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Title **LICENSE PLATE CHARACTER RECOGNITION USING YOLO AND GENERATIVE ADVERSARIAL NEURAL NETWORKS**

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LICENSE PLATE CHARACTER RECOGNITION USING YOLO AND GENERATIVE ADVERSARIAL NEURAL NETWORKS

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ABSTRACT: With the popularization of automobile and the progress of computer vision detection technology, intelligent license plate detection technology has gradually become an important part of intelligent traffic management. License plate detection is used to segment vehicle image and obtain license plate area for follow-up recognition system to screen. It is widely used in intelligent traffic management, vehicle video monitoring and other fields. The number plate recognition (NPR) system is one of the categories of smart transportation and detection mechanism. This is a combination of the technology in which the application enables the system to detect and automatically read the license id of number plate of vehicle from digitally captured images. The detection and recognition of a vehicle License Plate (LP) is one of the key techniques in most of the applications related to vehicle movement. Hence in this work, license plate character recognition using YOLO (You Look Only Once) and Generative Adversarial Neural networks (GANs) is presented. This system is divided into three parts, i.e. number plate detection, segmentation, and character recognition. In our proposed system for number plate detection Yolo method is used, after that some filters are applied and then characters are segmented.

KEYWORDS: Vehicles, License Plate Recognition, YOLO, Generative Adversarial Neural networks.

I. INTRODUCTION

Due to the rapid development of modem transportation industry and urban construction industry, there is a significant increase in the number of motor vehicles, more and more traffic safety accidents have occurred in world, especially with the development of expressway, the injury and fatality rate of traffic accidents are greatly increased [1].

At present, the main solutions to traffic problems are as follows: controlling the traffic demand, such as taking measures to reduce the number of motor vehicles, but this method is not conducive to long-term development; building more transportation infrastructure, but this way is limited by financial shortage, unreasonable road design and other factors; adopting intelligent transportation system, which is a ground transportation system based on computer technology, artificial intelligence technology and information technique [2]. License Plate Character Recognition (LPCR) is a technology for reading vehicle registration plates using optical character recognition from images and videos, and it has a long history due to its usefulness. Each country has its own number plate numbering system, different number plate sizes and colors, and character language.

License plate (LP) character information is uniquely assigned so that each vehicle on the road can be identified. Therefore, it is widely used for vehicle recognition in situations such as toll charges on highways, speed and signal violations, and illegal parking detection. Due to the serious number of traffic-related problems caused by the rapid increase in vehicles, research is currently underway to improve the traffic environment and LP information is used as an important source of information.

For this reason, the study of Automatic LP Recognition (ALPR) has been underway for a long time and is continuing to this day. License plate character recognition (LPCR) is a technology for reading vehicle registration plate character information using optical character recognition. In the conventional LPCR process, each character is segmented from the LP image and the character recognition is performed for individual characters.

An automatic system to recognize vehicle license plates is a growing need to improve safety and traffic control, specifically in major urban centers. The License Plate Recognition task is generally a computational-intensive task, where the entire input image frame is scanned, the found plates are segmented, and character recognition is then performed [3].

The conventional Automatic Number Plate Recognition (ANPR) is based on image processing mechanism for automatic vehicle authentication using number plate of a vehicle. The applications of number plate recognition include identification and prevention of vehicular crime, traffic management and handling road challan process. However, APNR exhibits incompetent in case of poor plate localization, improper plate sizing and plate disorientation. Moreover, the ANPR algorithms such Optical character recognition, geometric analysis and character segmentation mechanism less efficient in adverse conditions such as illumination flare on the number plate [4].

The detection and recognition of a vehicle License Plate (LP) is a key technique in most of the applications related to vehicle movement. Moreover, it is a quite popular and active research topic in the field of image processing. Different methods, techniques and algorithms have been developed to detect and recognize LPs. Nevertheless, due to the LP characteristics that vary from one country to another in terms of numbering system, colors, language of characters, fonts and size.

The environmental conditions and the variety of registration plates are the primary concerns of the license plate recognition problem. Consequently, the environmental side, such as varying illumination, colour, dirt, shadows, or background patterns, significantly influences number plate recognition. Hence, varying illumination can degrade the quality of the vehicle image, and background patterns add extra difficulty to the number plate location process. Otherwise, registration plate position, quantity, size, font, colour, character sharpness, language, and tendency all pose significant challenges in constructing a reliable ALPR framework. The recognition unit is often installed at the gate of the residential area, toll gates, or other highly secured facilities like defence institutes and nuclear plant facilities [6].

In the Internet plus era, artificial intelligence has developed rapidly. Some repetitive mechanized manual operations are gradually replaced by artificial intelligence. At present, there are many existing methods, but the effect is far from the actual requirements, so it is difficult to adapt to the requirements of high speed and fast rhythm of modern transportation system. Therefore, further research on character recognition is also urgent and necessary [5].

In order to solve these issues, license plate character recognition using YOLO (You Look Only Once) and Generative Adversarial Neural networks (GANs) is presented. The remaining work is organized as follows: The section II describes the Literature Survey. The section III presents license plate character recognition using YOLO (You Look Only

Once) and Generative Adversarial Neural networks. The section IV demonstrates the result analysis of presented approach. Eventually the conclusion is provided in section V.

II. LITERATURE SURVEY

Kazuo Ohzeki, Max Geigis, Stefan Alexander Schneider et. al., [7] describes License Plate Detection with Machine Learning without Using Number Recognition. A method is described to determine the threshold value for binarizing input by machine learning is proposed, and good results are obtained. The detection rate is improved by about 20 points in percent as compared to the fixed case. It achieves the best performance among the conventional fixed threshold method, Otsu's method, and the conventional method of JavaANPR.

Diogo M. F. Izidio, Antonyus P. A. Ferreira, Edna N. S. Barros et. al., [8] presents An Embedded Automatic License Plate Recognition System Using Deep Learning This paper proposes an embedded solution to detect and recognize Brazilian license plates using convolutional neural networks (CNN). The system was implemented in a Raspberry Pi3 with a Pi NoIR v2 camera module, which was used to obtain the images of vehicles. This system has demonstrated to be robust to angle, lightning and noise variations. The system was validated using real license plate images under different environmental conditions reached a good detection rate.

Zied Selmi, Mohamed Ben Halima, Adel M. Alimi et. al., [9] describes Deep Learning System for Automatic License Plate Detection and Recognition. An automatic system is presented for LP detection and recognition based on deep learning approach, which is divided into three parts: detection, segmentation, and character recognition. To detect an LP, many pretreatment steps should be made before applying the first Convolution Neural Network (CNN) model for the classification of plates / non-plates. Subsequently, we apply a few pre-processing steps to segment the LP and finally to recognize all the characters in upper case format (A-Z) and digits (0-9), using a second CNN model with 37 classes. The performance of the suggested system is tested on two datasets which contain images under various conditions, such as poor picture quality, image perspective distortion, bright day, night and complex environment. A great percentage of the results show the accuracy of the suggested system.

Zuhaib Ahmed Shaikh, Umair Ali Khan, Muhammad Awais Rajput and Abdul Wahid Memon et. al., [10] describes Machine Learning based Number Plate Detection and Recognition. robust and computationally-efficient ANPDR (Automatic Number Plate Detection and Recognition) system which uses Deformable Part Models (DPM) for extracting number plate features from training images, Structural Support Vector Machine (SSVM) for training a number plate detector with the extracted DPM features, several image enhancement operations on the extracted number plate, and Optical Character Recognition (OCR) for extracting the numbers from the plate. The results obtained by long-term experiments performed under different conditions, demonstrate the efficiency of our system. They also show that this system outperforms other ANPDR techniques not only in accuracy, but also in execution time.

III. LICENSE PLATE CHARACTER RECOGNITION USING YOLO

In this section, license plate character recognition using YOLO (You Look Only

Once) and Generative Adversarial Neural networks is presented. The workflow diagram of presented approach is shown in Fig. 1.

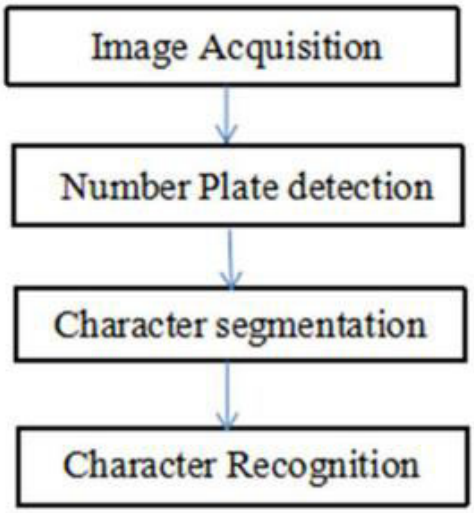

Fig. 1: Workflow diagram

This work describes a deep learning algorithm namely YoLO for recognizing and detecting number plate. This system is divided into three parts, i.e. number plate detection, segmentation, and character recognition. In this system, YOLO is used for number plate detection after that some filters are applied and then characters are segmented.

For training, Stanford car dataset from kaggle is used. The dataset contains 16.815 images of 196 classes. It is split into training and testing. A camera is equipped for taking infrared photographs up to 3280×2464 pixels is utilized. This camera is likewise equipped for catching video at 1080p30, 720p60 and 640×480p90 goals which is an excellent video. To diminish the computational burden on system, a camera arrangement to catch pictures with just 640×480 pixels can be used. Before starting to test the system with a real time/live image, a test image is preloaded to verify.

The input image is a gray-scale image taken from an Infra-Red (IR) camera. Image Pre-processing has to be performed by taking into account the background illumination conditions and the number plate localization algorithms. It is important to eliminate as much background noise as possible, contrast enhancement and de-blurring in the pre-processing step itself to optimize the localization algorithm and also save the processing time. For pre-processing we are going to use some matlab function which will help in pre-processing of the image.

A generative adversarial network (GAN) is a class of machine learning frameworks he core idea of a GAN is based on the "indirect" training through the discriminator, another neural network that can tell how "realistic" the input seems, which itself is also being updated dynamically.[5] This means that the generator is not trained to minimize the distance to a specific image, but rather to fool the discriminator. This enables the model to learn in an unsupervised manner. GANs are generative models: they create new data instances that resemble your training data. For example, GANs can create images that look like photographs of human faces, even though the faces don't belong to any real person.

YOLO is built on a single Convolutional Neural Arrange (CNN) that partitions a picture into districts and predicts various bounding boxes and likelihood for each lesson all at the same time. It is an end-to-end neural network that makes predictions of bounding boxes and class probabilities all at once. It differs from the approach taken by previous object detection algorithms, which repurposed classifiers to perform detection. As the name suggests, the algorithm requires only a single forward propagation through a neural network to detect objects. This means that

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prediction in the entire image is done in a single algorithm run.

The number plate images are converted to gray scale. After that, bilateral filter is applied on the grayscale image. A bilateral filter is an edge preserving, non - linear, noise reduction and smoothening filter. Each pixel is replaced with the weighted intensity values of the neighborhood pixels. Specifically, it will preserve the edges while removing the noises in the image. After that, Canny's edge detection is applied The process of edge detection involves five steps: i. Gaussian filter is applied to remove the noises in the image; ii) To find the intensity gradients in the image; iii) Non-maximum suppression is applied to get rid of spurious response from edge detection; iv) Double threshold is applied to determine the potential edges; v) Suppress the other edges that are not connected to strong edges by hysteresis

After edge detection, contours are traced. The extracted segmented characters are sent as an input for character recognition. In order to detect/recognize alphanumeric characters from the segmented image, the potential license plate is segmented later into individual set of characters before Optical Character Recognition testing is done. Optical Character Recognition (OCR) is the conversion of images of handwritten or printed text into a machine text. There are several OCR engines. This system uses Tesseract - OCR engine. This can be downloaded in Anaconda using git. The engine path must be specified and added. The segmented characters are given as input to OCR. The OCR will recognize those characters. The extracted data is stored in a data file or an excel sheet.

IV. RESULT ANALYSIS

In this section, license plate character recognition using YOLO (You Look Only Once) and Generative Adversarial Neural networks is implemented using python. The result analysis of license plate character recognition using YOLO (You Look Only Once) and Generative Adversarial Neural networks is demonstrated here. The Fig. 2 shows the home page of implemented license plate character recognition using YOLO (You Look Only Once) and Generative Adversarial Neural networks.

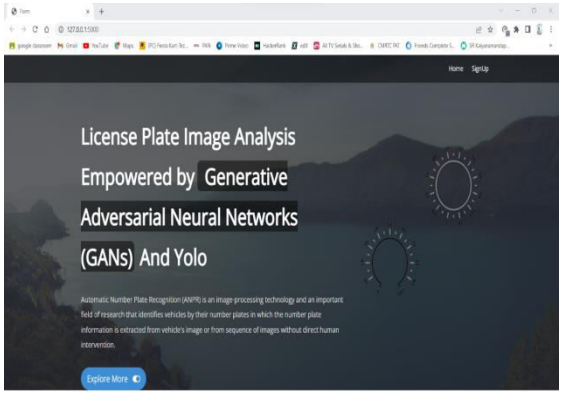

Fig. 2: Home Page

The fig. 3 shows the sign-in page.

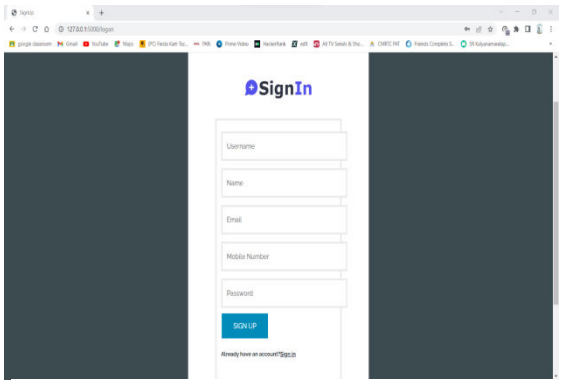

Fig. 3: Sign in page

In this sign-in page the user needs to enter his name, email id, mobile number and password. The Fig. 4 shows the licence plate detection using YOLO v3 ((version 3).

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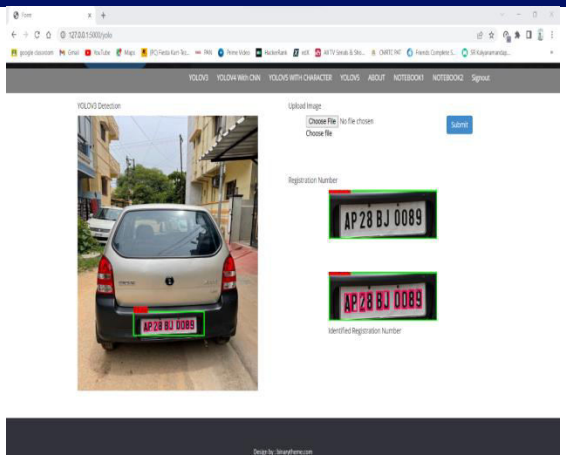

Fig. 4: License plate Detection

The Fig. 5 shows the license plate characters recognition using YOLO v5 (version 5).

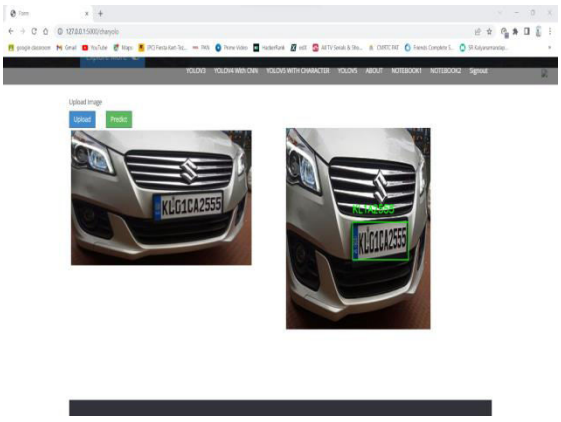

Fig. 5: Licence plate character recognition

Whenever an image is uploaded in implemented system it detects the number plate and recognizes the character which is shown in Fig.6.

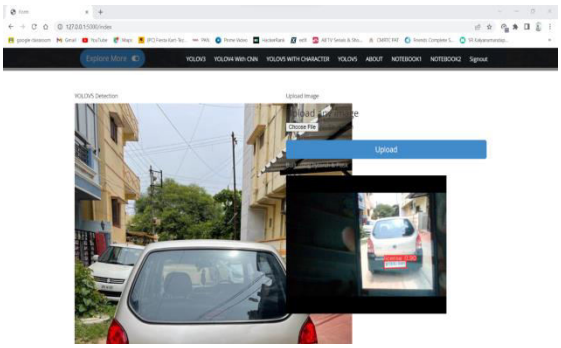

Fig. 6: License Plate Recognition

In this manner, this approach recognizes the license plate characters very accurately.

V. CONCLUSION

In this work, license plate character recognition using YOLO (You Look Only Once) and Generative Adversarial Neural networks is presented. Stanford car dataset from kaggle is used in this approach. The dataset contains 16.815 images of 196 classes. Generative adversarial Neural networks (GAN), is used which can be able to generate realistic super-resolution images. A deep learning algorithm namely YoLO is employed for detection and recognition of vehicles license plate. This system is divided into three parts, i.e. number plate detection, segmentation, and character recognition. In this system, YOLO is used for number plate detection after that OCR is employed for character recognition. This appraoch is generally helpful for security purposes, keeping vehicle record, toll collection, improved traffic monitoring, better parking system, vehicle tracking, etc.

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