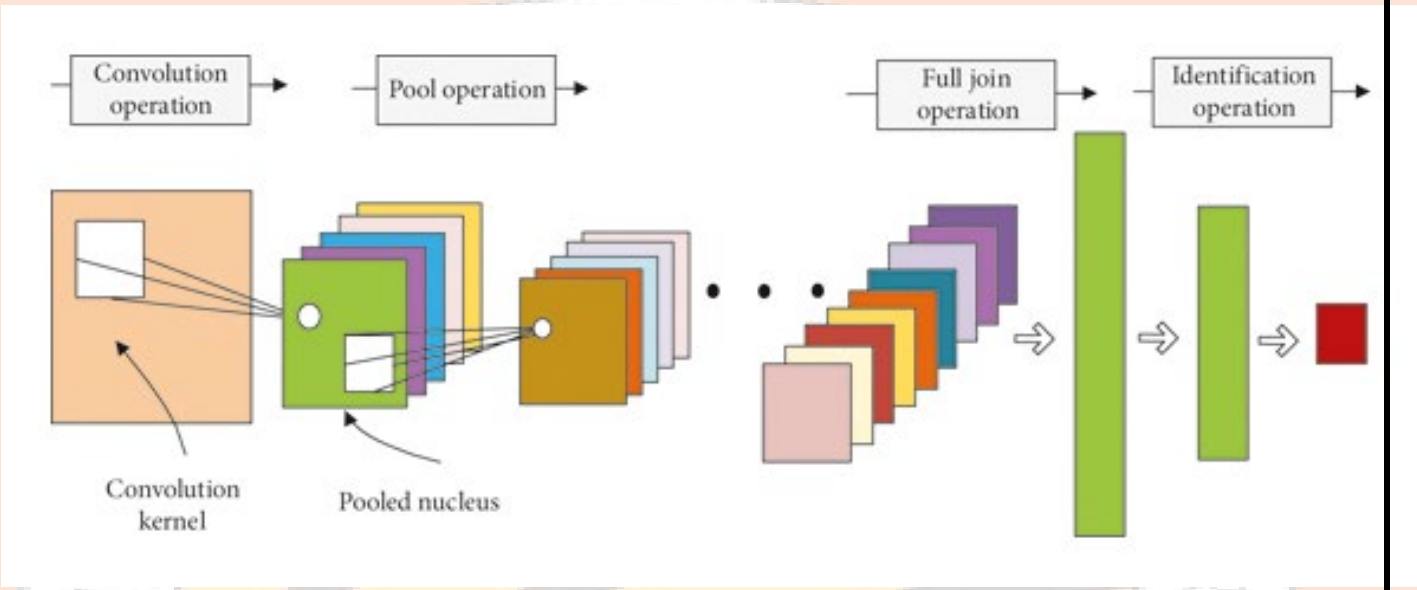


. **Figure .2 Opm15 circuit diagram**

2.2. Parking Space Recognition Technology Based on Convolution Neural Network Algorithm

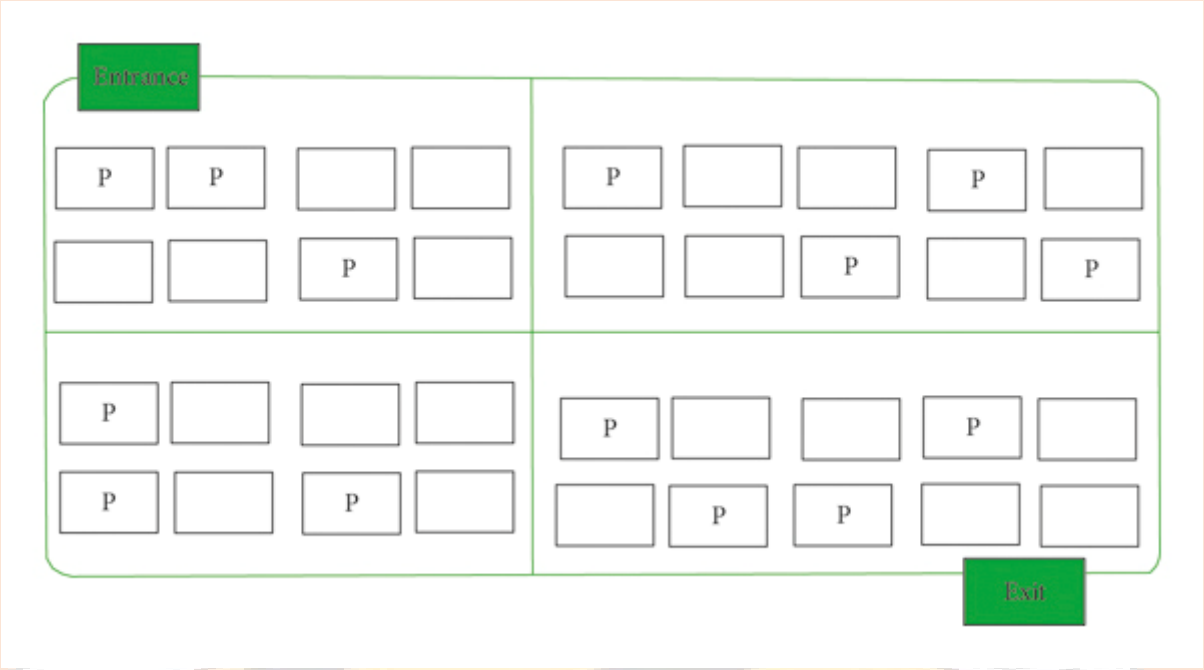
The first step of automatic parking is to detect, identify, and locate the free parking space in the parking lot to get the real-time occupancy information. In this study, CNNs algorithm is used to extract the features of the collected parking image, identify the vehicle target, and then judge the parking occupancy.

Figure 3
Feature extraction and recognition of convolution neural network.



2.3. Establishment of Parking Space Recognition System Based on Convolution Neural Network Algorithm

After the vehicles in the parking lot are accurately identified, it is necessary to establish a parking lot model. It is necessary to judge the coordinates of the detected vehicles and compare with the prior parking space box to judge the parking space occupation, which is reflected in the parking lot model. See Figure 7 for parking space identification.



Parking space Recognition System

Figure .4

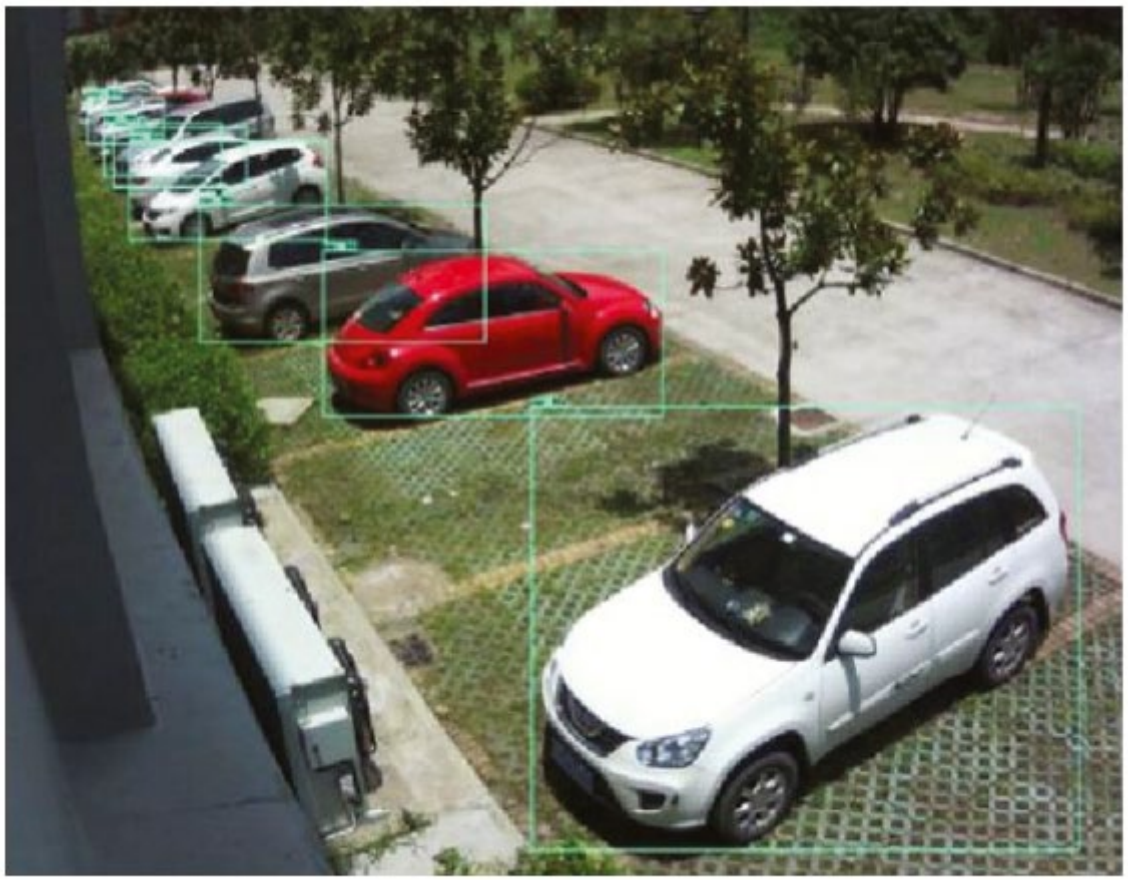


Figure .5

AI-based Smart Parking Solutions

click on the link

https://parkingtelecom.com/en/ai-based-smart-parking-solutions/

AI-based smart parking solutions have become a crucial part of our daily lives. They are important and beneficial for both sides – parking managers and parking users. AI-based smart parking solutions use hardware and software to analyze parking vacancy. They help for efficient parking management and can transform and improve the whole parking industry.

In this article, the team of **Parking Telecom** will show you 4 applications of AI (artificial intelligence) in parking management. All of them improve the parking experience and parking lot efficiency:

Automated License Plate Recognition (ALPR) / Automatic Vehicle Identification

The ALPR system also is one of the AI-based smart parking solutions. It works via ALPR cameras and uses the optical character recognition technique. That way, it scans and reads

vehicle plates and provides automatic access to the parking lot.

Benefits for parking managers: The ALPR parking system allows you to give the needed access to your parking occupants. You decide who can enter and when. The smart parking system will keep that data and make the whole process easier for controlling.

Benefits for parking users: This AI-based parking solution can easily identify a vehicle, granting automatic access, in order to eliminate the need of pressing a button, getting a parking ticket, etc. It uses a ticketless parking system. That makes the vehicle entry/exit flow faster and the parking experience – faster.

Real-time parking occupancy and availability

AI-based smart parking solutions include special IoT tools that can count the number of parked vehicles and empty parking spaces in a parking lot. It detects if there is a car presence in a parking space and sends the information to the management platform. The best part is that this AI-based solution collects and formats the information in real-time.

Benefits for parking managers: That real-time information about parking occupancy and availability can be observed or analyzed later. Every parking manager, parking analyst or decision-maker can optimize the current parking management strategy at any time!

Benefits for parking users: We all know that there are too many vehicles and not enough parking spaces. Thanks to the real-time data about parking occupancy and availability, parking users can easily find where to park their vehicle. That eliminates one of the biggest parking problems – circling for an empty parking space and city traffic.

Predictions and forecasts on the parking occupancy rate

AI-based smart parking solutions also include an algorithm that can automatically create predictions and forecasts on the parking situation and future parking occupancy rate. It allows automatic learning by analyzing past information.

Benefits for parking managers: This AI-based solution can predict future parking demand taking into account the time, the weather, the day of the week, peak hour timings, the current level of traffic and the behavior of the parking users.

Dynamic pricing

The dynamic pricing for parking lots is an AI-based system that calculates real-time parking pricing changes. These changes depend on peak/non-peak times and many other factors. That system includes special cloud-based software that analyses the parking occupancy, availability and frequency of use. This way, the dynamic pricing solution predicts consumer demand, congestion, etc.

Benefits for parking managers and parking users: By modifying parking pricing automatically, parking managers can navigate parking users to vacant parking spots based on that real-time information. It is time-saving and far more convenient for both sides. In addition, it makes parking management more effective and reduce congestion.

Parking Telecom's AI-based smart parking solutions:

There is no doubt that artificial intelligence has a big impact on parking management in our digital age. The AI-based parking management solutions help for better parking experience, parking spaces control, convenience, flow speed and city traffic.

Parking Telecom's AI-based parking solutions and systems are created to solve every parking management problem! We understand the difficulties that parking managers usually face and know how to solve them.

Youtube link for the video tutorial:

https://youtu.be/lpG3_yNM5yE

If we want any reference we can go through it:

The graph percentage of AI used in parking management system.

is the car (15%), followed by a bicycle (13%). Least preferable mode of transport is the bus (

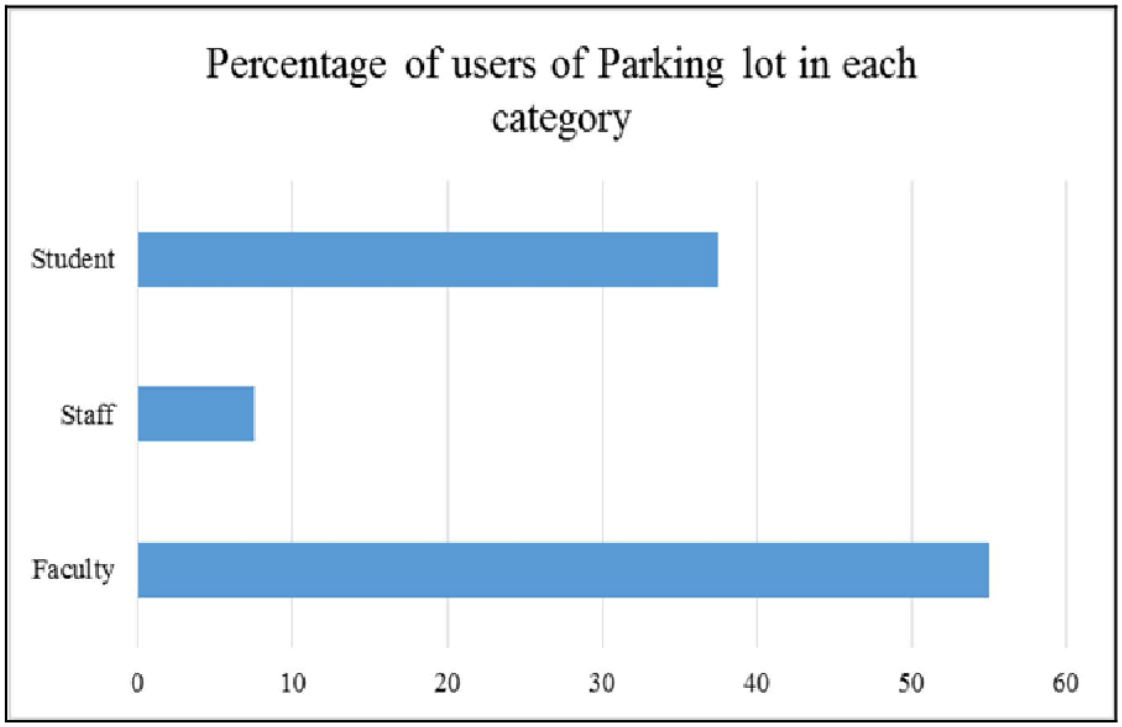
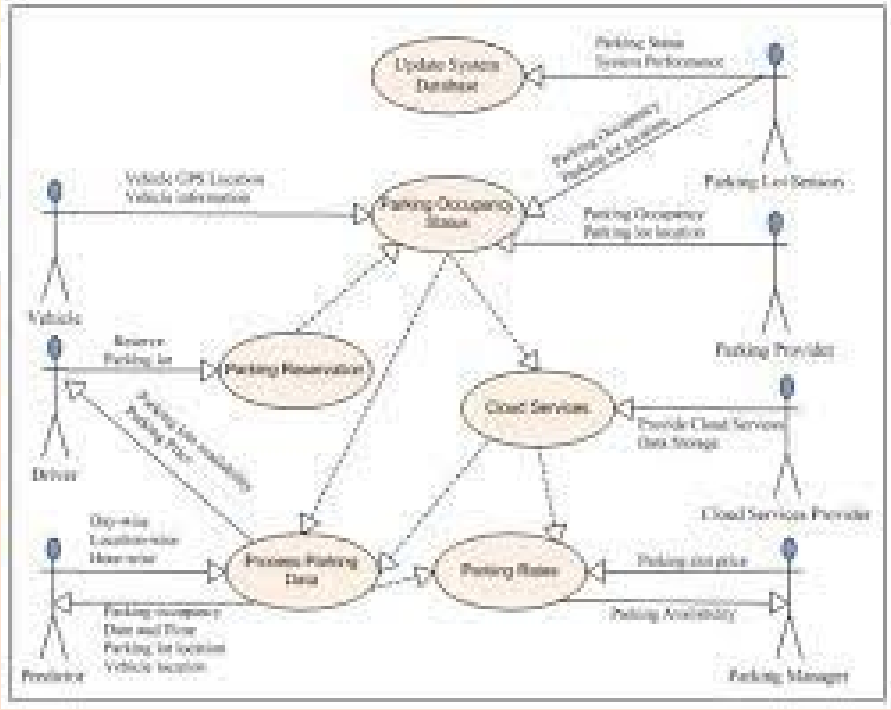
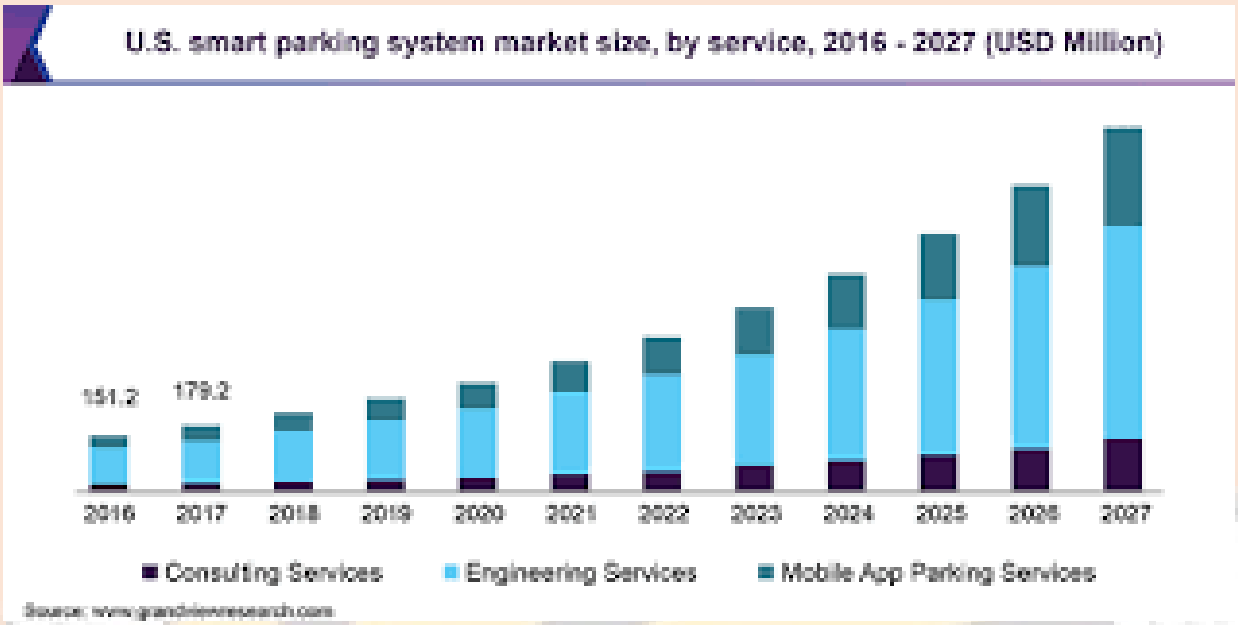


Fig. 2 Bar Graph depicting Percentage share of each category of user of the parking lot facili

Rapid increase of Ai in the field of parking management system.





These are the some graphs related parking management system.
Refrence of graphs from
https://www.hindawi.com/journals/cin/2021/4391864/

This is the link related the graphs and more information

Here are 6 application ideas made possible by a 2.0 management of your parking data.

Link :

https://blog.izix.eu/en/artificial-intelligence-and-parking-management-6-concrete-examples

- Count the number of occupants and vehicles
- Facial recognition
- Predictions on the occupancy rate
- Detection of vehicle speed
-
- Deduce models using parking data
- License plate reading
-

1. Count the number of occupants and vehicles

Business Intelligence (B.I) is the set of methods and tools used to collect and format data for processing by decision-makers. Bosch has implemented an IoT tool capable of detecting the presence of a vehicle in a parking space and to transmit formal information via an analysis platform. This data can then be analyzed by parking managers, any other analyst or decision-maker to **optimize the parking management strategy**. This is the case with BePark's platform, which allows you, for example, to observe this data in order to analyse it later.

2. Facial recognition

Artificial Intelligence is a vast field that includes Deep Learning. This Machine Learning method is inspired by the functioning of our brain, in particular through a system of neural networks. There are thus many applications, such as facial recognition. This one can have several uses. First of all, it can help to recognize a person by name in order **to facilitate access**. And then, it is a further step towards a more **secure parking lot.**

3. Predictions on the occupancy rate

Machine Learning is a statistically based method. This is a type of algorithm that allows automatic learning by deducing general laws from past information. This method can be very useful for performing predictive models. The latter may, for example, have the virtue of **anticipating a future need** according to different parameters: taking into account, in particular, the time, day of the week or the current behaviour of motorists.

4. Detection of vehicle speed

Always with the goal of improving safety in parking lots, speed control can be a work in progress given the risk of collisions. Thanks to a simple video, a Deep Learning (D.L.) algorithm can detect the speed of a vehicle. Once this speed has been detected, several measures can be taken if someone is speeding. For example, it is possible to automatically notify an occupant by email for preventive purposes. In addition, the speed of vehicles travelling in parking lots can be an interesting factor in itself, as it may become a performance indicator in terms of the parking experience, particularly in terms of traffic flow.

5. Deduce models using parking data

Another advantage of Business Intelligence is the ability to deduce models and general laws from parking data. This deduction can be made automatically or consciously. For example, it is possible to establish correlations using graphs between time and occupancy rate. Your data has something to tell you: by interpreting it, you can implement strategies accordingly.

6. License plate reading

The **automated recognition of license plates** is done in a classic way using an optical character recognition technique. This is very effective and can also be replaced by a Deep Learning algorithm. For example, reading the plates can identify an occupant in order to grant him **automatic access** to a parking lot, without having to ask him for any action (pressing a button, removing a ticket, etc.) and without the intervention of a third party. This automatic reading can also be useful in the acquisition of parking data. For example, suppose that by using these parking data, we can deduce that sales representatives are making greater use of parking lots, it will be possible to readjust their parking management strategy according to the number of sales representatives recruited, their schedules or their attendance within the company.

As you can see from the examples cited, artificial intelligence has an impact on parking management in the digital age. However, it is crucial to address the issues that can be barriers to the wider adoption of this technology, as it is essential to build user confidence in it. Factors such as convenience, speed, accuracy, confidence and experience are extremely important for any technology to be better accepted, and artificial intelligence is not a unique case.

Overall, AI is being used in parking management systems to improve efficiency, reduce congestion,

and enhance the overall parking experience for drivers.

Advantages of AI Parking management system.

1). Improved parking efficiency and utilization.

2). Reduction in traffic congestion and emissions.

3). Increased revenue from parking facilities.

Enhanced user experience with real-time parking availability information and automated payment systems.

Conclusion:

The proposed AI parking management system aims to optimize parking space usage, reduce traffic congestion, and enhance the user experience. The system will be developed using a combination of hardware and software components and will include a parking guidance system, automated payment systems, and integration with other transportation systems. The system is expected to provide a number of benefits, including improved parking efficiency, increased revenue, and a better overall parking experience for use.

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