Automatic parking system using Automatic number plate recognition (ANPR)

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Abstract - *In the majority of residential areas like societies, industrial areas like the organizations, companies the parking system is always working in the manual mode. There is one specific person who is always there to take care of the parking area and to make sure that everything works perfectly. There are so many disadvantages of this system as we have to depend upon the person for this whole work. The parking system is the work which not only includes the parking area but also includes almost everything like maintaining the entries of the vehicles i.e when the vehicle had entered the premises and when it leaves the premises. The parking system also includes the security which cannot be offered by the manual person and even if the manual system decided to do that it cannot be achieved easily. The automatic parking system using ANPR checks for the vehicle authority to enter into premises. The system makes sure that the vehicle is not unknown to the premises if it is then it will not be allowed inside the premises. The vehicles which are allowed to enter are totally dependent on the users of the system. The system detects the vehicle number plate using the Yolov4 algorithm and uses optical character recognition (OCR) to extract characters and checks in the database. Users can maintain their own list of vehicles to allow entry. The proposed solution focused on ensuring higher security, reducing the third person dependency, and increasing the effective response time of the process.*

Key Words:—ANPR, Automatic Parking, YOLOv4, Database, OCR.

1. INTRODUCTION

In recent years, the population of the world has been chasing the higher and higher numbers on the graphs. In cities with higher populations, there are more vehicles traveling on the ground, and there are more rules and prohibitions requiring these vehicles to move around. The number of vehicles is increasing every day, which has led to an increase in parking requirements. People are buying land to maintain the parking service there. It will surely rise to very new heights in the near future. The studies show the no. of vehicles moving on the road in the next few years may become double. Such rapid growth cannot be ignored.

As the lifestyle of the peoples is changing rapidly more and more peoples are really interested in having their personal vehicles. With the rapid growth in urbanization, the sales of motor vehicles are on the rise, especially in countries like India and China. In the period 2001-2015, the number of private vehicles in India increased by almost 400%. The number has increased from 55 million to 210 million, which is quite a significant change. This huge growth will surely boost the parking needs and these parking needs will lead to traffic problems, time-consuming processes, and compromises in security. In the current working parking systems, there is the manual work involved to a very higher extent the person does the work of marking the entries of the vehicle and the drivers have to come out of the vehicle to sign in the handwritten documents. When 100's of vehicles will be standing in the queue this manual process will cost hours for all of them to enter into premises again it will take some time when they have to checkout. When the security personnel will not be available there for the security then people have to wait there for him to arrive. If he decides to take the work-off then the organization suffers for the security of the vehicles. In emergency needs, manual work always leads to unknown errors which may be costly sometimes when the entries need to investigate for some serious issues. Using the books for writing those entries costs those books and leads to the damage to nature for every book getting used every two to three days. Even after all of these disadvantages, the manual system does not ensure security and authenticity. Manually person cannot just search in the whole loads of books to check if the vehicle belongs to the organization or not.

Hence some robust and feasible solution is required for this which can solve all these problems at once and offers the highest security and authenticity along with a very low response time. If there is a system like an automatic parking system then all of these problems are handled by the system. Using the automatic parking system there is no need for manual work hence even when the security person is not there it is no longer the problem the algorithm will detect the no plate of the vehicle through the CCTV footage and then it can extract the license plate number and can create the entry for the vehicle in the database. Security can be ensured along with the check-in and check-out as the system is able to check the car no. plate across the valid vehicles to

enter the premises. If the vehicle number is not among the number of valid vehicle numbers then the vehicle entry is denied by the system. As the parking for the outsiders is not available. Those database entries can be checked by the admin at any time without any delay.

1.1 Aim

The aim is to provide a quick, immediate and easy way to detect the number plate of the car using the yolov4 algorithm and to perform the recognition of characters on top of it using the tesseract OCR engine. The recognized number plate is then fetched with the database to recognize the authenticity of the vehicle and depend on whether the entry is provided or restricted.

1.2 Objectives

The main objectives are as follows:

1. The objective is to develop an automated secured parking system using automatic number plate recognition. The human interaction in the same is reduced to a greater extent, less human work leads to fewer human errors. Only administration work is manual.

2. The system is very time-saving and very efficient. Unlike a human, it is always available 24 hours a day and provides an extra layer of security.

3. The system uses the database for recognition of the car's authenticity. Hence it is almost impossible for the outsider's car to enter the premises. This provides reliability as the system is completely secure and the database is only handled by the authorized person.

4. The system uses a security cam like a CCTV camera or the web camera for capturing the images of the cars. Hence the system is very cost-efficient. Only cost includes the cost for the CCTV installation or the installation of the web camera and the cost for the computer system.

5. User interface is provided with the system which can be used with some clicks of a mouse. Only one click of a mouse is sufficient to turn on the system also the output is displayed in the same window. Hence the system is extremely easy to use without any complexities

1.3 Scope

This model is used for the no. plate detection system and is a very important step towards the proper parking management as well as can maintain the security of the restricted areas. The scope of this project includes automation of this manual system and also the addition of the extra layer of security to the existing system which is handled manually in societies or buildings by the persons to maintain the logs of the vehicles entering the buildings and

exiting the buildings. The ANPR performed using YOLOv4 is extremely powerful in detecting the objects even in real-time. The model provides quick and very maximum accuracy results without any glitches or errors by performing the filtration techniques as well as a powerful OCR algorithm The user interface will make it easier for the common people to use the application without any doubts or any other programming knowledge. The system can be scaled for future use in which it can even identify the car colors as well as the car model the information can be collected and can be used later for many business intelligence applications

1.4 Open-CV

Currently, computer vision technology is the most trending field. Computer vision is the ability of the computer to detect objects in images and videos. Artificial Intelligence is the most trending field utilizing computer vision technology. A computer vision library such as OpenCV can be used to perform image processing and machine learning. It is an open-source library that can be used to perform computer vision. Multiple language support is available for Open CV. Most of the operating systems support Open CV including Windows, Linux, macOS, iOS, and Android. For ex. from the image of a dog the various information about the dog can be recognized as the breed of dog, action dog currently performing, etc.

1.5 Python

It is an open-source and High-level programming language that was designed to have an appealing appearance as well as be easy to read. Although it has a simple syntax, it is powerful. Consider the range of different applications it is used in, such as machine learning, artificial intelligence, data science, and scientific computing. It is simple enough that a complete beginner can learn it. with libraries like NumPy and pandas, data manipulation can easily be performed so as to bring data to a point where machine learning algorithms can be developed. A python is a powerful tool for working with Machine Learning algorithms. You can generate baseline results, further improve it, with scikit-learn, and work on data visualization with matplotlib with most types of plots. Python is also well supported. Python is a popular language for Machine Learning due to all these factors.

1.6 Yolo-V4

YOLO stands for You Only Look Once. It can recognize multiple objects in a single frame in real-time. The performance of Yolo recognizing objects is more precise and faster than other recognition systems. By using it we can predict 9000 classes and even classes that haven't been seen before. It recognizes multiple objects from a frame in real-time and also makes a boundary box around the object. One can easily train and deploy Yolo in the production system. YOLOv4 is the advanced version of Yolo which is composed

of CSPDarknet53 as a backbone, spatial pyramid pooling additional module, PANet path-aggregation neck, and YOLOv3 head. YOLOv4 is a recognizer that has high FPS and greater accuracy than other detectors.

2. Related work

According to [1] the ANPR is used to create the automatic check-in and check-out system using ANPR. The methods such as image acquisitions, character segmentation, and character recognition are performed to detect the number plate of the vehicle. The proposed system makes use of CCTV cameras to capture the pictures of the vehicles in front of the gate and perform the number plate detection. The database is used to add the entries of the vehicles. If the vehicles already exist then update the entry else add the new row for the new vehicles. [2] performs the detection of the number plate using a few steps like image binarization and region filtering, then uses character positioning, and character segmentation to extract the number plate.

The survey is conducted on the ANPR [3]. Paper compared the rate of various character recognition techniques along with the type of recognition they offer like only digits, only letters, or both. The paper also compares the result of detection on images of various sizes and the image in the size range of 360x288 to 1024x763 turns out to give high rate results of 98.3% ANPR is adopted in various countries like India, China, and many more European countries [3]. A smart parking system [4] is implemented using the number plate recognition with Tesseract OCR engine by filtering out the garbage characters.

3. Proposed System

This project provides a solution to automate this process of recognizing by using the deep learning approach and Yolo algorithm. When the car will approach near to the camera will detect the exact car no. plate through the OpenCV and then the car no. plate captured by the camera will get processed and some image filtering techniques will be applied on the go. plate extracted image in order to make the image ready for the OCR or the character recognition. Using the tesseract OCR technique the characters can be recognized and can provide the output to the user with maximum security. Next backend and server work is involved to search the no. plate in the database whether it exists in the database or not. The car is valid to enter the restricted area or not and will provide the results as the car entry is denied or accepted. The system is very efficient and very reliable.

4 Algorithms

4.1. Number plate detection using Haar-cascade:

For the detection of the number plate using the OpenCV. The dataset in the format of .xml is used. This dataset is from Haar-Cascade which is a cascade of the classifier. This approach is based on the machine learning approach. It is somehow similar to trial and error where a model is trained by providing the positive images to the model as well as the negative images to the model. Positive images are the images that have the object which we aim to detect and negative images are those which does not contain the object which we aim to detect. This algorithm is quite useful while determining the objects and very easy to implement. The model used using this algorithm was able to detect the object successfully but with some specific problems which include detecting the objects which have a similar shape as number plates but is not a number plate.

4.2. Number plate detection using Yolo V4 (You only look once):

The YoloV4 is the object detection model used for detection of the objects in real-time. The model is trained with loads of images of the car number plates. After the model is trained and getting the weights file for the detection which is very similar to the .xml file in the Harr-cascade. It is used to perform the detection of the images. After the successful detection of the images, the model is used for videos and real-time object detection using a webcam. The model works pretty well and with very better accuracy. The model is almost free from false detections.
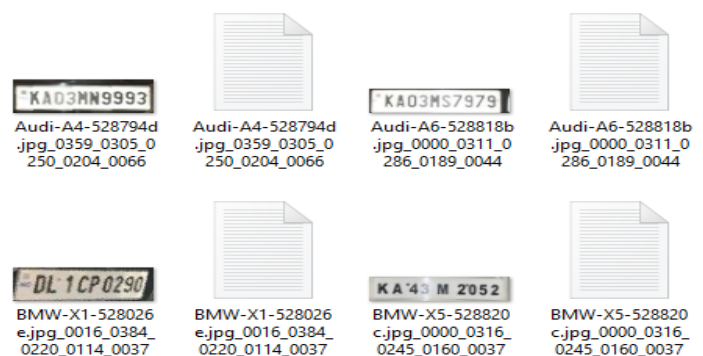
5. System Description

The Manual system of entering vehicle information at the entry points and building gates has created difficulty for residents as well as security guards. To encounter such problems Automatic parking system using ANPR is developed.
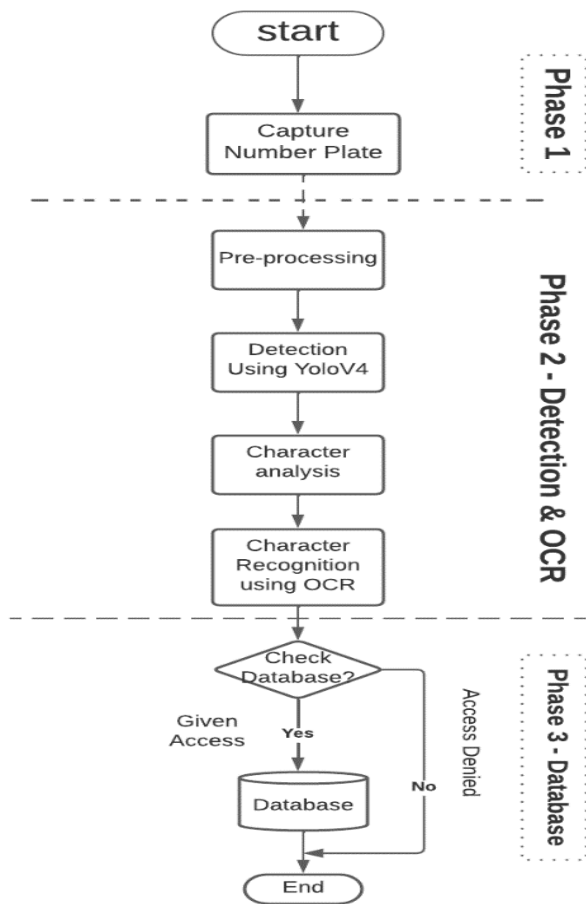
Flowchart of automatic parking system using ANPR.

Fig. Represents the Automatic parking system using ANPR along with the complete flow of the project.

In the first phase, the webcam captures the vehicle image. The second phase is the detection and OCR phase which includes pre-processing of an image where the image is converted from BGR to Greyscale and all the background of the image is removed then the number plate is detected using the yoloV4 algorithm and finally using optical character recognition (OCR) every character has been extracted and recognized.

The third phase includes the Database, where the OCR output will be sent to the database and it checks with the available database if it is present in existing data then the entry is given along with the timestamp, or else access is denied.

6. Results

The graphical user interface is created using the python Tkinter to make it easy for the user to interact with the system. The user interface consists of two buttons. One to start the camera and the other to stop the camera. When the user click on the button to start the camera. The camera pops out and starts to record. The graphical user interface also

contains the output region which is used to provide the outputs to the user.
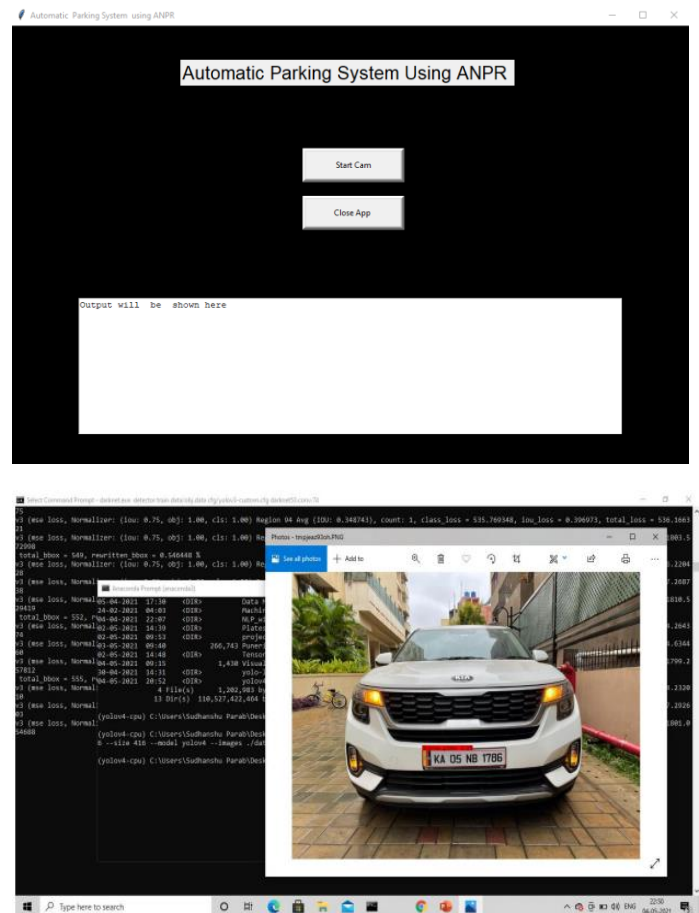
After the detections and recognitions are done. The system gives the output. If the vehicle is known then system will give output as the car recognized along with the information of car's owner and the building number car belongs to. If the number is not valid then is gives output as the car entry denied. If the car is already recognized then it gives output as the already recognized.
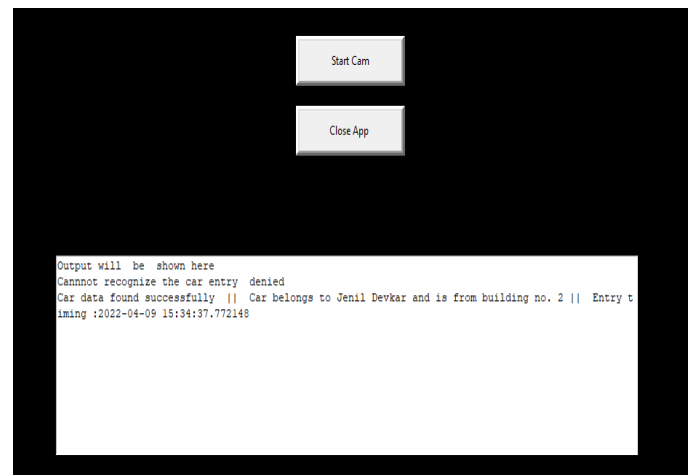
Now for the entries user can check the database where the number plate along with the timestamp is already mentioned. To add more cars in the validity list user can make respective changes in the database.

license_plate	first name	second name	budilding_no.
FMA6383	Hritik	Mondkar	3
KS67AEA	Jenil	Devkar	2
STA5131E	Sudhanshu	Parab	1
NULL	NULL	NULL	NULL

license_plate	entry_timing	date
STA5131E	2021-10-29 08:23:19	2021-10-29
STA5131E	2021-10-29 08:34:45	2021-10-29
STA5131E	2021-10-31 14:20:17	2021-10-31
STA5131E	2021-12-16 22:58:44	2021-12-16
STA5131E	2021-12-16 23:15:06	2021-12-16
STA5131E	2021-12-17 22:41:20	2021-12-17
STA5131E	2022-01-22 09:22:36	2022-01-22
KS67AEA	2022-01-22 09:29:28	2022-01-22

7. CONCLUSION

The ANPR-based automatic parking system was developed primarily to minimize the inconveniences for residents and security personnel. An ANPR system was implemented by extracting the vehicle number plate from captured images by using a Yolo algorithm and optical character recognition (OCR) that can translate pixels from imagery into alphanumeric characters. After an individual character is recognized, the No plate is checked whether it is in the database, and an entry is provided depending on the output obtained from the system. If true, the details are automatically stored in a database with the corresponding timestamp and the next entry process gets verified.

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