AI IN SMART PARKING

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AI IN SMART PARKING

ABSTRACT-

In this project it is aimed to introduce a smart parking management system using artificial intelligence. By the use of this AI we are able to detect the suitable parking lot for the vehicle and to reduce the collision between the vehicles. When a vehicle enters a parking lot, it recognizes the vehicle number using embedded camera, tracks which parking space the vehicle is parked in, and updates parking space information. Vehicle number recognition system uses Optical Character Recognition(OCR) technique and is implemented on a Raspberry system. By managing the vehicle number recognized at the entrance of the parking lot as an Object ID, it was possible to effectively track the vehicle as a moving object inside the parking lot and finally identify the parking location. In order for accident detection, YOLO with CNN deep learning process is used. Experimental results show that the detection accuracy of parking and accident detection increases as the number of training images increases. By using the smart parking system implemented in this paper, it is possible to effectively manage the vehicle's parking location, free space information and possible accidents.

Keywords- smart parking, yolo, parking, accident detection, OCR

INTRODUCTION-

Artificial intelligence technology such as You Only Look Once (YOLO) has been applied and used in various industries. You only look once (yolo) is a new approach for the object detection. In this new world where the population of the world is increasing which leads to the increase in the number of vehicles which creates a lot of traffic especially during the peak hours or the office hours. Also when we enter the parking lot of the malls or any other public place it is very difficult for us to find the parking space or if we get the parking space it is sometimes difficult to park the vehicles due to the other vehicles. In order to alleviate these issues, a camera-based PGI (Parking Guidance Information) system has been studied (Chen & Chang, 2011). Camera-based PGI System has three advantages

Firstly, special hardware infrastructure is not necessary because a CCTV camera can cover large parking spaces.

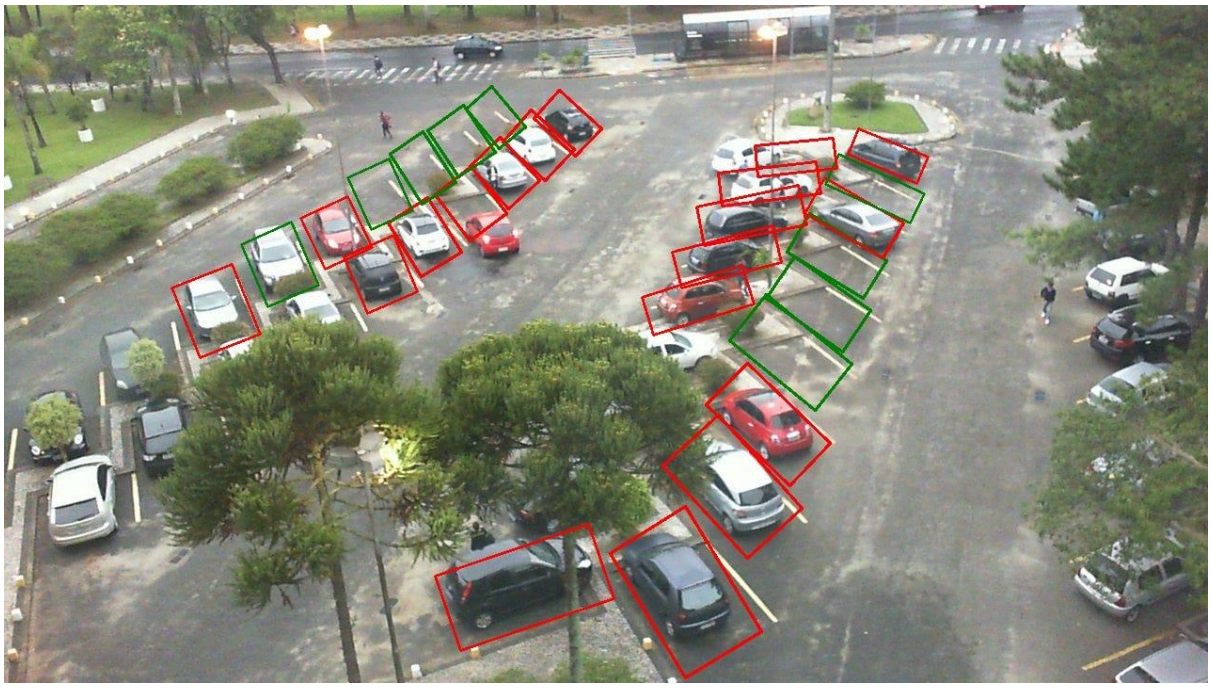
Secondly, the system can provide an accurate location that is essential for finding the vacant parking position.

Thirdly, camera-based system can also be applied to the parking lot in the street or residential area

Smart parking is an innovative solution that uses various techniques to improve the parking management and reduce the traffic congestion. AI in smart parking system uses various sensors cameras and other devices to detect the parking spaces or the availability of the spaces. This data is then analysed by the system to generate the data which helps in the parking management.

In India we are still using manual vehicle parking system and that is why we are struggling with the waste of time and fuel problem, when we need to park our car, we need to park our car, which requires a good amount of lighting. Another issue is the chaos that

occurs when parking because there is no special system. Anyone can park anywhere that sometimes causes damage to vehicles while going out or in the parking lot. Security is also an issue

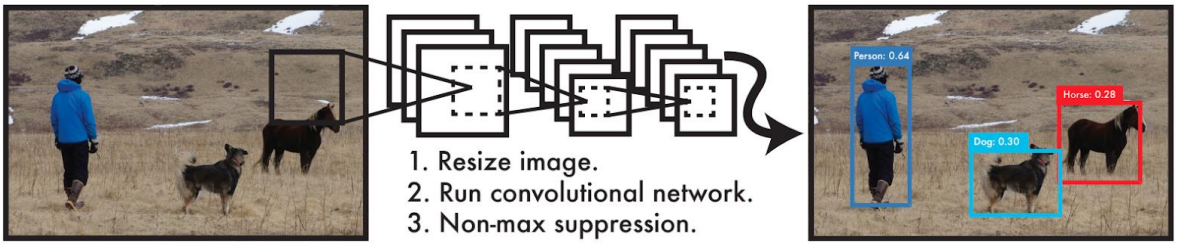


YOLO-

It was proposed by Joseph Redmond and others in 2016. It is a deep learning approach of the object detection. It was proposed to deal with the problems face by the object recognition. YOLO, which has been proposed by Joseph Redmond and others in 2016 (Redmond et at.,

2016), is a real-time object detection system based on Convolutional Neural Network (CNN). On the Conference on Computer Vision and Pattern Recognition (CVPR) in 2017, Joseph Redmond and Ali Farhadi released YOLO v2 which has improved the algorithm's accuracy and speed (Redmond & Ali Farhadi, 2017). In April this year, Joseph Redmond and Ali Farhadi proposed the latest YOLO v3, which has further improved the performance on object detection (Redmond &

Farhadi, 2018). In order to track vehicles inside a parking lot, a YOLO v3 is used in this paper.



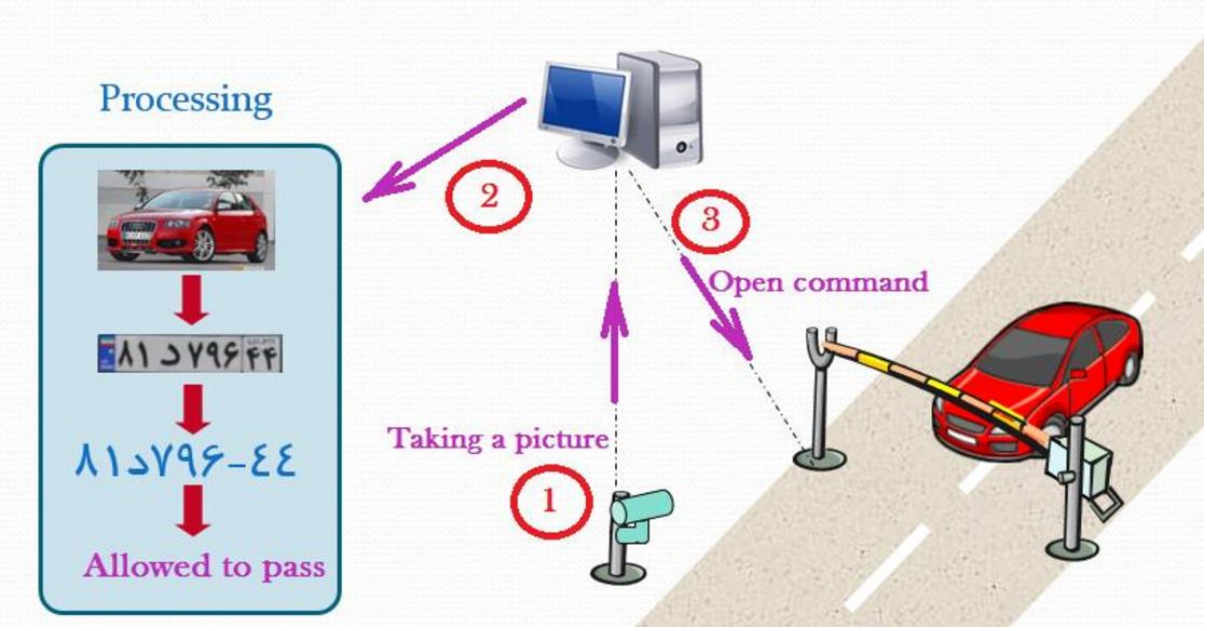
VEHICLE NUMBER RECOGNITION-

The technology for recognizing vehicle number plates is commonly used and typically employs deep learning techniques such as Faster R-CNN or YOLO. However, in this particular paper, the focus is not on license plate recognition, and a simpler Optical Character Recognition (OCR) method using Open CV was used to extract characters from images instead of deep learning technology.

VEHICLE TRACKING-

The paper describes a vehicle tracking system that uses YOLO v3 to track vehicles in a parking lot. The system identifies vehicles using their unique ID, which is passed from the entrance management system. As the vehicle moves in the parking lot, the system

continuously tracks it and checks whether it has parked in the correct parking space by comparing real-time images with stored images of the parking spaces. If the system confirms that the vehicle is parked in the correct space, the parking information database is updated. The system is an efficient solution for managing parking lots and reducing parking-related issues.



ACCIDENT DETECTION-

The paper describes the implementation of a collision detection system using deep learning in a parking lot. The system was trained using over 500 images of collisions and non-collisions. If an accident occurs, it is detected by the tracking application and stored in the database, and an alarm is sent to the driver's smartphone app. When the vehicle is about to leave the parking lot, the entrance management system checks the database to see if the vehicle was involved in an accident. If so, the gate does not open and the manager is notified. This system helps to ensure the safety of vehicles and drivers in the parking lot.

VEHICLE IDENTIFICATION SYSTEM -

An automatic vehicle identification and recognition system is a technology used in the transportation system, which uses hardware such as cameras to instantly identify vehicles through their license plates. This system, also known as ALPR, is important for enforcing traffic rules, collecting tolls, and identifying people of interest in law enforcement. ALPR plays a vital role in modern intelligent transportation systems and has high accuracy and efficiency in identifying vehicles. Law enforcement agencies often use ALPR to quickly identify vehicles and their owners.

AUTOMATIC LICENCE PLATE RECOGNITION (ALPR)-

ALPR uses several technologies. It consists of several parts-

1. **Image capture-**

   It is a hardware based operation which depends upon the quality of camera and the type of camera, whether condition, light strength and several other factors. As a result, the file is collected.

2. **Plate detection and localisation-**

   It is responsible for finding and separating the image on the board, which includes searching and changing the image from the file received.

3. **Image normalisation and binarisation-**

   Binarization is the process of converting a pixel image to the binary image. Binarization is a process of converting a grayscale or color image to a binary image, where

each pixel is either black or white. This technique is commonly used in image processing and computer vision applications, such as OCR (Optical Character Recognition) and object detection.

There are several methods of binarization, including global thresholding, adaptive thresholding, and Otsu's method. In global thresholding, a single threshold value is applied to the entire image, which divides the pixels into two groups: foreground (pixels above the threshold) and background (pixels below the threshold). Adaptive thresholding, on the other hand, adjusts the threshold value for each pixel based on the local image properties.

Regardless of the method used, the goal of binarization is to separate the foreground from the background, which can help isolate the object of interest in the image. For example, in a document image, binarization can be used to convert the text to black and the background to white, making it easier to recognize the characters and extract the text. Similarly, in an object detection task, binarization can be used to separate the object from the background, which can improve the accuracy of the detection algorithm.

4. **Character segmentation-**

   Character segmentation is a crucial step in optical character recognition (OCR) systems, which involves separating individual characters from the input image to identify and recognize them. The character segmentation process is typically performed after the image has been preprocessed, such as by binarization or noise reduction, to improve the accuracy of the segmentation.

There are several methods for character segmentation, including projection-based methods, connected component analysis, and morphological operations. In projection-based methods, horizontal and vertical projections of the image are computed to identify the regions where characters are likely to occur. The connected component analysis method identifies regions of the image where the pixels are connected, which could be individual characters. The morphological operations involve applying mathematical operations such as dilation and erosion to the image to extract individual characters.

Once the individual characters have been segmented, they can be fed into the OCR system for recognition. The accuracy of character segmentation plays a crucial role in the accuracy of the OCR system, as any error in the segmentation process can lead to misidentification of characters.

5. **Character recognition-**

   Optical Character Recognition (OCR) is indeed a crucial step in Automatic License Plate Recognition (ALPR) systems. The purpose of OCR is to recognize and interpret the characters on a license plate image and convert them into text that can be further processed by the ALPR system.

   In order to achieve high accuracy in OCR, the technology must be able to handle various challenges that can affect the quality of the input image. These challenges can include low lighting, poor image resolution, motion blur, and other forms of image distortion or degradation.

   OCR technology has come a long way in recent years and can now produce highly accurate results, even in the presence of noise or bad input characters. This is achieved through the use

of advanced image processing techniques, machine learning algorithms, and deep neural networks that are trained on large datasets of license plate images.

FUTURE SCOPE-

The future scope of AI in smart parking is quite promising. As cities become more crowded and the number of vehicles on the road continues to increase, the need for smart parking solutions will only grow. Here are a few potential areas where AI could play a role in smart parking:

- Predictive parking: AI algorithms could analyse real-time data from parking sensors and predict the availability of parking spots in a given area. This could help drivers save time and reduce congestion on the roads.

- Automated payment: AI could be used to automate payment processes, eliminating the need for drivers to interact with payment kiosks or attendants.

- Real-time traffic management: AI algorithms could help manage traffic flows in real-time, directing drivers to available parking spots and optimizing the use of parking spaces.

- Autonomous valet parking: With the development of autonomous vehicles, AI could be used to enable self-parking cars that drop off their passengers and park themselves.

- Improved user experience: AI could be used to personalize the parking experience, allowing drivers to easily find parking spots that meet their preferences and needs.

- Smart recognition of cars: We can recognize the cars by their number plates with the help of image processing. By using this type of technology users can directly pay for their car parking using mobile phone's prepaid balance or car parking account balance.

- Updating Users about available slots and account balance: User can get updates about available slots of a particular parking space and account balance by sending a simple SMS to the data base

- Will be helpful in reducing the accidents

  Overall, the potential applications of AI in smart parking are vast, and as the technology continues to evolve, we can expect to see even more innovative solutions emerge in the years to come.

ADVANTAGES –

There are several advantages of using Artificial Intelligence (AI) in smart parking systems, including:

Optimized parking: AI can help optimize the parking process by providing real-time data on available parking spaces, allowing drivers to find a parking spot quickly and easily. This can save time and reduce traffic congestion in busy areas.

Improved traffic flow: Smart parking systems that use AI can help reduce traffic congestion by directing drivers to available parking spaces, preventing them from circling around in search of a parking spot. This can help reduce emissions and improve air quality.

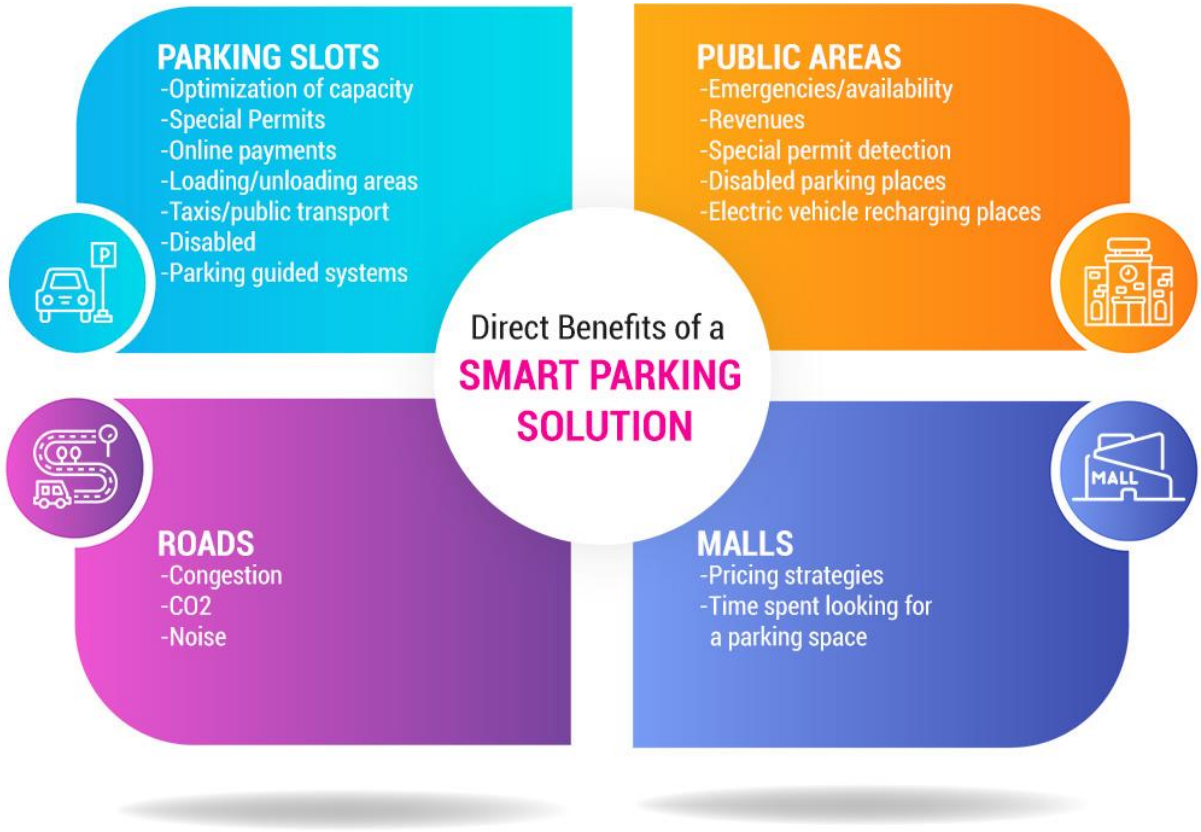
Reduced operating costs: AI can help reduce operating costs associated with managing parking spaces by automating tasks such as parking enforcement and maintenance. This can help reduce labor costs and improve efficiency.

Enhanced user experience: Smart parking systems that use AI can provide users with a seamless parking experience, from finding a parking spot to paying for parking. This can help improve customer satisfaction and loyalty.

Data analysis: Smart parking systems that use AI can collect data on parking usage patterns, which can be used to optimize parking operations and inform future parking policies and decisions. This can

help cities and businesses make more informed decisions about parking management.

Overall, the use of AI in smart parking systems can help improve the efficiency, sustainability, and user experience of parking operations.



DISADVANTAGS-

While there are many advantages of using Artificial Intelligence (AI) in smart parking systems, there are also some potential disadvantages to consider, including:

High initial costs: Implementing an AI-based smart parking system can require significant upfront costs, including the installation of sensors and other hardware, as well as the development and deployment of the AI system. This can make it difficult for some businesses and municipalities to justify the investment.

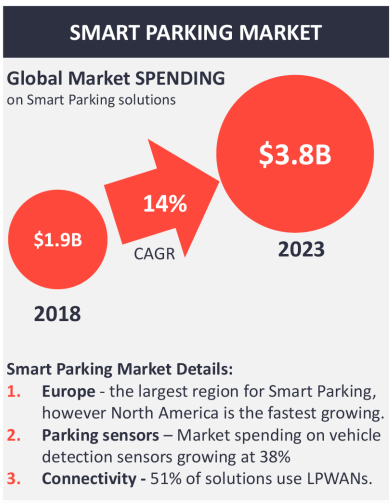
Technical difficulties: AI-based smart parking systems can be complex and require specialized expertise to develop and maintain. This can create technical challenges that may require additional resources to overcome.

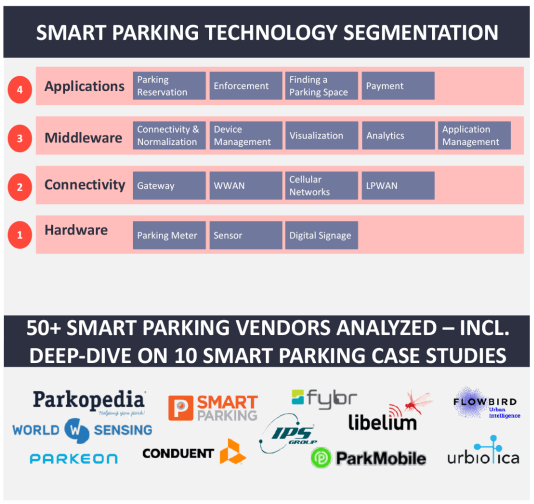
Security concerns: Smart parking systems that rely on AI can collect and process sensitive data, such as license plate numbers and payment information. This data must be kept secure to protect users' privacy, which can be a challenge in the face of potential cyberattacks.

Limited accessibility: Some people may not have access to or be comfortable using technology, which can make it difficult for them to use smart parking systems that rely on AI. This can create equity issues if certain groups are disproportionately affected.

<u>Reliance on technology</u>: AI-based smart parking systems are dependent on technology, which means that they may be vulnerable to system failures or outages. This could result in disruptions to parking operations and negatively impact the user experience.

In summary, while AI-based smart parking systems offer many potential benefits, there are also some drawbacks to consider, including high costs, technical difficulties, security concerns, limited accessibility, and a reliance on technology.





New Market Report: Smart Parking 2019-2023

CONCLUSION-

In this paper, a smart parking management system using AI technique was presented. The implemented system recognizes the vehicle number and uses it as an object ID, and tracks the vehicle by applying YOLO technology. Training and learning algorithms based on CNN deep learning algorithm were applied to detect whether a vehicle was parked or an accident occurred. A number of experiments was conducted to check the detection accuracy and it was confirmed that the deep learning algorithm works effectively after training reasonable number of images. Experimental results show that the detection accuracy of parking and accident detection increases as the number of training images increases. The accident detection needed more training images because it has more diversity. In both experiments, greater that 95% of detection accuracy was observed. The smart parking app allows drivers to easily check parking information and accident information. As a conclusion, the system implemented in this study can be utilized as an AI-based unmanned parking management system. The implemented system used a simulated parking lot. Therefore, future research following this study is to implement a system for an actual parking lot. In addition, research to improve the detection accuracy and the processing speed will be performed.

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