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License Plate Recognition using a Sequential Model and OpenCV

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***Abstract*—With the increasing number of vehicles on the road every day, tracking every vehicle can be difficult in today's world. Due to the tremendous diurnal development of vehicle assiduity, it is not possible to manually keep a record of the entire vehicle density on the road. Many techniques like MATLAB, OCR (Optical Character Recognition), and YOLO (You Only Look Once) were used. This study proposes an automatic vehicle detection system that makes use of a surveillance camera. With the advancement of this system, it is now simple to keep a record and use it when needed. To identify the characters, the CNN model is trained and used. The extracted images are then segmented. This system is primarily intended for security purposes as safety and security in corporate places is a challenging task. As soon as the car arrives at the security checking area, the system will snap an image of it. The segmentation procedure is then used to extract the collected images. The data obtained is then compared to the data in their database. Here, a model has been constructed for training by using a sequential model from TensorFlow, Keras, and models, and the model produces the best results at epoch 23.**

Keywords—Keras, TensorFlow, Segmentation, License plate

I. INTRODUCTION

As a result of the widespread adoption of information technology in all facets of modern life, cars are often viewed as conceptual resources in information systems. As an autonomous information system is worthless without data, vehicle information between reality and the information system should be reformatted. This can be accomplished through the use of human agents or specific intelligence technology that can identify automobiles based on their license plates in real-world settings. The system for detecting and recognizing vehicle license plates is mentioned among intelligent equipment. The system of vehicle number plate detection and recognition is used to detect plates and then recognize the plates, which is to extract text from an image, all due to calculation modules that employ location algorithms, plate segmentation, and character recognition.

License plate detection is the process of identifying the location of a car's license plate in an image or video. License plate recognition involves determining the values or text on the license plate. These techniques are often used in various applications, such as identifying vehicles that are breaking traffic laws, tracking vehicles entering or exiting a certain location, and managing vehicle parking. These techniques are made possible through the use of computer vision systems that can detect and recognize license plates in real-world settings, using techniques such as location algorithms, plate segmentation, and character recognition.

The technique captures photos or videos from license plates via optical character recognition and converts the optical data into alphanumeric information. Vehicles entering or departing the region may be tracked using license plate recognition technology, as well as the number of times the vehicle arrives, how long it stays, and so on. Vehicle management activities such as parking control, access control, toll assortment, traffic monitoring, security, and many more systems make widespread use of license plate recognition technology. The list of its uses is endless on the road, that's how widespread this technology is.

A. Problem Statement

Generally, in corporate offices, hotels, etc. to authorize vehicles for security reasons, the security guards manually enter the license plate numbers and ask for permission for the vehicle's entry. This can be automated by license plate detection and checking for authorization by comparing it with the previously stored database and also automating the data entry of the vehicle number along with the time of entry. This helps prevent theft of that vehicle and identify the crimes committed using that vehicle. By registering the vehicle, a record is created, which gives the vehicle its unique identity.

B. Objectives and Applications

The recording of data on the vehicles helps establish security in the surveillance area. With the detection of the license plate and recognition of the vehicle, authorization can be ensured. Authorization contributes to creating a secure space. Keeping track of the entry and exit of the vehicles can play as vital information when in emergencies or at a crime scene.

To detect and show the license plate. To check the license plate against a pre-defined database. It determines if the vehicle is authorized to enter the grounds. If the detected license plate matches the previously defined database, the car is allowed inside. If it is not discovered, the entrance is rejected.

C. Proposed Work

The proposed work involves using license plate detection and recognition to capture and track vehicle data for security purposes. By identifying and verifying the license plate of a vehicle, the system can ensure that only authorized vehicles are given access. This can be useful in emergencies or criminal investigations, as it allows the system to keep track of vehicle entry and exit and compare it to a database to determine whether or not a vehicle is permitted. This can help improve overall security in the surveillance area.

II. Literature Survey

This section provides an insight into the past references and studies at were made use of to develop the project. It is mainly used to improve the scope of the project and mainly concentrate on the challenges occurring in the problem.

To control the traffic and some of the vehicles like unauthorized vehicles which are roaming the security areas, the signal crossed vehicles, automatic number plate recognition is most useful. In this ANPR there are different approaches such as processing time, image size, artificial neural networks etc., which help to recognize the proper image of the vehicle number plate [1].

In recent views, license plate recognition was done by converting the pixels of the image is converted into plane text. In this, image recognition is done with mathematical morphological operations like erosion, and dilation. And, for the segmentation the number plate was detected by using OCR inbuilt is used. An OCR is inbuilt which is used to detect the text in the number plate [2].

There are different methodologies for automatic number plate detection. Novel image processing is one of the processes in number plate detection. A novel image processing system will help to deal with noisy, low-illuminated, cross-angled, non-standard font number plates. These major issues should have to be considered in number plate detection. In this process, Gaussian thresholding and Gaussian smoothing are in the pre-processing stage. These are also the main key issues that should have to be considered in number plate detection [3].

In the process of number plate recognition, the high definition of the image is also the most important. In the Nighttime, Smokey areas, rainy time, etc., in all the parameters the image should be captured clearly. So, convolution neural networks are one of the methods used to detect image recognition. Faster R-CNN to detect the vehicle image which helps to scale the information. And the morphological operations used in the ANN. For acter recognition, the look-up table (LUT) is used as a classifier by boosting with a modified census transform [4].

There are many ways two detect the license plate of vehicles. Artificial neural networks (ANN) are one of the methods to detect vehicles. In this ANN technique the number plate can be detected with good quality image detection and also sharping of edges with the edge detection algorithm of the developer. The edge detection algorithm in image processing is used to reduce the dramatical data. And also, makes the image smoother, and thinner, and properly cleans the image [5].

MATLAB-based number plate detection is also one of the modelling concepts in vehicle number plate detection. Optical character recognition is used in the process of MATLAB. The optical character technique is used to recognize each character in the detection and segmentation. This MATLAB method is widely used in traffic control areas, tolling, parking areas, etc. So MATLAB is also one the useful technique [6].

III. Proposed Method

The proposed method involves identifying and extracting information from a car's license plate in an image or video. This is typically accomplished through the use of computer vision techniques that are designed to locate the license plate in the image. Once the license plate is detected, it uses our model that is trained with CNN to extract the alphanumeric information. This information can be saved into any data form and then be checked against a stored database to verify the authorization of the entry vehicle. By verifying the license plate, a system can allow only authorized vehicles to pass through the access point, which can be beneficial in various settings such as parking lots, gated communities, co-operate offices, and secure facilities.

A. Design Methodology

Design is the process of creating a plan or sketch that outlines the appearance, function, or workings of a product or system. It helps designers tackle challenges in various projects, settings, and locations. The methodology for design typically includes the following steps: creating a workspace, setting up the environment, detecting the license plate, performing image processing on the license plate to identify characters, and segmenting the alphanumeric characters from the license plate.

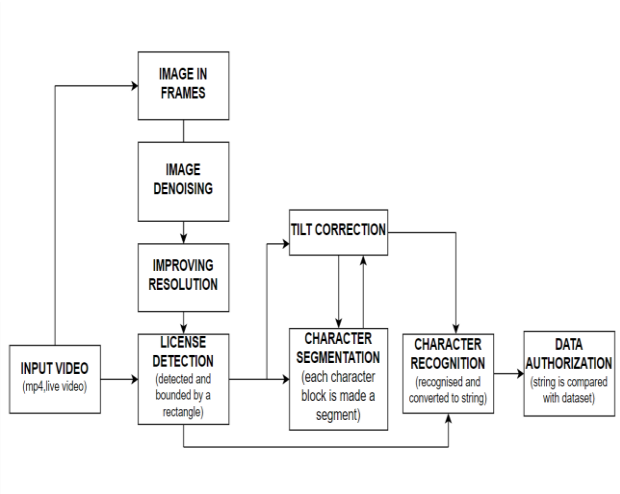

Fig a: Architecture diagram of the Proposed System

Initially, From the input video (maybe mp4 or live streaming video) images are captured at an instance. From this, the license plate is detected and stored in any data forms and performed operations. The operations like denoising and dilating are performed on these frames. The image resizing is implemented and image resolution is increased. Now, it is examined to see if the image is

oriented properly. The goal of character segmentation is to break down an image of a series of characters into smaller images of individual symbols. The characters are recognized from the images. Finally, the authorization of vehicles is done and the vehicles are detected and allowed.

B. Implementation

The process for creating a license plate recognition system involves the following steps: creating a workspace, setting up the environment, detecting the license plate, performing image processing on the license plate to identify characters, segmenting the alphanumeric characters from the license plate, creating and training a machine learning model for the characters, training a CNN model, generating an output of the license plate number as a string, checking if the license plate number is in the database, allowing authorized vehicles to pass, and recording the vehicle's activity.

C. Algorithm

TensorFlow Sequential Model:
Step 1 – Create a blank decision list, „R". Step 2 – „Learn-One-Rule" Algorithm
It excerpts the best rule for a particular class "y."
Step 2. a – if all training instances ∈ class "y", then it is classified as a positive example.
Step 2. b – else if all training instances ∉ class "y", then it's classified as a negative example.
Step 2. c – The new rule is added to the bottommost of the decision list, „R".
Step 3 – The rule becomes „desirable" when it covers a mainstream of positive examples.
Step 4 – When this rule is obtained, remove all the training data associated with that rule.
(i.e., when the rule is applied to the dataset, it covers most of the training data, and must be uninvolved)
Step 5 – The new rule is added to the lowermost of the decision list.

An architectural diagram is a diagram of a system that is used to abstract the overall outline of the system. The architecture of a system for license plate detection and authorization typically involves several steps. First, the input video is processed using computer vision algorithms and techniques to detect the presence and location of the license plate. The detected license plate is stored in image frames. The image is converted to a grey image i.e., image processing and image segmentation are done on the frames. Extracting the alphanumeric information from the image is adequate because the system is trained on the training datasets using the Sequential Algorithm from the Keras and validation is done using 23 epochs. The information is stored in any data form and compared to the stored database for data authorization. This process is typically repeated each time a vehicle approaches the gate or access point, ensuring that only authorized vehicles are allowed entry.

A digital camera was put at a predetermined distance and height in the proposed system to collect photos of vehicle license plates. When a vehicle is within a certain distance of the camera, a picture of the front of the car, including the license plate, is captured. This image was then subjected to multiple pre-processing techniques to remove the undesired background and pinpoint the license plate region. After extracting this region from the original picture, a character segmentation method was employed to separate the characters from the license plate backdrop. A CNN classifier trained on sequential algorithm characteristics was then used to identify the segmented characters.

Fig b: The process of detection of License Plate

An outline of the proposed system for automatic license plate detection is depicted in the figure above. The system finds the counters around the license plate in the image it captures at an instance of the video, now the preprocessing is done on the bounded image and segmented characters are detected.
Required tools:

OpenCV, NumPy, Urllib, TensorFlow, Keras, and CNN are the required tools for our project.

IV. RESULTS AND OBSERVATIONS

The result that was observed is the division of the number plate into the form of boxes.

Fig c: Segmentation of the Image

To analyse a video file to detect and recognize a license plate, the video file is first used as the input dataset. The data is then extracted from the video as individual frames, which are processed and converted to black and white. This is done by identifying the boundaries of the license plate through contouring. The dimensions of the license plate are then passed to the segmentation function, which divides the image into smaller segments for further analysis. This process helps to isolate the individual characters on the license plate, making it easier to extract alphanumeric information. The extracted information can then be compared to a stored database to check the authorization of the vehicle for gate entry or other security purposes.

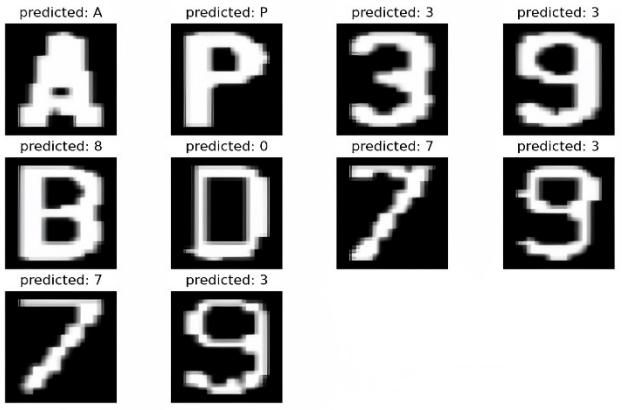

Fig d: Detecting the Characters in License Plate.

After the image has been segmented into smaller parts, the segmented output is sent for characterization. During this process, the image is further processed to identify the individual characters on the license plate. The output of this process is displayed, and the license plate number is obtained. This number is then compared to a stored database to check for authorization. If the vehicle is authorized, it is allowed to enter; if it is not authorized, access may be denied, or other actions may be taken. This process helps to ensure that only authorized vehicles are allowed entry and can be useful in a variety of settings, such as parking lots, gated communities, and secure facilities.

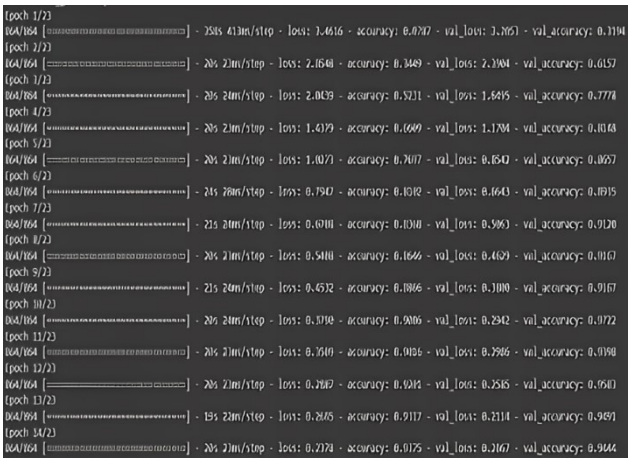

Fig e: Epochs of Training Dataset

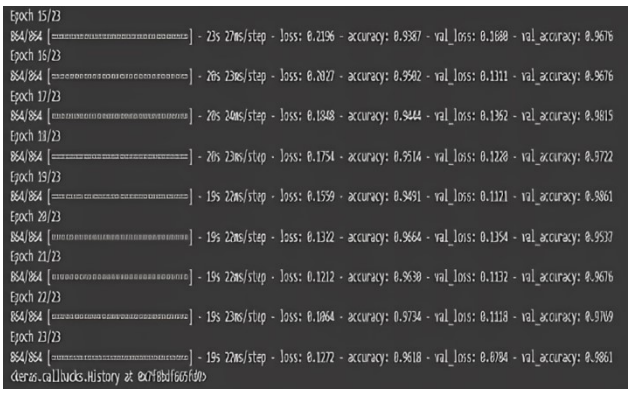

Fig f: Epochs of Validation Dataset

Through the 23 epochs, the system gains maximum accuracy of 97. The training dataset and the validation datasets are the classes of Alphanumeric characters in different styles and forms, which will help the model understand the pattern and develop a predictive instinct.

V. Conclusion And Future Work

This Chapter briefly explains the purpose of this paper subtly and understandably.

A. Conclusion

In conclusion, the process of license plate detection and checking authorization for gate entry from a stored database involves several steps that utilize computer vision techniques and algorithms for license plate detection from an image or video input. Extracting the alphanumeric information from its license plate is possible with the Sequential Model developed to an accuracy of 97%. The system can verify the authorization of the vehicle for entry through a gate or other controlled access point by using the database stored. This process can be useful in a variety of settings, such as parking lots, gated communities, and secure facilities, and can help to ensure the security and efficiency of these systems. By continuously repeating this process, a system can continuously verify the authorization of incoming vehicles and allow only authorized vehicles to pass, improving overall security and efficiency.

B. Future Study

In our project, we use license plate recognition to capture and store information about vehicles, including the time they entered a specific area. We also plan to expand the capabilities of our project to include recognition of the type and colour of the vehicle for added security. By continuously gathering and storing this information, we aim to improve the protection and efficiency of our system.

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