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Vehicle Information Retrieval by Number Plate Detection

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ABSTRACT

According to NHTSA (National Highway Traffic Safety Administration), every year on an average 1,578 deaths is due to two-wheelers and four-wheelers crashes near traffic signals and road intersections. Drivers who neglected the red signals are the main reasons behind these accidents. Around 51% of major crashes are because of this negligence by the drivers. 30% of these accidents are caused by the drivers who are having age above 65 years. To avoid such fatal crashes near the road intersections and traffic signals a Vehicle Information Retrieval System (VIRS) is introduced in this article. This Vehicle Information Retrieval System (VIRS) collects the details like owner of vehicle, Registration State & City, Engine details, Age of Vehicle from the day that user has purchased, Vehicle Pollution Certification dates, Vehicle Insurance and other necessary information is gathered by using the cameras near the signals. The system is trained by using a Convolutional Neural Network (CNN) machine learning algorithm to identify the number plates of the vehicles. If the vehicle violates the traffic rules near the signals and intersection points the vehicle is detected through the cameras and the vehicle details is sent to the RTO office and the officers present there will generate fines to those vehicles.

Key words : Vehicle Information Retrieval System (VIRS), Registration Details, RTO office, National Highway Traffic Safety Administration (NHTSA), Machine Learning.

1. INTRODUCTION

Classification of license plates from the captured images of the different vehicles can be implemented by using a most used neural network model called Convolutional Neural Network (CNN). To get the accurate results we need to have large dataset to train the model. But gathering such huge amount of data and training the model by using this dataset is highly complicated.

To avoid such complications in training the model we try to reduce the large dataset required to train the model Convolutional Neural Network has the capability of considering only enough weights of small patch of image pixels as shown in figure 1 which is similar to reading a book where we will be using magnifying glass to see only a small patch.

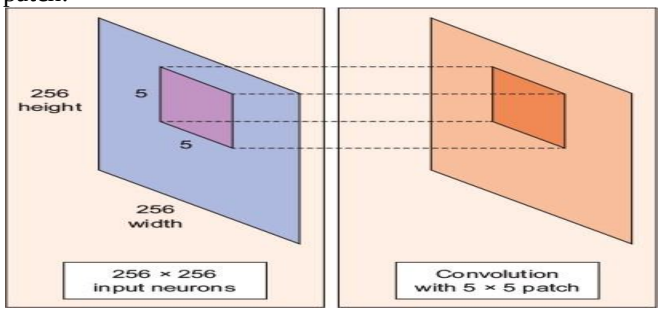


Figure 1: Considering 5X5 Pixels from 256X256 Pixels to reduce the dataset size

2. LITERATURE SURVEY

To automate and ease the process of traffic management and flow of traffic an Automatic Licence Plate Recognition technique is implemented which uses Neural Network and Image Processing for optimization, analysis of several parameters of neural networks. This License Plate Recognition Technique is used as a Parking Security in malls, offices, hospitals, educational institutions, Public Parking and several other places.[1] An efficiency of 97% is obtained by using these machine learning algorithm which is implemented by using a Raspberry Pi 2B IoT device for which commands are written by using a MATLAB Platform.

Highly restricted areas like Government offices and military areas are to be secured. Several security measures have to be taken for the entry of the vehicles to these places. An Automatic Number Plate Recognition (ANPR) which uses Image Processing Technology to identify the vehicles entering into these places by identifying the vehicle number plate which is extracted by using image segmentation method. After extracting the characters in the number plate are recognised by using Optical Character Recognition technique and compared with the database to obtain several details like owner, registration, address of the vehicle. [2] The ANPR is simulated by using MATLAB and the system recognises the number plate in different lighting conditions successfully.

Automatic Number Plate Surveillance System that uses Image Processing Technique to identify the vehicles which violates rules and regulations at hospitals, universities, parking lots and malls. This system, also identifies the usage of car for terrorist activities, stolen cars, invalid number plates, smuggling, other illegal activities and toll collections on highways. The main advantage of the system is to identify the vehicles number plate by using Artificial Neural Network (ANN) which performs recognition and detection process simultaneously. [3]

To serve the purpose of identification of any vehicle, automatic licence plate recognition system majorly contains 4 steps: Pre-process the image that is captured, Identify the region of the licence plate, Segmentation of the image, Character recognition from the image. Sobel Edge Detection Algorithm is used as a key step to identify the region of the licence plate has been used previously. To overcome this a Novel Algorithm, [4] a unique edge detection algorithm which uses Internet of Things (IoT) to update the data into database, where all the cameras are connected based on the region that creates "Universal Eye" for tracking the vehicles over the cameras used.

Investigation and Prevention of crimes in the cities, automatic number plate recognition technology that is used widely near Toll Gates and Parking Lots when the vehicles are missing which is time consuming, tedious and hard to find the vehicle. To detect the number plate of the moving vehicle Computer Vision Technology [5] plays a major role. The videos that are captured by using camera, image will be extracted from that video and based on the aforementioned System genuine and fake number plates are differentiated.

Deep Learning Approach is used in the process of training the machine learning model which classifies the number plates at extreme cases. This method consists of two parts, one is to use HOG to pre-process and remove elements, and the second section classifies each number and alphabet to classify and isolate each number and letter found on the number plate of the vehicle. Extreme Learning Machine (ELM) [6] is a quick learning algorithm for supervisors running on single hidden layer feed forward networks, and is comparable to the SVM in its classification performance. When HOG extracts important characteristics from the plate to classify Thai characters on the plate, ELM is used as a classification method.

Recognition of number plates in India, a huge variety of problems arises. This may be due to, a multitude of font types, various colours and number plates with double rows, etc. In the final result add a high degree of inaccuracy. Many of these issues are taken care of in this work on actual Indian road conditions. ANN is used for character recognition and SVM is used for plate contour detection. Different algorithms to remove noise and enhance plate recognition and use of neural network for best results with lots of camera restrictions[7].

3. PROPOSED SYSTEM ARCHITECTURE

Figure 2 shows the architecture of the proposed system.

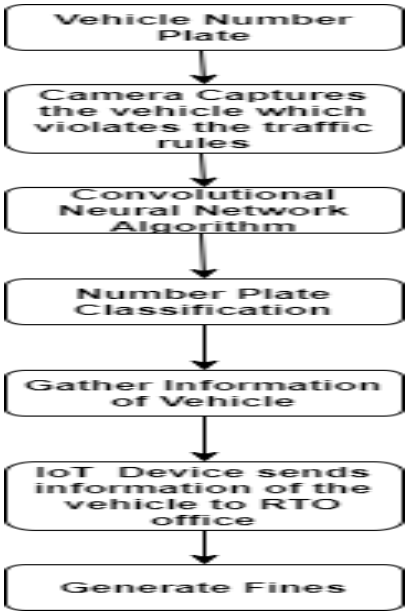


Figure 2: Flowchart of proposed system

4. WORKING

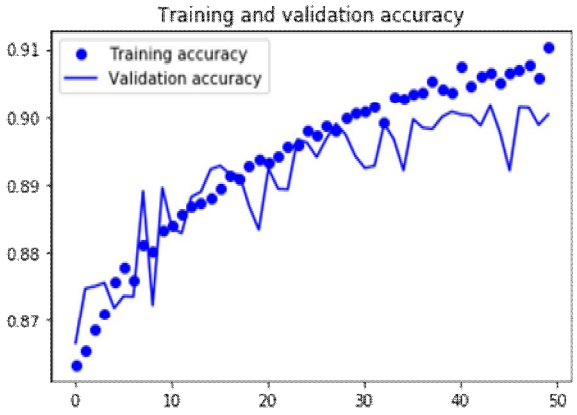
In the Vehicle Information Retrieval System (VIRS), initially the system is trained to identify the vehicle number plates which violates traffic rules which is available in different formats even in heavy traffic zones. Here Convolutional Neural Network (CNN) machine learning algorithm is used to train the system. Initially, how the Convolutional Neural Network (CNN) algorithm works is explained.

The datasets that used for training the model is very large in case of any algorithm. Even in case of Convolutional Neural Network same large quantity of dataset is used. Typically, when it comes to images, we can reduce it by cropping the images with random horizontal flip, random RGB colour and brightness shifts. All these techniques are used to extract and learn the features. To reduce this process, ImageDataGenerator module a pre-processing function is implemented which is an augmentation technique to reduce the dataset size.

The data is split into 80% for Training and 20% Validation. Consider, the training dataset and train the model by taking images in batch size of 256 with categorical_crossentropy loss function and Adam optimizer. Also train the model by augmentation of data by shifting, rotating and zooming. Previously, the data is stored in the array format with values from [0,255] interval. Now, by using this CNN we shape the network and scale them into [0,1] values.

Figure 3: Number Plate Recognition on Highways

After training the model the results are shown in the below figure 4.



Test loss: 0.2484699842095375

Test accuracy: 0.9104

Figure 4: The Accuracy of the Trained Model after augmentation of the Data

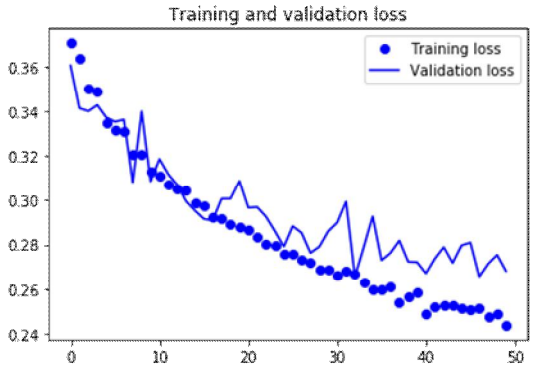
The information obtained from it will be shared with the RTO office. The people in the RTO office will be generating the fines for those vehicles. The categorical_crossentropy loss function is given by:

$$L(y,\hat{y}) = -\sum_{j=0}^{M}\sum_{i=0}^{N}(y_{ij} * log(\hat{y}_{ij}))$$

Where, $\hat{y}$ will be predicted value which will be set to 0 or 1. To learn different parameters individually, an adaptive learning method called Adam (Adaptive Momentum) estimation is used. For adapting the learning rate of neural network each layer weight, it uses first and second moment gradient.

$$w_t = w_{t-1} - \eta \frac{\hat{m}_t}{\sqrt{\hat{v}_t} + \epsilon}$$

4. RESULTS



Test loss: 0.22102486880123615

Test accuracy: 0.9229

Figure 5: The loss of the Trained Model

After testing the model as shown in figure 5, we got 92% percentage of accuracy which is more than any other machine learning algorithms like KNN, Naive Bayes. This training method also reduces the training cost as shown in figure 6 with the dataset we have considered.

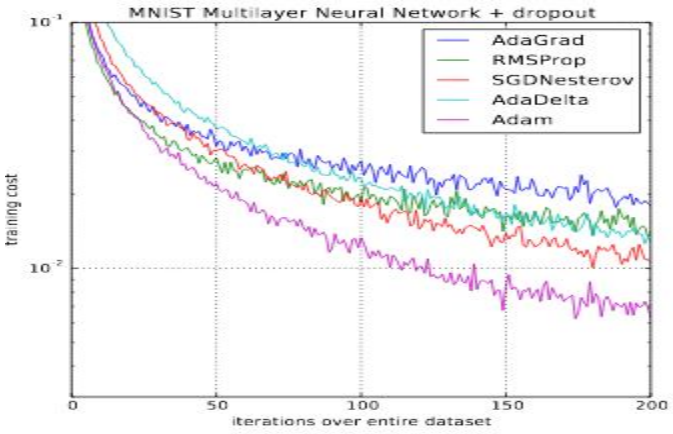


Figure 6: Training cost

5. CONCLUSION

The main advantage behind developing such system is to avoid accidents near traffic signals and intersection points of the roads. For this we trained the model by using a Convolutional Neural Network Algorithm by which we can reduce the training cost of the system and also reduce the training dataset by augmentation of the data captured from different vehicle number plates.

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