



AUTOMATIC NUMBER PLATE RECOGNITION SYSTEM

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Abstract— The Automatic Number Plate Recognition System is a technology that does the work of recognizing, locating, extracting, and storing license plate photographs on the local storage along with the license plate numbers in a CSV file. The ANPR system works upon supervised machine learning models. It is built with the help of performing a detailed analysis of a vast majority of data gathered from various online sources including platforms such as Kaggle. The technology built by us aims at performing operations such as locating the number plate, recognizing the characters on the number plate, and storing the information gathered in a short period of time with high accuracy in real time.

Keywords— Vehicle Detection System, Automatic Number Plate Recognition, ANPR, etc.

INTRODUCTION

India is a country with the third largest road network in the whole world, the number of vehicles in the country stood at a whopping 323.6 million in the year 2022. The percentage of passenger cars alone is set to increase by 776 percent in the coming two decades. Now, think about how much pressure that number of vehicles would put on the manual systems working today to manage parking, toll plazas, traffic, issuing of challans, and something which can't be performed in real-time, such as detecting suspicious vehicles or vehicles which were once stolen, this will make us arrive at a point where we will conclude that it will be a complete system breakdown in the domain of vehicle management.

This is the place where Automatic Number Plate Recognition Systems come in place. What an Automatic Number Plate Recognition system basically does is that it captures an image of the vehicle and then after performing various image processing techniques upon it, an ML model trained upon a vast variety of images of vehicles with their number plates takes this image as input and increases its contrast to separate the background from

the highlight. Then the number plate is extracted from the image and the characters upon it are divided and then recognized based on the object training model. Then the image of the license plate is saved on local disk space, and the license number is saved in a CSV file.

The ANPR system built is very much efficient in capturing images of the vehicle and extracting the license plate and the license plate number. This technology has a vast implementation and will cater to the problem of managing parking, toll plazas, traffic, issuing of challans, etc. as the number of cars increases and will replace manual labor reducing the errors caused by human beings drastically.

Machine learning is one of the domains of technology which has grown drastically over the past few years and has applications over a vast domain. ML techniques are used in the development of ANPR systems by building models trained on a vast variety of data.

PROBLEM STATEMENT

The aim of this research paper resides in building an Automatic Number Plate Recognition System that does the work of successfully capturing license vehicles and then extracting the license plate without any loss of information, then storing it in an image format and is license number in a CSV file and is beneficial in various Indian vehicles managing systems, such as at toll plazas or car parking management or issuing of e challans, traffic management and monitoring finding lost vehicles and efficient detection of suspicious vehicles at important government offices or the ones involved in criminal activities all done in real-time

LITERATURE REVIEW

The Automatic Number Plate Recognition System is a technology that when talked about may sound new to people but is not actually new, the earliest implementations of the technology date back to 1979. The technology was actually founded in 1976 but the first success using the technology was achieved in the year 1981 when a stolen vehicle was founded by the UK police with the help of it. Since then technology has been an interest of research. Some of the work studied us are mentioned below -

Lubna et al. (2021) did the work of performing a detailed analysis of all the algorithms used in building the ANPR system across all the phases such as NP Extraction Using Edge Information, NP Extraction Using Color Features used for Number Plate Extraction among others, NP Segmentation Using Characters Features, NP Segmentation Using Boundary Information used for Number Plate Segmentation Methods, Character Recognition Using Extracted Features for Number Plate Recognition among others.

Yepez et al. (2018) did the work of using morphological operations such as Morphological top hat, to make the image more focused on the object which fits the SE parameters. Then they also defined algorithms for Noise removal such as Morphological opening and closing and further used geometry for locating license plates.

Li, Jie et al. (2020) did the work of using the Rapid-Moving Window Method and Wavelet Analysis Method to perform data cleaning on the information gathered via ANPR systems to determine Urban travel time and perform traffic monitoring.

METHODOLOGY

The following methodology was used to develop the Automatic Number Plate Recognition in Real-time using machine learning.

Capturing Images: The first stage is that we capture images in real-time of the vehicle through our ANPR camera or a regular webcam. Algorithms defined in OpenCV are used to perform image processing and video processing in this phase.

Pre-processing: Here, we perform image formatting to enhance the features of the image, such as increasing the saturation of the image, converting it to grayscale, and increasing its contrast to separate background from highlight, before passing it through our trained model.

License Plate Localization: In the third stage, we remove noise from the image and the output of this stage is a sub-image consisting just of the license plate.

Segmentation: In the segmentation phase, the characters on the number plate are divided into blocks, here the image captured is converted into a set of binary images each containing a single character.

Optical Character Recognition: OCR does the work of taking the set of binary images from the previous step as input and trying to recognize each and every character correctly.

Storing Data: The image of the license plate is stored on the local disk space, and the license number is stored in a CSV file, all generated in real time.

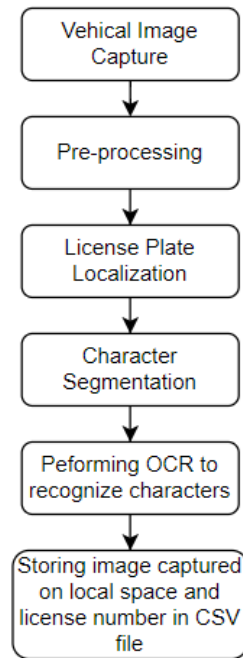


Fig.1-Flowchart depicting the methodology

WORKING OF ANPR TECHNOLOGY



Fig.2- Image Captured through an ANPR camera



Fig.3-Pre-processed Image (converted to grayscale)



Fig.4-License Plate Localization being performed

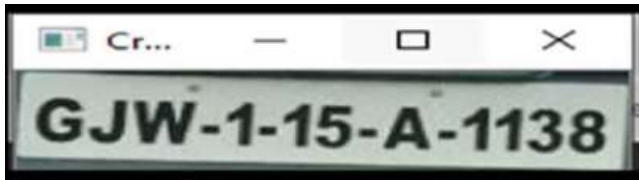


Fig.5-License Plate Extracted and stored on local disk space.

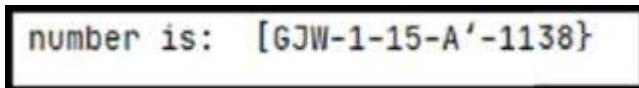


Fig. 6-License number stored in CSV file in real-time.

The above charts (from Fig.2 to Fig.7) depict the graphical illustration of the concentration of the respective pollutants and their corresponding AQI values.

RESULT

The Automatic Number Plate Recognition system built by applying the methodologies mentioned above, gives us an ANPR system that works efficiently with an accuracy of up to 70% and in real-time. The system will do the work of capturing the photo of the vehicle and storing the photo of the license plate along with the license number stored in a CSV file, all done in real-time. The accuracy of the system can be increased if the algorithms used by us are further optimized if we also further enhance data analysis and use better camera equipment that doesn't fail or confuse characters such as P and R while capturing from certain angles, and also work efficiently in poor weather conditions.

The ANPR system built can be integrated into various other systems and be used for Vehicle Parking Management, Toll-plaza management, Traffic management, and monitoring, issuing of e-challans, detection of suspicious vehicles, and stolen cars. Hence reducing manual labor, ensuring efficient working practices, and decreasing the pressure on the workforce and also the errors caused by them.

The result of the ANPR system built us is as followed :



Fig.7 Picture of the vehicle as captured by an ANPR Camera



Fig.8 Picture of the license plate as extracted after license plate localization and stored in our local disk space.

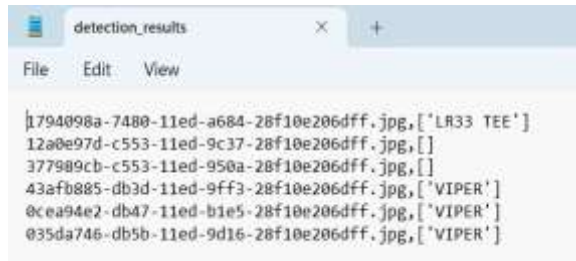


Fig.9 License Number stored in a CSV file in real-time. ['LR33 TEE']

FUTURE SCOPE

The field of ANPR technology is changing rapidly adding more optimized algorithms for faster operations and improving the quality and accuracy of the data to be stored over a period of time and with advancements in technology. Here are a few potential future scopes for the Automatic Number Plate Recognition System :

Faster image processing algorithms: As the image quality increases with the installation of better cameras, the pressure increases on image processing modules and techniques and they slow down. Faster image processing algorithms will help reduce the turnaround time while maintaining the quality of data.

Higher Optical Character Recognition Accuracy: During the character recognition phase the characters must be recognized correctly while capturing the vehicle from different angles. The system should be able to differentiate between confusing characters P and R when capturing from certain angles.

Better hardware equipment to capture images in even poor weather conditions: Better cameras will be beneficial in capturing and recognizing the license plate number correctly on a foggy day and improve OCR accuracy.

Standardization of license plates and number sizes: The size of the number plates and the numbers on them change with countries and is not universal. Standardization of them will help in better segmentation and OCR.

Zero Human Intervention: ANPR is a technology that has progressed along digitization and has reduced human intervention vastly in its operations but the road to Zero Human Intervention is still long to go.

Overall the future of the ANPR System seems to be promising as the implementation of the technology is set to increase by 30-35% in the coming five years.

CONCLUSION

In conclusion, the Automatic Number Plate Recognition System is a technology with its implementations over a vast domain including issuing of e-challans, effective car parking management, traffic management, toll plaza management, and many more. This domain of implementations of ANPR system will keep on increasing adding, more and more areas with advancements in technology (such as better hardware equipment), more optimized algorithms (faster image processing algorithms, higher OCR accuracy), and governments adhering to the changing trends and more efficient ways of working.

In this research paper, we have developed an ANPR system that takes an image of a car as input and processes it with the help of various Image processing techniques, it further does the work of removing the noise from the image, then extracting the number plate, it further proceeds to dividing the characters on the number plate and recognizing them before storing the photos of the number plate on the local storage and license plate number in a CSV file. It does all of so, this with an accuracy of up to 70%. However, in the future, if more optimized algorithms are used, and better data analysis, along with better hardware equipment such as high-resolution cameras then achieving higher accuracy would be possible.

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