International Journal of Future Generation Communication and Networking
Vol. 13, No. 3s, (2020), pp. 1685–1694

Vehicle Number Plate Recognition for automatic toll tax collection Using IoT and Machine Learning

Aheraaz Tamboli and Shounak Sugave

School of computer engineering & technology, MIT World Peace University, Pune, Maharashtra, India

Abstract

Automatic number plate recognition recent the recent Trend in current environment, various systems has already developed by existing authors to detect the license plate as well as number plate using machine learning and deep learning algorithms. Internet of things (IoT) and some machine learning techniques for image processing is also contributed many classical systems. In this paper we proposed automatic number plate recognition for smart toll system, in traditional approach it is very tedious to perform the entire process with manual human interfaces. Sometime it also generate long traffic queue on toll plaza, to eliminate such a problem with this propose systems. This system initially deals with some IoT devices which contains camera sensor and arduino based microcontroller. The deep learning libraries have used to process the capture image by IoT environment with OCR library. This system also deals with user applications to auto debit toll charges. The state of art provides the conceptual model of entire system execution with real time as well as synthetic dataset, and theoretical experiment analysis shows the effectiveness of system..

Keywords: *CNN, image process, ImageNet, Artificial Intelligence, Deep Learning, machine learning*

1. Introduction

System proposed smart toll collection which reduces the time consuming long queue of vehicles. The product basically works for automatic vehicle number detection and toll tax collection using IoT and deep learning technique. Each vehicle owner having a E-wallet where he can refill amount from any bank account. Whenever transaction has done system automatically deduct tax amount from available wallet balance. System can gives penalty to vehicle owner if he didn't paid the minus amount within given time. The plate detection stage predicts the presence of numbering plates in the question picture (classification) and the respective positions. The test image is transformed at the time of training by the mean and standard deviation values measured. Optical Character recognition (OCR) is a technology that is mainly used for recognizing machine printed or human written text in scanned documents, images and then converting into editable form. This system about how we detect the number plate of different vehicles and storing them in the database. The ideology of the project had come up with the difficulties faced by the security to record the numbers of various vehicles at the gate way of the campus. Sometimes the user might not be able to record the data due to various inferences such as bad vision, Light factor, bad interpretation, failure to record the data when there are multiple buses at an instance. This might not be considered as a serious issue but in case of failure of recording the data at gate ways where there is large scrutiny and high security it may lead to some serious security issues. Image pre-processing is an important step in any image analyzing system. Without a proper pre-processing, the recognition will be ineffective or may give improper results in later stages. The main motive of pre-processing is to

ISSN: 2233-7857 IJFGCN

enhance the quality of the image that will be processed for recognition. Various processes that we are going to apply are converting RGB image to Grayscale, noise reduction and binarization of image.

Overview of Deep learning:

The rapid implementation of IT has resulted in the vehicles being listed as analytical instruments in the information systems in different aspects of the modern world. Since a data-free autonomous information system makes no sense, there is a need to update vehicle information between reality and the information system. This can be done by human agents or special, intelligent equipment that enables vehicles to be identified in specific environments through their registration plates. Classified among smart devices is the vehicle number plate detection and recognition system.

Plate identification reflects the final step on the OCR component of the proposed system. The vehicle plate identified from the preceding CNN provides the CNN data for plate recognition. The network architecture proposed in the paper[19] has been used for this specific character recognition method with some adjustment to suit the Serb standard in plate character recognition where the proposed system was tested. There are some neurons in the network output layer used in this article, multiple characters representing some neurons (digits, small letters and capital letters). Plate recognition CNN was also introduced in Tensorflow, due to improved device compatibility.

Rest of the paper is organized as follows. Section 2 gives brief overview of latest research, section 3 explains proposed work, system overview, datasets description section 4 observations Section 5 research contribution Section 6 application of image object detection Section 7 concludes the paper section 8 future work.

1.1 Background

According to Soomro, Shoaib Rehman et al [1].The The goal is to design and implement an efficient Vehicle Number Recognition System for automatic tax collection. The computer first detects the car and then pictures the vehicle's front view. The number plate of the car is placed and the characters are segmented. The system is designed to detect the number plate regardless of color for gray images. When digital camera advanced and processing speed increased, various groups of scientists became interested in VNR after the 1990s. VNR is an imaging technology that enables digital images to be retrieved from the vehicle's license number. Template matching technique is used for character recognition. The resulting vehicle number is then compared to all available vehicle records for collecting vehicle type information and paying the toll tax accordingly. The machine is then allowed to open the vehicle's road barrier and produce the receipt of toll tax. The specifications of the car are also contained in the database. the record.

According to Saiyadi, Parviz et.al [2] Attempts to implement an algorithm that first uses the Sobel Operator to locate vertical edges of the vehicle plate image and then extracts the vehicle plate from the image by evaluating the histogram and composing the morphological operators. To determine the exact location of the vehicle plate in the picture and classify the vehicle plate numbers and letters, a system should be designed and implemented for this purpose. Time analysis in plate recognition systems is distinct based on different techniques and is of particular importance in the application context. Tried to apply a mixture of edge detection method, histogram analysis and morphological operation; there wasn't much processing time and processing was done quickly.

In [3] an approach based on a simple and effective method for morphology and sobel edge detection. We also present an easy approach for segmenting all the letters and numbers used in the plate number. Using histogram equalization, we are trying to improve the contrast of the binarized image after the

ISSN: 2233-7857 IJFGCN

noise from the input image. We focus on two measures in particular: the first is to locate the number plate and the second is, and many more.

In [4] The LPR The solution consists of two key modules: a module for finding the license plate and a module for classifying the license number. The former attempts to extract license plates from an input image, separated by abstract disciplines, while the latter attempts to translate the number into a license plate, conceptualized as neural artifacts. Soft computing techniques rooted in fuzzy and neural disciplines were implemented to account for the inconsistencies caused by noise, measurement error, and imperfect processing. Although the proposed algorithm concerns the license plates of one country, some parts of the algorithm are easily extended to other license plates. countries.

According to [5] for label the number plate, an inventive approach is implemented. To classify number plates, this uses a series of image manipulations. To do the same thing, this uses 4-6 algorithms. Different traditional methods of image processing are used for plate placement. Techniques including image enhancement, unsharp masking, edge detection, filtering, and analysis of components play a role in the extraction process. The computer input is a digital picture of high-speed rotor cameras or digital cameras in our case, of a car and converted to gray scale using NTSC standard.

In [6] The ALPR To capture images, use a black and white color camera or an infrared camera. The accuracy of the collected images is a major factor in the findings of ALPR. As a real-life scenario, under various environmental circumstances, such as indoor, outdoor, day or night time, ALPR must process license plates quickly and efficiently. License plate collection from different countries, territories or states by dirt, lighting, and towing accessories on the car.

In Deep Learning, "deep" indicates the number of hidden layers in the Neural Networks. Deep Learning models are trained by using any large set of labeled data. Deep learning techniques are used for image sentiment analysis and providing optimum results. Deep learning plays a massive role for image sentiment analysis for providing various techniques like Convolutional Neural Network, Deep Neural Network, Region Neural Network and Deep Belief Network to get optimum results [11].

We have purpose to describe the application of deep learning algorithm like convolutional neural network is used to visual media for determining its sentiments accurately. The major problem occurs in situations where we have found incompatible emotions which are express through image and text, and thus it fulfill the requirement [12].

This can be used for the further general estimation of individuals about state of mind too. Likewise it is valuable to comprehend the sentiment an image delineates to and consequently anticipate the class label. As a chunk of this task, it intends to give a sentiment based class to an image. Images conventionally fall under five classifications - love, happiness, sadness, violence and fear [13].

Several posts on social media rarely contain any textual caption, but are rather flooded with images. Thus primarily contributing to a variety of opinions and emotions being conveyed quite implicitly merely through visual content. One can express sentiments through text, image or videos. Although several works in past have employed techniques to decipher sentiments from user posts, especially on social media [14],

2 Literature Survey

We have surveyed several recent trends in this fied and tabulated the techniques, datasets used and research gap in Table 1

ISSN: 2233-7857 IJFGCN

Table1. Brief overview of survey

No.	Technique	Dataset	Advantages	Research Gap
[1]	Machine learning and image process	Number plates	Can work on heterogeneous dataset of images	No support for multi-language characters detection
[2]	Image processing with supervised learning	Twitter vehicles	The forefeet will be automatically charged to the car owner if PUC has been expired.	System cant support for linguistic information of plates
[3]	It offers easy access for the people.	Real time vehicle	For avoiding long queue as no need to prevent the vehicle and no need of manual transaction at the tollgate	Much expensive as well as hardware dependency for real time execution.
[4]	Image recognition with various feature extraction	License image dataset	RGB and CMYK features, OCR	This system only active for automation fee system.
[5]	Image processing with machine learning	Vehicle number plate dataset	Histogram feature extraction, binary features extraction	Low accuracy PCA and define methods.
[6]	Machine learning	Video frames dataset	Textual feature generate good accuracy and reduce the error rate	Low accuracy for linguistic classification
[7]	DNN,PNN, RNN base deep learning algorithms	Sina Weibo Dataset	System carried out execution like	The system is not able to detect multiple objects in a grid

ISSN: 2233-7857 IJFGCN

			supervised learning like already trained module while unsupervised earning like pre-trained module.	and loss accuracy rate. Sometimes it detects an objects many times. unable to localize small objects
[8]	Deep CNN	Twitter and Flickr	Easy training less complexity than RCNN with acceptable accuracy	More and more computing resources are required simultaneously.
[9]	NLP with supervised learning algorithms.	Flickr	It works like text sentiment analysis and classification based on features on large text data.	No provision for image sentiment classification. Machine learning algorithms should be take large processing time
[10]	Deep learning base visual features extraction using multi CNN layers.	ImageNet and ILSVRC	No need for predefined anchors much faster than basic CNN	More time is spent generating corners and evaluating the base networks

3 Proposed work

The main part of this system is the master image as well as vehicle information database which are stored on central server. This database includes all owner information of registered vehicles. When the registered vehicle passes through the toll plaza, the amount of toll is automatically deducted from the linked wallet of the driver. The database is updated concurrently with this information and the user is informed via the program SMS

ISSN: 2233-7857 IJFGCN

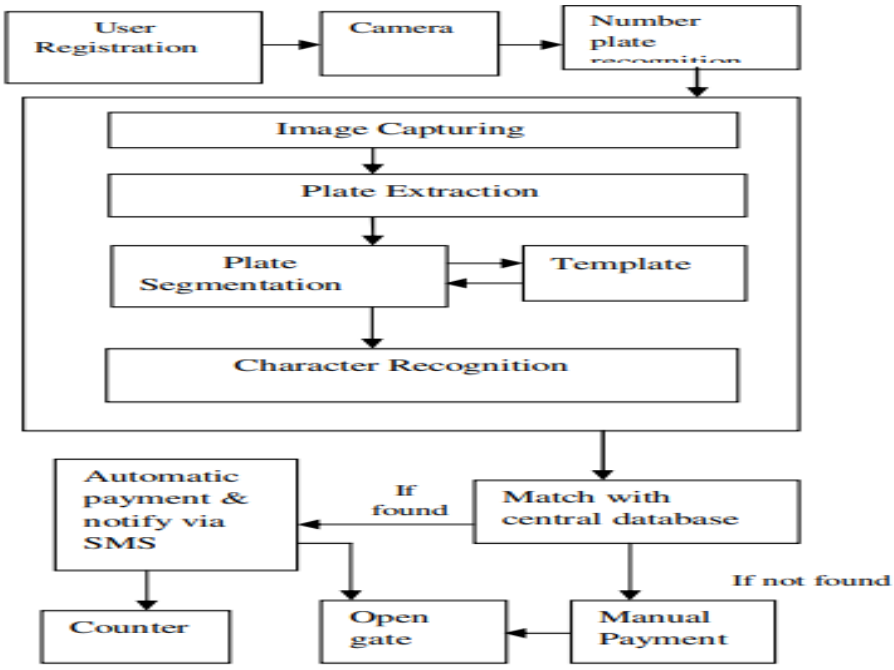

Fig.2 Proposed system overview

Prerequisite: Each user create the account on web application which unique vehicle no as well as chassis id, once account has successfully created system will send user id and password to users mobile number or mail id. Using those credential user can login to web application.
After successfully login user can add amount to wallet using given virtual procedure, and view the updates as well as entire transaction history of vehicle based on duration.
1 : Deploy a system with deep learning approach, with DCNN, initially system read the input image and pre-process using imageNet Library.
2 : Apply optical character recognition to extract each character form input image using OCR lib.
3: System extract entire metadata from master table using extracted vehicle id number, which contains vehicle details as well as owners information, and pending dues.
4 : if pending dues is > 2500 then it will gives an alert to pay manual amount. Else it will automatically reduce the respective amount from wallet.

3.1 System overview

In base system, a Simple technique for the ANPR process, which can be used in many automated vehicle number plate recognition applications. It is designed to use camera images to perform a simple algorithm that can help identify vehicle number plates. Recognition of the number plate algorithm consists of five parts: image acquisition, pre-processing, edge detection and segmentation, extraction function and number plate character recognition using correctly ML algorithms.

To design a system with IoT and Deep Learning (DL) approach to automated number plate recognition of incoming vehicles on toll plaza. Initially system works with two camera sensor (left and right side) at location which takes continuous VDO steaming for outgoing vehicles. Then steaming data converted into different image frames and passes to CNN. CNN detect if image contains number and extract the vehicle type information from master cloud database. According to vehicle type it generates automatic tax bill for respective vehicle, and send to transaction web server.

ISSN: 2233-7857 IJFGCN

Server automatically triggers the process and deduct balance from wallet while if wallet does not have sufficient balance even then system continue with transaction and shows minus amount, but when amount will be > -2500 it will automaticity stop next toll exit door for respective vehicle.

3.2 Datasets used

UCSD

Around 10 hours of recorded video of cars entering the UCSD campus from Gilman's entrance at different times of the day. Video still feed frames, hand labeled with information about the brand and model, license plate positions, and license plate texts.

Frame by frame snapshots of the 878 car license plates. Still pictures of 291 cars taken with a digital camera in parking lots. Records are protected by passwords.

Indian_Number_plates

Dataset of various number plates from cars in India, it contains around 9500 number plate with vehicle object images

Algorithm Comparison

Machine Learning:

We need to get a training set (hundred thousand images) of number plates. Convert all the images into feature vectors and train a model. This model could be chosen from an umbrella of algorithms that fall under 'ML': SVM (support vector machine) to a 3 layer neural network with a softmax classifier. No clear way to identify which algorithm to use.

Deep learning:

It is essentially a neural network with multiple layers (usually more than 3) that would require a fairly robust dataset of images to make very accurate predictions. Convolutional Neural Nets (CNN) deep learning models have proven to get very good results. The plus side is that this approach provides a one-for-all architecture to solve such problems. However, it would require more powerful machines than a simple 3 layer neural network.

The major advantage of Deep learning rather than machine learning classifiers, it gives very good results for problems where sufficiently large datasets are present. Conventional image processing would still be necessary in cases where the image dataset is not vast enough

4 OBSERVATIONS

- Many researchers have used machine learning techniques with image processing to extract the characters from where is images [6].
- DCNN basically provides highest classification accuracy all the linguistic data set with different kind of font styles [5].
- Many systems still facing character detection issues due to imbalance image data set as well as unsettle environment for a object capturing.
- Optical character recognition (OCR) library provided by Google deep learning module which also provide data classification accuracy as well as detection accuracy from heterogeneous characters [10].

The below figures shows the partial implementation of prosed system, and its evaluated parameters details. The below figure 2 shows image preprocessing and filtration time required for numbers of samples in seconds.

ISSN: 2233-7857 IJFGCN

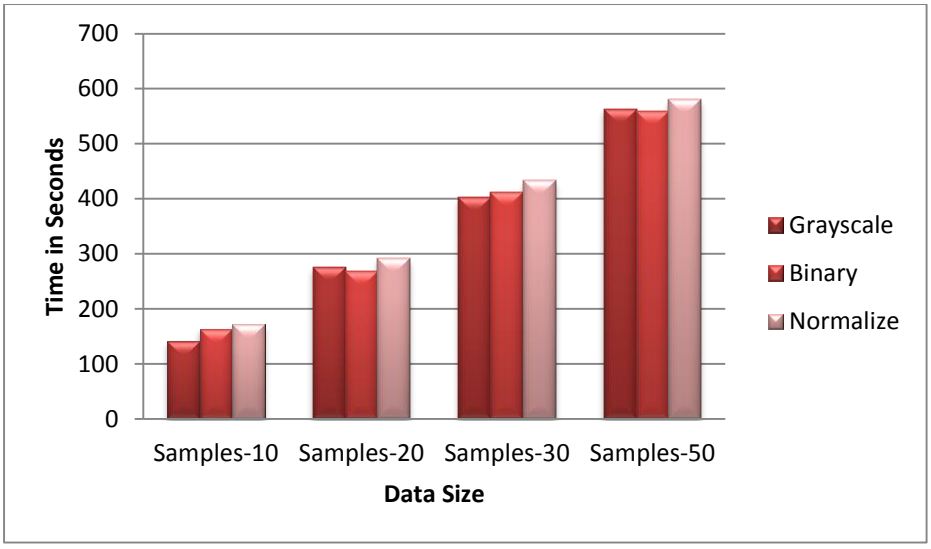

Figure 2 : Time required for preprocessing of different sample of images before training or testing

The above figure shows three different processes has been implemented on various sample sizes during the preprocessing phase. Once preprocessing has done those extracted normalized images passes to training to DCNN for generating the Background Knowledge (BK).

In Figure 3 shows future extraction has done with proposed DCNN algorithm, this algorithm extract the unique deep features and training classifiers with no. of defined convolutional layers.

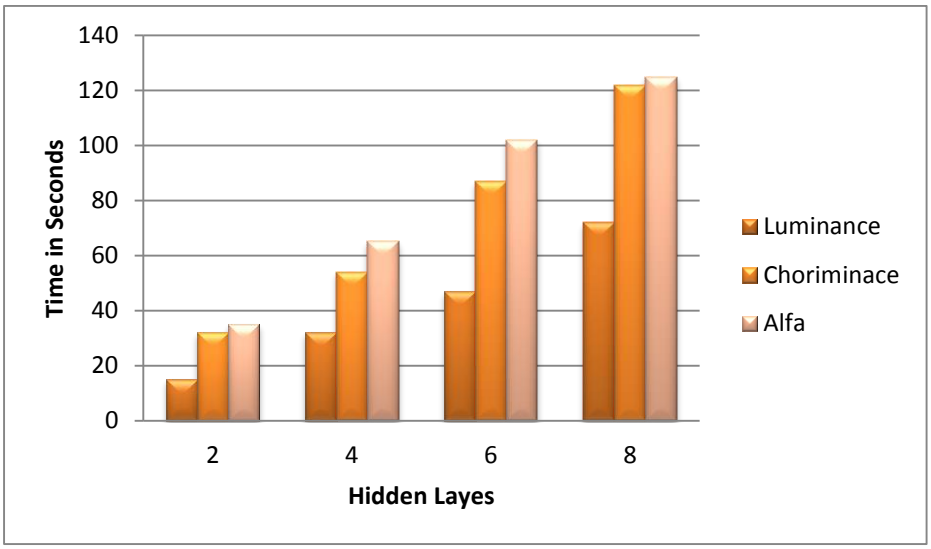

Figure 3 : Time required for extract various features using DCNN

The above figure 3 shows the effectiveness of algorithms with time flexibility provision with various features.

5 Research Contribution

To develop Moto system with various image feature extraction technique as well as different machine learning and deep learning algorithms. To detect the various kind of number plates like a multi-language support provide for recognition using deep learning approaches like DCNN algorithm.

ISSN: 2233-7857 IJFGCN

6 Applications

- Automatic number plate recognition using IoT and ML based applications.
- Number plate recognition for toll tax systems
- Number plate recognition for automated parking systems.

7 Conclusion

This work describes an automated license plate recognition system designed entirely around synthetic image-trained CNNs. To solve the additional problems of plate detection and character detection, a single CNN architecture is defined and tuned. The networks are trained on a virtual dataset to avoid annotating real images that are labor-intensive. We test our framework on a data set of real images taken with commodity imaging systems in natural light conditions. Our preliminary test results show that while the system is trained on purely synthetic images, the accuracy-recall efficiency can be exceeded. Automatic License plate recognition is a wide field that can be applied using a number of algorithms and techniques. Every approach has its own advantages and inconveniences. Our suggested approach initially conducts pre-processing steps including RGB conversion to grayscale, elimination of noise, and binarization of images. After that, the license plate is removed using Sobel's edge detection algorithms. The characters are then segmented using horizontal scanning provided as input to the CNN in order to recognize the character correctly. Training our system with ANN has made our system more reliable and efficient in order to recognize the characters correctly

- It is user friendly to use an automated toll collection system.
- It can reduce traffic congestion in toll areas, while preventing the loss of gasoline.
- All drawbacks of the current manual toll collection system such as time and human effort can be removed.
- No tag requires only the best quality camera.

Future Work

The system will automatically remove the toll from the customer's account. The same concept can be used to improve the program of car parking and safety. To subtract various fines, including chalan, drunken motorist, non-helmate holder, no seat belt, high speed vehicles, etc., the police department should be interested in this system in the future.

References

1 Soomro, Shoaib Rehman, Mohammad Arslan Javed, and Fahad Ahmed Memon. "Vehicle number recognition system for automatic toll tax collection." 2012 International Conference of Robotics and Artificial Intelligence. IEEE, 2012.

2 Saiyadi, Parviz. "Optimizing the vehicle plate recognition using the mathematical morphology." Journal of Basic and Applied Scientific Research (2012): 9044-9048.

3 Roy, Sourav, Amitava Choudhury, and Joydeep Mukherjee. "An approach towards detection of indian number plate from vehicle." International Journal of Innovative Technology and Exploring Engineering (IJITEE) 2.4 (2013): 241-244.

4 Chang, Shyang-Lih, et al. "Automatic license plate recognition." IEEE transactions on intelligent transportation systems 5.1 (2004): 42-53.

5 Shaikh, Sahil, et al. "A novel approach for automatic number plate recognition." 2013 International Conference on Intelligent Systems and Signal Processing (ISSP). IEEE, 2013.

6 Du, Shan, et al. "Automatic license plate recognition (ALPR): A state-of-the-art review." IEEE Transactions on circuits and systems for video technology 23.2 (2012): 311-325.

ISSN: 2233-7857 IJFGCN

7 Yuhai, Y., Hongfei, L., Meng, J., and Zhao, Z.: Visual and Textual Sentiment Analysis of a Microblog Using Deep Convolutional Neural Networks., Algorithms 9, pp. 2, 2016.
8 You, Q., Luo, J., Jin, H. and Yang, J.: Robust image sentiment analysis using progressively trained and domain transferred deep networks., In Twenty-ninth AAAI conference on artificial intelligence, 2015.
9 Yang, Y., Jia, J., Zhang, S., Wu, B., Chen, Q., Li, J. and Tang, J.: How do your friends on social media disclose your emotions?, In Proc. AAAI Conf. Artificial Intelligence AAAI, 2014.
10 Frome, A., Corrado, G., S., Shlens, J., Bengio, S., Dean, J., Ranzato, M., A., and Mikolov, T.: DeViSE: A deep visual-semantic embedding model, In Proc. Advances in Neural Information Processing Systems (NIPS), pp. 2121-2129, 2013.
11 Jindal, S., & Singh, S.: Image sentiment analysis using deep convolutional neural networks with domain specific fine tuning. In International Conference on Information Processing (ICIP), pp. 447-451. IEEE,2015.
12 Kunte, A., Panicker, S.: Using textual data for personality prediction: a machine learning approach. In International Conference on Information Systems and Computer Networks (ISCON),2019 (in press)
13 Mittal, N., Sharma, D., & Joshi, M. L.: Image Sentiment Analysis Using Deep Learning. In International Conference on Web Intelligence (WI),pp. 684-687. IEEE,2018
14 Kumar, A., & Jaiswal, A.: Image sentiment analysis using convolutional neural network. In International Conference on Intelligent Systems Design and Applications (ICISDA),pp. 464-473. Springer,2017

ISSN: 2233-7857 IJFGCN