License Plate Detection using Computer Vision technique with Artificial Intelligence

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***Abstract*— The term "Automatic Vehicle Plate Recognition," abbreviated "AVPR," refers to the process of extracting information about a vehicle's licence plate from a picture or series of photographs. Since the beginning of the last century, AVPR has evolved into a hard and exciting field of study. Applications may be found for AVPR systems in a broad variety of contexts. It has proved beneficial to a great number of real-world applications, including electronic toll collection, automated parking management, access control, radar-based speed control, border control, criminal pursuit, and traffic law enforcement, amongst others. Even if there are a number of commercial AVPR systems on the market right now, there are still a lot of obstacles and problems with the proper recognition of licence plates. In India, the rules for number plates are seldom put into practise. The identification of licence plates is plagued by a number of issues, including the presence of superfluous information, variations in font size and type, blur, skew, and other environmental influences. Recognition of number licence plates may be difficult due to the many different kinds of licence plates and the surroundings in which they are displayed. The creation of a robust, accurate, and dependable automated automobile licence plate recognition system is the primary goal of this thesis. The following are the stages involved in implementing our strategy: The first step is the pre-processing of the picture that was read in. The second step involves the extraction of character areas, and the third phase involves the identification of the characters that have been taken from the previous phase. The work being presented here has been done in order to recognise Indian licence plates.**

Keywords— license plate; number plate; computer vision

I. INTRODUCTION

In the present day and age, pattern recognition and image processing are two of the most important and expansive study fields. Over the last three decades, a significant number of academics from all over the globe have been focusing their efforts in these areas in order to automate [1] procedures. Over the course of the last several years, there has been a significant rise in the number of automobiles [2]. The rise in the number of cars calls for increased focus on the management of road traffic in a way that is both effective and efficient. It is necessary to focus on developing intelligent systems that can manage automobiles since the managing of vehicles is crucial for a variety of reasons, including concerns over safety. A licence [3-5] plate serves as a one-of-a-kind identification for each and every vehicle on the road today. Recording automobiles by hand requires a significant investment of time and money and is inefficient.

Because of this, automating the process of recognising licence plates on vehicles is almost always beneficial. Automatic Vehicle Plate Recognition, [6,7] often known as AVPR, is the process of extracting the information contained on a vehicle's licence plate from a photograph or series of photographs of automobiles.

AVPR is the abbreviation for automatic vehicle plate recognition, which refers to the method of utilising a machine to identify a car registration number. It is known by a variety of names across the globe, including Automatic Number Plate Recognition [8] (ANPR), Automatic Vehicle Identification (AVI), Automatic Licence Plate Recognition (ALPR), Car Licence Plate Detection and Recognition Systems (CLPDRS), Car Plate Recognition (CPR), and just plain Licence Plate Recognition. This technology has become widely utilised (LPR). AVPRs may be broken down into two main groups: stationary and mobile. These categories are determined by how and where the cameras are positioned on the device, respectively [9].

In order to monitor areas that are plainly not in motion, stationary AVPR systems use high-quality infrared cameras in permanent places. The readers may be installed in a variety of places, [10] including signboards, street lights, telephone poles, entry-exit gates, or any other stationary item that may be met on the road. It has been common knowledge for a very long time that stationary AVPRs are the most cost-effective option.

On the other hand, mobile AVPR [11] involves the use of cameras that are mounted on moving vehicles.

The movement of cars is used to take the photos that are used for the licence plate.

It has been shown that mobile AVPR systems are able to record an average of one thousand licence [12] plates per hour and are far more effective at tracking mobile cars.

II. RELATED WORK

During the pre-processing step, the picture of the car will have any noise eliminated that may have been there. At this point in the process, the picture will also have its contrast adjusted. The quality of the picture has been improved, and

it has been processed in advance, so that the number can be read easily. In the research that has been done, several preprocessing methods have been suggested. The Gaussian filter was used in [13] in order to eliminate the noise that was present in the input picture. Calculating weighted averages is the process that a Gaussian filter uses to smooth a picture. The Gaussian filter also has control over the degree to which the picture is blurred. The authors of [14] enhanced the contrast of their images by using histogram equalisation.

The authors [15] employed a technique called "Median Filtering" to get rid of the noise in the image's foreground. The picture may have noise removed using a method called median filtering, which keeps the edge information intact while doing so. To do this, it moves through the picture one pixel at a time, replacing each value with the median value of the values in the surrounding pixels. In [16], a Mexican Hat Filtering was applied to the pictures in order to get rid of the noise and the distortion [17]. This technique is used to improve certain areas in photos that are otherwise noisy. Morphological operators were used in references [18] in order to further improve the picture. In [19], the impact of the image edge burr was eliminated with the use of image corrosion technology.

III. Proposed Method

Although AVPR systems have been around for a very long time, it wasn't until the 1990s that they were recognised as a significant field of study. This was because to the significant rise in the number of cars on the planet. In general, it can be seen that the research that has been done on AVPR has indicated a number of different ideas and methods that are considered to be the most effective. The literature that was reviewed for the Automatic vehicle plate identification project made it quite clear that there is a lot of room for study advancement in this particular field. Despite the fact that there are regulations governing licence plate numbers in India, they are seldom enforced. As a result, there is a significant amount of variety seen in the licence number plates.

Variations in licence plates are one of the most significant problems, and it is difficult to accomplish the goal of attaining a high degree of accuracy. As was said at the beginning of the article, the difficulties in AVPR need to be addressed for the following: language size, filth, and bad lighting. It has been determined that there is a need to design an accurate and reliable system for automatic vehicle plate recognition (AVPR) in order to avoid these difficulties and to handle different problems linked with licence plate detection and recognition. As a result, the purpose of the research that has been offered is to investigate and comprehend the state-of-the-art work for licence plate detection and identification using a trustworthy AVPR framework. The difficulty of identifying the registration number inscribed on the licence number plate of the car in a real time scenario is addressed by the method that has been suggested.

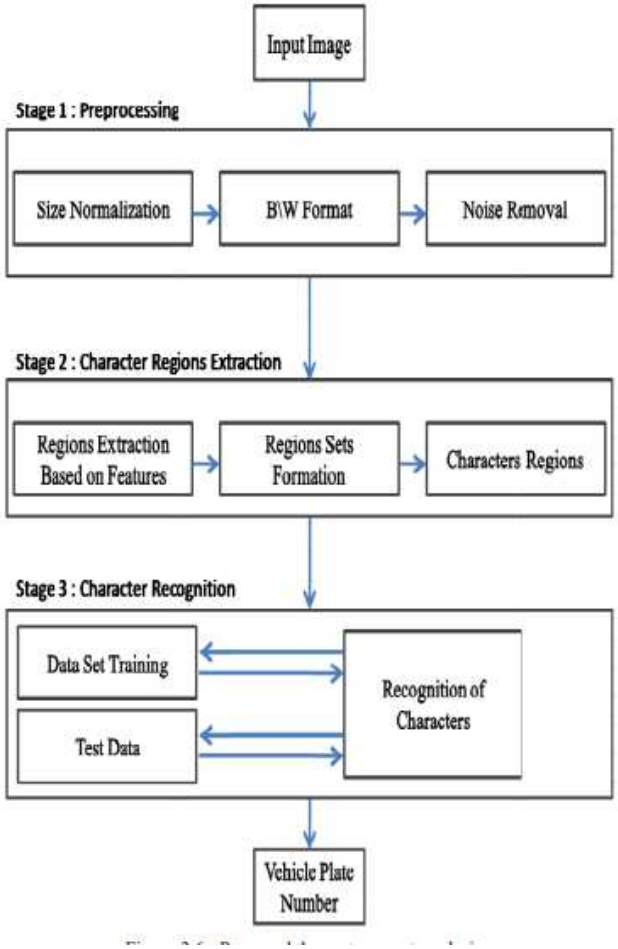

Fig. 1. Proposed Block Diagram

Recovery of Stolen Automobiles Stolen automobiles, even if the criminals who stole them modified them in some way, are still detectable with the use of technologies like as AVPR. The AVPR uses a character recognition system to read the licence plate, thus changing the outside of the car will not make the crooks go away. The use of AVPR has made it much simpler to track down and recover stolen vehicles.

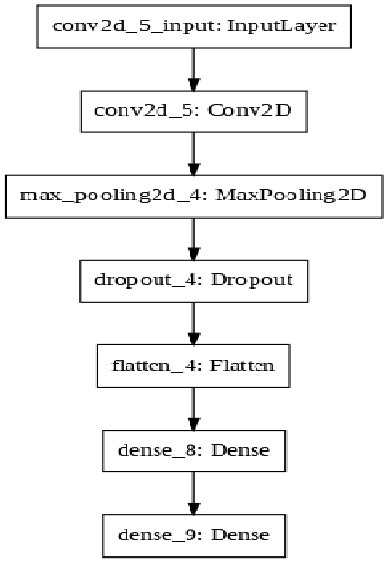

Fig. 2. Proposed Block Diagram layers

To determine whether or not the vehicle has been licenced or registered. Since the beginning of time, it has been illegal to operate a vehicle that has neither been licenced nor registered. When an AVPR system creates digital photos of licence plates, those images are continually watched by the relevant authorities to determine whether or not the vehicle in question has a valid licence. Using AVPR has made it much simpler to identify dishonest members of the team.

Historical investigation - One of the applications of AVPR that comes into play after a crime has been committed and the police are now investigating the site of the crime is the historical investigation. For instance, if there was a theft, all of the cars that were in the area or nearby at the time of the theft could be traced and investigated with the assistance of AVPR. This would be possible in the event that there was a nearby location.

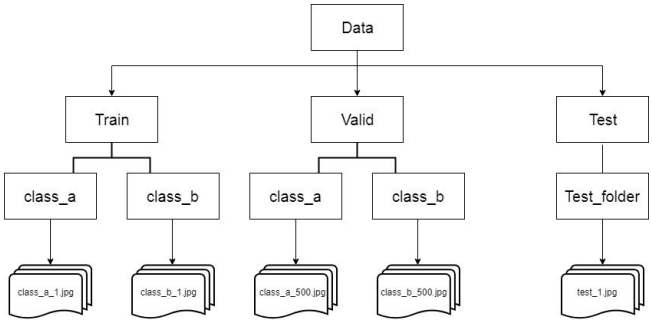

Fig. 3. Layer structure

Marketing tool to log pattern of use - Studies show that even though AVPR was designed for criminal tracking purposes and has a wide area of application in the domain, the same aspect of the same is also of much use in the non-criminal aspect of the same. AVPR was designed for criminal tracking purposes and has a wide area of application in the domain. The analysts are able to pinpoint the area of their area of interest based on the quantity and kind of cars in a given region and may set the groundwork for the marketing of their goods in accordance with this information. Establishing solid marketing foundations almost always results in more lucrative company prospects.

Identify travel patterns and travel behaviour analysis - This is a form of realtime recognition in which if the previously tracked details of a vehicle can be recognised with AVPR systems, along with the locations that have been visited for the previous time duration, the probable future location can be detected. This can be done by combining the locations that have been visited for the previous time duration with the locations that have been visited for the previous time duration. This might be of assistance in locating the vehicle and carrying out the necessary action that is required.

IV. Result Analysis

To decrease the noise we need to obscure the information Image with Gaussian Blur at that point convert it to grayscale.

Fig. 4. Grey scaled source image

A. Find vertical edges in the image.

To uncover the plate we need to binarize the picture. For this apply Otsu's Thresholding on the vertical edge picture. In other thresholding techniques we need to pick a limit worth to binarize the picture however Otsu's Thresholding decides the worth consequently.

Apply Closing Morphological Transformation on thresholded picture. Shutting is helpful to fill little dark districts between white locales in a thresholded picture. It uncovers the rectangular white box of tag.

Fig. 5. Transformed source image

To recognize the plate we need to discover shapes in the picture. It is essential to binarize and transform the picture prior to discovering forms with the goal that it can discover more significant and less number of shapes in the picture.

Presently track down the base region square shape encased by every one of the form and approve their side proportions and territory. We have characterized the base and greatest space of the plate as 4500 and 30000 individually.

Presently discover the forms in the approved locale and approve the side proportions and space of the jumping square shape of the biggest shape around there. Subsequent to approving you will get an ideal form of a tag. Presently separate that shape from the first picture.

Fig. 6. Input source license plate

To perceive the characters on tag unequivocally, we need to apply picture division. For that initial step is to extricate the worth channel from the HSV organization of the plate's picture.

Presently apply versatile thresholding on the plate's worth channel picture to binarize it and uncover the

characters. The picture of plate can have distinctive lightning conditions in various regions, all things considered versatile thresholding can be more reasonable to binarize on the grounds that it utilizes diverse edge esteems for various areas dependent on the splendor of the pixels in the locale around it.

Fig. 7. Transformed image of license plate

Subsequent to binarizing apply bitwise not procedure on the picture to track down the associated parts in the picture so we can remove character applicants.

Fig. 8. Inverse transformed license plate image

Build a veil to show all the character segments and afterward discover shapes in cover. Subsequent to extricating the shapes take the biggest one, discover its bouncing square shape and approve side proportions.

In the wake of approving the side proportions track down the curved body of the form promotion draw it on the character applicant veil.

Fig. 9. Location block of the characters

Presently track down every one of the forms in the character up-and-comer cover and concentrate those shape territories from the plate's worth thresholded picture, you will get every one of the characters independently.

Fig. 10. Individual identified characters

Now use OCR to perceive the character individually.

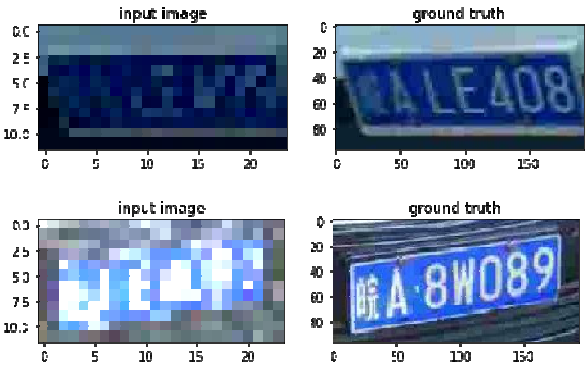

Fig. 11. Individual identified characters example plate

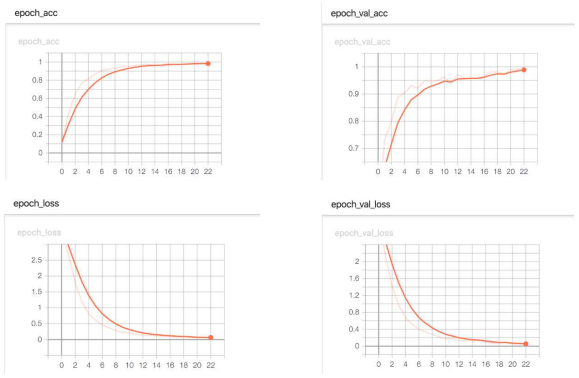

Fig. 12. Graphical analysis of training and loss

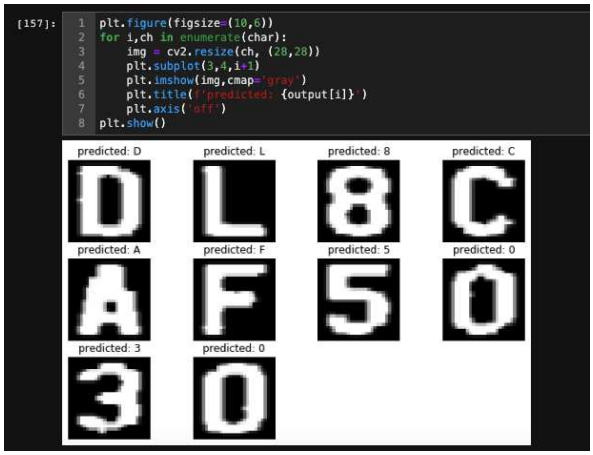

Fig. 13. Graphical Analysis Of Training And Loss

V. Conclusion

Research on the detection and identification of licence plates has been going on for more than three decades at this point. The efforts of researchers in the field of automatic licence plate recognition should be commended for the job that they have done. The prevalence of variations in licence plates is one of the most significant problems, and achieving a high level of identification accuracy is a laborious operation. This complete study project has been carried out in a methodical and sequential manner from start to finish. This research study is predicated on an in-depth and all-encompassing literature review that was conducted in the subject of AVPR.

Following a comprehensive review of the relevant literature, gaps in knowledge have been uncovered and need to be addressed. The primary objective of this thesis is to plan for and create a system that is capable of autonomous vehicle recognition. This objective was accomplished given that the created technology properly detects Indian licence plates. A robust and reliable vehicle plate character extraction and recognition method (VeLiPET) was presented in this thesis for Indian number licence plates. This method uses the characteristics of characters such as area, height, width, perimeter, and aspect ratio to extract the vehicle number characters from the picture of the car. These characteristics include: area, height, width, perimeter, and aspect ratio. Character recognition relies on a process called template matching. The suggested method is assessed using a data set consisting of 500 photographs of moving

automobiles that were collected in a real-time setting. The photographs were taken in numerous parking lots located on the campus of Punjab University in Chandigarh. In order to assess the usefulness of the suggested structure, a number of experiments are carried out. The findings of the experiments demonstrated that the suggested method yields accurate results of 96.69% for character regions extraction and 95.34% for character recognition, respectively. These figures are comparable to the work that has been published in the literature. In terms of the accuracy of recognition, the system that was suggested performed quite well. The suggested framework is adaptable enough to be used in the deployment of real-world applications such as toll management systems, automated parking systems, intruder detection systems, and many more.

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