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License Plate Recognition for Detecting Stolen Vehicle Using Deep Learning

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***Abstract*—India is anticipated to overtake China as the third-largest vehicle market in the near future. Vehicle theft, according to data, has increased yearly. But the proportion of cases that the police really resolve is still quite small. It is challenging for police to locate stolen vehicles since they are sometimes carried to locations distant from the scene of the theft. Therefore, a need for an automated system to assist in tracking such cars arises. These issues are what our project tries to fix. The police will receive a tonne of information from this system that they may utilise to solve theft cases. Using the YOLO V3 algorithm and Canny Edge Detection, the identification system will automatically recognize automobile license plate numbers. After a license plate is identified, the following actions are taken: 1. to photograph the license plate. 2. to recognize and divide characters. 3. The time and date are then recorded in a database together with the identifying license plate for further use. 4. In the event that a stolen vehicle is discovered, a thorough report detailing the location and the time the vehicle first appeared is prepared, and police are notified that a match has been made. The method may be applied to increase security and accuracy.**

Keywords—License Plate Detection, Stolen Vehicle Detection, YOLOv3, Theft Vehicle Detection, Canny Edge Detection

I. INTRODUCTION

The population proportion of automobiles has drastically grown during the last 20 years. But it causes problems and difficulties for people to go about living their lives. It generates traffic delays, loud noise, and criminal activities such as car theft and accidents, among other things. In order to avoid the aforementioned societal issues, it is crucial to control and manage vehicles. Numerous initiatives are being started as a result to minimize the problems with automotive mobility. The identification system will often be installed at the entry to a residential neighborhood, a factory, a parking lot, a toll gate, a university, or other high security institutions like nuclear power plants and defence institutes.

A. Purpose-

There are now an increasing number of automobiles on the planet. It is essential to get from one place to another in a predetermined amount of time. We can see that the area is filled with vehicles. For a number of reasons, everyone needs a car. The percentage of automobiles in the population has dramatically grown during the last 20 years. But it causes problems and difficulties for individuals to live their lives. In addition to other issues, it causes traffic jams, loud noise, and criminal activity such as car theft and accidents. In order to avoid the aforementioned societal issues, it is crucial to control and manage vehicles. Numerous initiatives are being developed as a result to minimize the challenges related to automotive mobility.

B. Product Scope

India is anticipated to overtake China as the third-largest vehicle market in the near future. Vehicle theft, according to data, has increased yearly. But the proportion of cases that the police really resolve is still quite small. It is challenging for police to locate stolen vehicles since they are sometimes carried to locations distant from the scene of the theft. Therefore, a need for an automated system to assist in tracking such cars arises. These issues are what our project tries to fix. The police will receive a ton of information from this system that they may utilize huge solve theft cases.

C. Objectives-

- To detect License Plate of Vehicles passing through toll booth using CCTV Cameras
- To extract License Plate Number from the real time feed of CCTV camera input
- To compare the extracted Number with stolen vehicle Database • To alert Police about the detection of License Plate for further investigation
- To provide an additional functionality to manually search if a particular vehicle is stolen by searching in stolen vehicle database.

II. BACKGROUND

A. License Plate Detection

As input, the license plate recognition system gets footage from the CCTV camera. The camera's resolution must be high in order for the obtained footage to be processed further. Using Dark flow, we will train a YOLO (You Only Look Once) model with photographs of automobiles with annotated license plates. Labelling is a tool for visual image annotation. The dataset will be made up of online images of autos. YOLO v3 should be able to accurately recognize the cars and their LPs in considerably less time. YOLO predicts bounding boxes using four

coordinates (x, y, w, h), confidence, and C class probability using anchor boxes. The frames from the video stream will be sent into the algorithm, which will look for a license plate.

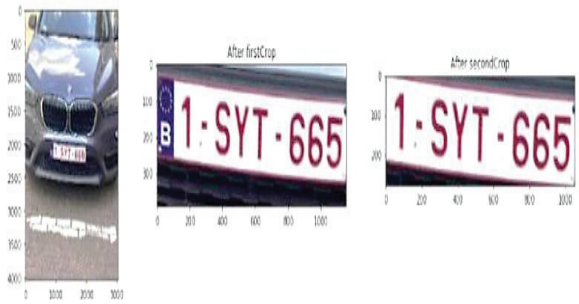

Fig. 1. License Plate Recognition

B. Character Segmentation

Greyscale frames will be taken from the stream. Using the threshold method, the greyscale image is converted to monochrome. Using this approach results in a less complicated picture (input). After locating the license plate, we may utilize the CNN for character segmentation and identification. Using images of license plates with character annotations, a YOLO model may be created. OpenCV may be used for image processing, such as cropping photos.

Fig. 2. Character Segmentation

C. Character Recognition

It is used to create characters from text-based visual representations. For character recognition, a convolutional neural network will be trained using the TensorFlow and Keras frameworks.

Fig. 3. Character Recognition

D. Searching Database

After the license plate is successfully detected, the license plate number will be searched for in the database of stolen vehicles provided by the police. If a match is found, the police will be notified about the detected vehicle. The police can then take suitable actions.

III. Literature Survey

[2] It has been suggested that a sliding-window single class detector can be built with the use of small YOLO CNN classifiers. The traditional YOLO architecture, which formerly consisted of 27 CNN layers and 24 convolutional layers, has been simplified to only have 13 CNN layers and 7 convolutional layers. There is a dedicated class detector deployed for each every class. As a consequence of this, 36 small YOLO models are utilised in order to identify 36 different classes (10 digits, an alphabet consisting of 25 letters, and 1 plate). The letter "O" is missing from all Taiwanese vehicle licence plates. Both the process of detecting something and the process of recognising it happen simultaneously within an image. Because YOLO detects and recognises characters and numbers in a single phase, it is able to do so without the need for character segmentation, which enables it to recognise both characters and numbers. The technology has a detection accuracy of 98.22 percent and a recognition accuracy of 78 percent when it comes to licence plates. A single detection recognition phase that lasts between 800 milliseconds and one second is carried out by the system for each image that is input. The system has additionally been evaluated in a variety of settings, such as in the presence of rain, darkness and dimness, as well as varying degrees of picture colours and saturation.

[3] A reliable licence plate recognition system finds automobiles first, and then it extracts licence plates from the vehicles. This helps to reduce the number of false positives that occur during the plate detection process. CNNs are utilised to assist in the improved identification of individuals in images that are hazy or unclear. It reduces the number of false positives that occur during plate detection. Then, CNNs are utilized to improve character recognition in foggy and opaque pictures. According to this study, plates should be identified first, followed by vehicle detection, in order to handle the complexity of pictures acquired by crossroad cameras. This method might assist you in avoiding mistaking ads or traffic signs for license plates.

[4] There are hardware and software modules in this system. An image acquisition system, a sensor, an alarm, and a relay make up the hardware module. Images are taken using a digital camera. The software module includes an image processing component. Two components of image processing are number detection and recognition. when a vehicle pulls up to the toll booth. The gate will stop it, and the camera will capture an image of it. The camera sends the microcomputer unit the image of the approaching vehicle. Segmented characters and the licence plate are both extracted. Additionally, it acknowledges data gleaned from the MATLAB program. It is a piece of software for processing images. After that, MATLAB finds the licence plate and compares it to the stolen car database kept by the police station. The licence plate of the impounded vehicle is compared to stolen vehicle data provided by the police station. The IR sensor recognises a car as it approaches the gate. The gate won't open if it appears that the car is stolen. The alarm goes off and a message is sent to the police station at the same instant. All of the listed operations are carried out by the PIC microcontroller.

[5] A heuristic method has been developed to extract licence plates from images. The method used in this study not only expedites the process under certain restrictions, but also raises the likelihood of correctly identifying the licence

plate and segmenting characters. The processes of estimating character width, vertical height, segmenting licence plates into blocks, and character block recognition make the technique effective. The suggested method for identifying edges in an image of a car is Canny Edge detection. The gradient method is the foundation of this strategy. In order to expedite the process, bounding boxes are used. A licence plate frequently has four sides, so the enclosing box must have four edges as well. The licence plate image's aspect ratio must be between 3 and 6. Only those bounding boxes that fall within the lower half zone of a car image are selected because the licence plate is in the lower half of the image. These heuristics assume that the height of the entire car image should be greater than 0.5 when comparing the x coordinate of the bounding box to it. After that, the automobile image's best bounding box is cropped and taken for additional character segmentation. Through the use of the Region of Interest method, the bounding box is cropped. Vertical Image Projection is now used to carry out character segmentation. The characters have been identified using the Template Matching method. The detected character picture and the typical character database images are essentially matched by this method.

[6] In this article, the design and deployment of a National Detecting Stolen Vehicles Network System (NDSVNS) for the country and the police are discussed. In order to put up a Stolen Vehicle Identification System, the NDSVNS principally relies on pattern recognition algorithms (SVIS). It also connects several separate databases from urban and rural police departments. Second, feasible places for SVIS installation have been identified in every county, city, and toll booth in the state. The License Plate Recognition Workstation is responsible for identifying licence plate patterns and connecting data from vehicles that are believed to have been stolen to the Stolen Vehicle Database (SVD).

[7] Based on the findings of this study, a novel strategy for the identification of vehicle licence plates is proposed. This strategy makes use of a one-of-a-kind adaptive image segmentation method known as Sliding Concentric Windows (SCW), in conjunction with connected component analysis and a neural network for character recognition. Out of a total of 1334 input pictures, there were a total of 1287 correctly segmented licence plates (96.5%). The optical character recognition system is a two-layer probabilistic neural network (PNN) with the topology 108-180-36, and it achieved 89.1% total plate recognition. Using the information obtained through image processing, the PNN is educated to recognise the alphabetic and numeric characters that are found on vehicle licence plates. When the two success rates described above are combined, the overall success rate of the algorithm is calculated to be 86.0%.

[8] In this research, a method that is both intelligent and straightforward is proposed for use in the licence plate identification system of motor vehicles. This technique, which is based on pattern matching, may be used for the real-time identification of licence plates, for the aim of either gathering data for surveys or for certain application-specific goals. A working prototype of the intended system was developed in C++. This study provides a strategy that is both ingenious and straightforward for the licence plate recognition system of a car. The process of recognising licence plates in real time may be accomplished with the help of this method, which is based on pattern matching. Histograms that are composed of vertical and horizontal colour concentrations are used as the foundation for this method. The proposed system was developed in C++, and the testing results are tailored to the recognition of licence plates in the province of Alberta. The confusion that existed between characters such as the digit '0' and the letter 'O,' and the digit '8' and the letter 'B,' has been cleared up as a direct result of this prior understanding of the characters that are contained in the Alberta licence plates. The process of character segmentation is accomplished by taking vertical colour concentration readings from the picture, while the method of identifying the position of the number plate character is accomplished by taking horizontal colour concentration readings from the picture. Each matching procedure will return a group of possible characters that are most comparable to or connected to the section that is currently being analyzed. After carrying out this process multiple times using a variety of histogram patterns, the procedure filters out all but the most essential of the possible characters, leaving only the one that is correct. If we want to use this system, we will need to adjust this method so that we can recognise the licence plates from other countries, states, and provinces while keeping the system's overall structure intact. This is necessary because the orientation of number plates and the typeface that is used varies from location to location.

IV. COMPARATIVE ANALYSIS

Rate of Recognition ➔ pl: plate detection ch: char recognition ov: overall success

Scientific background ➔ P: Number plate detection method R: character on plate recognition method

TABLE I. COMPARATIVE ANALYSIS

Ref No.	pl	ch	ov	P	R
[2]	98.2%	78%	76.6%	sliding-window single class detector via tiny YOLO CNN classifiers.	
[5]	65%	89%	79%	P: Canny Edge detection, Heuristics (calculated guesses) (character width estimation, vertical height estimation).	Vertical Image Projection, Template Matching approach.
[7]	96.5%	89%	86.0%	Based on Sliding Concentric Window and connected component analysis with a character recognition Neural Network.	two-layer Probabilistic Neural Network (PNN).
[8]	NA	NA	NA	vertical color concentration in the image.	horizontal concentration of color.

V. Future Scope

The system proposed in this paper can be implemented by using the already available infrastructure like security cameras, cameras for identifying traffic rules violation, etc. The system is ideal to be integrated with the fast-tag infrastructure available at toll gates in India. The system can help to reduce the number of pending police cases related to vehicle theft. Currently, many such cases remain unsolved due to limited area of influence of a police station. This system can be used to monitor a larger area even different from different cities by weaving a large number of interconnected cameras for live feed and application servers. This will by no doubt require a huge amount of computational power.

VI. Conclusion

Our suggested approach aims to outperform current models with more accuracy. For more accuracy, YOLO Model and OpenCV are utilized. Vehicles can be recognized automatically rather than the current laborious methods. The above-discussed approach, which includes basic image processing processes, can be used to create the suggested system for automatic vehicle license plate recognition. Any vehicle's front view photograph may be used to identify and read the license plate number. Its three essential processes are plate detection, character segmentation, and character recognition. Additionally, we can identify stolen vehicles by matching them to a database, and alarm messages and a thorough report are instantly forwarded to the police. The report includes the license plate number and the time the stolen vehicle was found. As a result, the stolen vehicle's location can be found.

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