Vehicle Information Retrieval by Number Plate Detection

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ABSTRACT

In controlled areas such as parking and traffic zones, ensuring the security and management of transportation systems has become increasingly crucial. As the number of vehicles continues to rise, there is a growing demand for an effective, affordable, and efficient mechanism for vehicle identification. This article introduces the development of an automatic vehicle identification system that utilizes number plate recognition (NP recognition) technology. NP recognition is a computer vision-based image processing technique that involves capturing the vehicle's image and extracting its number plate information. The system is implemented at traffic signals to enable the identification of traffic violations and restrict access to authorized vehicles only within campus areas. When a vehicle is detected by the camera, the system captures an image of its license plate number.

After capturing the vehicle image, the system proceeds with optical character recognition to segment and investigate the characters. This involves employing a deep learning algorithm called Convolutional Neural Network (CNN) to train the system in identifying the number plates of the vehicles. To detect the plate number, the image undergoes pre-processing and utilizes a combination of Sobel Edge Detection and Laplacian Edge Detection Techniques. The system employs the Bounding Box technique to locate the number plate and performs character recognition.

Key words : Vehicle Identification, Number Plate Recognition, Image Processing, Optical Character Recognition.

1. INTRODUCTION

Using the popular Convolutional Neural Network (CNN) model, number plate classification from captured vehicle images can be achieved. However, obtaining a large dataset for accurate results and training the model with it can be a complex task.

To address this issue, an approach is taken to reduce the dataset required for training the model. CNNs have the ability to focus on specific weights of small image patches, similar to using a magnifying glass to examine only a small section while reading a book, as depicted in Figure 1.

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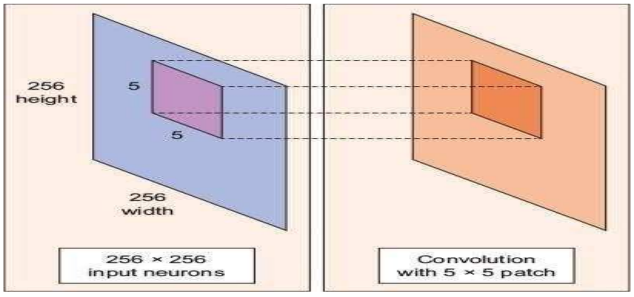

Figure 1: Considering 5X5 Pixels from 256X256 Pixels to reduce the dataset size

2. LITERATURE SURVEY

[1] To streamline and automate traffic management, an Automatic Number Plate Recognition (ANPR) technique is utilized. This technique leverages Neural Networks and Image Processing to optimize and analyze various parameters of the neural networks. Implemented as a Parking Security solution, it finds application in malls, offices, hospitals, educational institutions, public parking, and similar locations. By employing machine learning algorithms and utilizing a Raspberry Pi 2B IoT device, an impressive efficiency of 97% is achieved. The ANPR system's functionality is facilitated through commands written on the MATLAB platform.

[2] A system called Automatic Number Plate Recognition (ANPR) is implemented to identify vehicles entering certain areas by utilizing Image Processing Technology. The system extracts the vehicle number plate through image segmentation. Optical Character Recognition (OCR) technique is then employed to recognize the characters on the number plate, which are subsequently compared with a database to obtain details such as the owner's information, registration data, and vehicle address. The ANPR system is simulated using MATLAB and demonstrates successful recognition of number plates even under varying lighting conditions.

[3] An Automatic Number Plate Surveillance System is implemented at universities, parking lots, and traffic signals to detect vehicles that violate rules and regulations. The system utilizes Image Processing Techniques and Artificial Neural Network (ANN) to identify the number plates of the vehicles. One notable advantage of this system is its ability to perform both recognition and detection processes simultaneously.

[4] In efforts to combat and prevent crimes within cities, the utilization of automatic number plate recognition technology has become increasingly prevalent near Toll Gates and Parking Lots. Locating missing vehicles can be a time-consuming, arduous task. Computer Vision Technology plays a crucial role in detecting the number plates of moving vehicles. By extracting images from video footage captured by cameras, the system facilitates the identification of number plates.

[5] In the classification of number plates, a Deep Learning Approach is employed to handle challenging scenarios. This approach comprises two parts: firstly, using HOG (Histogram of Oriented Gradients) for pre-processing and element removal, and secondly, classifying each number and alphabet to isolate and categorize the characters on the vehicle's number plate. The Extreme Learning Machine (ELM) algorithm, which operates on single hidden layer feed forward networks, is utilized as a fast learning algorithm for classification, exhibiting comparable performance to SVM (Support Vector Machines). HOG extracts important features from the plate, while ELM serves as the classification method for identifying Thai characters on the plate.

3. PROPOSED SYSTEM ARCHITECTURE

Figure 2 shows the architecture of the proposed system.

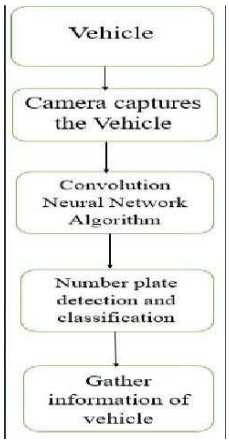

Figure 2: Flowchart of proposed system

4. WORKING

In the Vehicle Information Retrieval System (VIRS), the system is first trained to detect and identify vehicle number plates that violate traffic rules, even in complex scenarios such as heavy traffic zones. To achieve this, the system employs the Convolutional Neural Network (CNN) machine learning algorithm. Let's now discuss the workings of the CNN algorithm.

When training models, large datasets are often required, including for Convolutional Neural Networks (CNNs) that process images. To address this, we can employ techniques like cropping images, applying random horizontal flips, and adjusting RGB color and brightness. These methods are utilized to extract and learn features. Additionally, the Image Data Generator module is implemented as a pre-processing function, serving as an augmentation technique to reduce the dataset size.

The data is split into 80% for training and 20% for validation. The training dataset is used to train the model in batches of size 256, using the categorical_crossentropy loss function and the Adam optimizer. Data augmentation techniques such as shifting, rotating, and zooming are applied during the training process. Previously, the data was stored in array format with values ranging from 0 to 255. With the CNN, the network structure is defined, and the values are scaled to the range of 0 to 1.

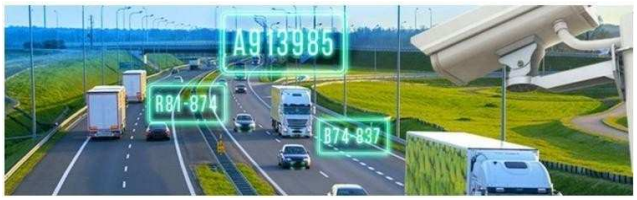

Figure 3: Number Plate Recognition on Highways

5. CONCLUSION

The primary objective of developing such a system is to enhance safety and prevent accidents at traffic signals and road intersections. To achieve this, the model is trained using the Convolutional Neural Network (CNN) algorithm. This approach helps to reduce the training costs of the system and minimize the required training dataset by augmenting the data obtained from various vehicle number plates.

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