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Analogical Study of Support Vector Machine (SVM) and Neural Network in Vehicle's Number Plate Detection

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Analogical Study of Support Vector Machine (SVM) and Neural Network in Vehicle's Number Plate Detection

Jyoti Kapasiya [α] & Vishal Jayaswal [σ]

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This thesis presents a training based approach for the recognition of vehicle number plate. The whole process has been divided into three stages i.e. capturing the image, plate localization and recognition of digits over the plate. The characteristics of HOG have been utilized for training and SVM has been used for adopted for classifying while recognizing. This algorithm has been checked for more than 100 pictures.

General Terms: ITS, NPR, SVM, ANN, ML.

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I. Introduction

At present, Indian vehicle registration number pattern starts with two characters representing state, followed by two digit code representing the transport office, followed by one or two character representing series of registration, followed by a four digit number indicating the serial number within the series like: UP15 EB 1234. Further, the registration scheme for union territory is slightly different. Union territory region registration number pattern has two characters region code, taken after by an arrangement code like 2M implying second arrangement for motorbikes and 14C connoting fourteenth arrangement for private autos and so forth.

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The union territory region registration patterns are like: DL 6C 2108. However, in India the size of number plate, font style and font sizes are not standardized. In some cases vehicles are frequently employed directly or indirectly in a wide variety of criminal and fraudulent activities. Conventional methods of investigation for involvement of vehicles in crimes and frauds is, either by deploying a very large police task force or aerial pursuit of criminals using helicopters, are largely cumbersome, expensive and ineffective. Further, the traditional system [1] of investigation depends on the human eye witness by law enforcers which is inadequate. In fact, in recent years, it is noticed growing reluctance or unwillingness by individuals to cooperate with the police for one or the other reason. Such a conventional system is an inefficient system and takes long time for investigation thus leading to cover the offence.

The development of Intelligent Transportation system has grown rapidly over the last two decades with the progress of the computer vision technologies. PC vision is the science and advancement of machines that see and get it. As an exploratory order, computer vision is apprehensive with the counterfeit frameworks that concentrate data from pictures and recordings. The picture information can take numerous structures, for example, video groupings, sees from different cameras and so forth. Computer vision is comprehended as a sub space of the computerized reasoning furthermore software engineering fields. Alternate ranges most firmly identified with computer vision are picture handling, picture examination and machine vision.

Major applications of computer vision are: Surveillance systems, Gestures understanding, Sign Language understanding, Face Recognition, Road Monitoring, Biometrics, Planetary Exploration, Industrial Inspection, Autonomous Driving, Robotic Control, Medicine, Docking, Military, Remote Sensing, Automatic perusing of information or data from archives, Objects Recognition and so on. The other important area of computer vision application is open for research is Automatic Reading of Number plates from vehicles. The need to comprehend the development of vehicles in our country's roadways is turning out to be more essential, since the development of cleared streets, confronted numerous issues with approaches to record vehicular

development. Not just this data is required for appropriate configuration of roadways; additionally new intelligent transportation systems (ITS) require constant learning of activity development to be successful. In the midst of current years, sharp transport frameworks are contained 16 sorts of advancements based systems. These systems are separated into savvy base frameworks and clever vehicle frameworks. PC vision and character acknowledgment calculations for Number Plate Recognition (NPR) Systems are utilized as centre modules for keen infrastructure frameworks like freeway, vehicle tracking, involvement in crimes, movement of suspicious vehicle, attack by terrorists, arterial management and electronic payment systems for traffic surveillance. NPR is one of the form of automatic vehicle identification. NPR utilizes picture handling techniques to recognize vehicles by their number plates. Presently vehicle plays a major role in transportation and requires an appropriate vehicle administration system.

II. Review of Literature

In this Paper [1] programmed distinguishing proof of vehicle turns out to be more functional in numerous applications with the quick improvement of an open transportation system. The system consequently recognizes a vehicle by perusing the number plate information from a picture or a video. The Automatic number plate recognition system is utilized distinguish the number plate under different perilous conditions like stormy, foggy climate impacts, low differentiation situations, objects like the number plate out of sight, and on a level plane tilted number plate. Diverse image processing methodologies, strategies, and calculations are utilized to construct programmed number plate recognition system technique to identify a number plate range from a picture or a video.

This paper [2] presents a training based approach for the recognition of vehicle number plate. The complete procedure has been segmented into 3 steps i.e. capturing the number plate's image, localization of plate and recognition of digits imprinted on the plate. HOG characteristics have been utilised for the purpose of training and SVM is deployed for the segmentation yielding in around 99% accuracy while recognising. The algorithm has been checked for more than 100 number plate pictures.

This work [3] developed completely unique methodology for the recognition of vehicle registration plate. The proposed method uses horizontal projection profile and Hough transform. Firstly, the extraction process of number plate from a given input image is located, then performed segmented the plate characters independently and applied template matching by using template data set for recognition of plate characters. Moreover, it is certain to be around 96% for the mining of plate area, 95% for partitioning optical character's recognition unit correct, producing the whole system performance better than the current system. The time taken to identify a plate, is between 5 and 15 seconds which is relatively lesser than existing taken time which is more than 30 sec. Apart from this, the location of the vehicle can be accurately traced in GPS enabled cars.

In this Paper [4],This research paper is deals with the topic of Automatic Number Plate Recognition (Identification)(ANPI) utilizing application of Android OS, as of now there is not any image processing tool available on the standard Android mobile phone that could do this job. So, ANPI using Android application gives so many merits like higher identification performance, less consumption of resources, and less computational difficulty. In early researches, many researchers have utilized a great quality computer and high camera with high resolution quality to deploy the ANPR [1] system. In this work, the improving the performance of ANPR algorithm on inadequate hardware of Android phone is shown. By optimization of ANPR, many merits could be attained, like; higher identification accuracy, less consumption of and less computing complexity.

In this research paper [5], we've discussed the photograph processing method to put into effect the computerized toll collection with a purpose to lessen congestion and fraudulent behaviour on the toll checkpoints. In addition we have mentioned the working of the proposed device together with the smart card implementation and the automated deduction of the toll from the car owner's bank account. The proposed system will assist in lessen the human intervention at the toll collection areas. The motive of this research paper was to improvise the toll series in addition to put into effect a gadget for smartcard users as clever playing cards is being utilized by many human beings with the intention to keep away from bodily coins.

In this paper [6], we propose an automatic and mechanized license and number plate recognition (LNPR) system which can extract the license plate number of the vehicles passing through a given location using image processing algorithms. No additional devices such as GPS or radio frequency identification (RFID) need to be installed for implementing the proposed system. Using special cameras, the system takes pictures from each passing vehicle and forwards the image to the computer for being processed by the LPR software. Plate recognition software uses different algorithms such as localization, orientation, normalization, segmentation and finally optical character recognition (OCR). The resulting data is applied to compare with the records on a database. Experimental results reveal that the presented system successfully detects and recognizes the vehicle number plate on real images. This system can also be used for security and traffic control.

In this Paper [7], the growing affluence of urban India has made the ownership of vehicles a necessity. This has resulted in an unexpected civic problem - that of traffic control and vehicle identification. Parking areas have become overstressed due to the growing numbers of vehicles on the roads today. The Automatic Number Plate Recognition System (ANPR) plays an important role in addressing these issues as its application ranges from parking admission to monitoring urban traffic and to tracking automobile thefts. There are numerous ANPR systems available today which are based on different methodologies. In this paper, we attempt to review the various techniques and their usage. The ANPR system has been implemented using template Matching and its accuracy was found to be 80.8% for Indian number plates.

With the growing number of vehicles, finding a car park is a serious issue today for a large number of students and faculty at Educational Institutions. Most of the car parks are managed manually by security guards who do not keep a track of the number of vehicles entering and exiting the premises. Hence, the vehicle driver have to keep circling the car park in order to find a vacant slot leading to a wastage of time, not to mention the anxiety and frustration of the driver. The absence of the security guards may also lead to vehicle thefts.

In this Paper [8], automatic Number Plate Recognition (ANPR) system is an important technique, used in Intelligent Transportation System. ANPR is an advanced machine vision technology used to identify vehicles by their number plates without direct human intervention. It is an important area of research due to its many applications. The development of Intelligent Transportation System (ITS) provides the data of vehicle numbers which can be used in follow up, analyses and monitoring. ANPR is important in the area of traffic problems, highway toll collection, borders and custom security, premises where high security is needed, like Parliament, Legislative Assembly, and so on. Real time NPR plays a major role in automatic monitoring of traffic rules and maintaining law enforcement on public roads. Since every vehicle carries a unique license plate, no external cards, tags or transmitters need to be recognizable, only license plate.

III. Basic Theory

One of the challenges in development of vehicle number plate recognition system is to outline models that work across a large variety of environments. A need for a model that detect, segment by combining features in real time is essentially required. Prior methodologies produced for discovery, division and acknowledgment of vehicle number plate experiences a few factors, for example, the division procedures not appropriate for constant applications and few issues like identification of perfect representation number plates, location of situated number plates are not tended to. These requirements in NPR (Number Plate Recognition) system motivated us to take up research in NPR system to explore few approaches/solutions required in building generic NPR system.

Toll booths in India generally employ a purely visual system of vehicle classification. However this causes a huge loss of revenue to the firms operating the tollbooths due to rampant malpractices and discrepancies. To keep a tab on the operators some tollbooths employ a system using fibre optic sensors to automatically classify a vehicle in the background and tally the results with the manual entries. However this system is expensive complicated and requires high maintenance. We aim to study the various systems that can be used to replace such a system with a cheaper and efficient alternative. To keep a tab on the operators some tollbooths employ a system using fibre optic sensors to automatically classify a vehicle in the background and tally the results with the manual entries. However this system is expensive complicated and requires high maintenance. We aim to study the various systems that can be used to replace such a system with a cheaper and efficient alternative.

However the social scenario in India is significantly different due to problems such as poverty, unemployment as well as a considerably lower respect for rules. This makes it unfeasible to go for a completely automatic tollbooth. The industry requires an automatic vehicle classification system in India not to reduce or eliminate human intervention or labour, but to ensure that human intervention does not cause any financial malpractices. The industry requires a system that runs in the background and merely keeps a cross-check on the manual.

As already stated, the system using fibre optics inherently possesses a large number of problems apart from the main concerns of high cost and maintenance. Although an IR curtain system reduces the cost significantly, it is still quite expensive and cheaper alternatives are desired. As almost all the tollbooths employ cameras for security purposes, it was felt that the feasibility of a system using IP cameras should be tested.

In most recent couple of years, ANPR or tag acknowledgment (LPR) has been one of the valuable methodologies for vehicle observation. It is can be connected at number of open spots for satisfying a portion of the reasons like movement wellbeing implementation, programmed toll content gathering [1], auto stop framework and Automatic vehicle stopping framework. ANPR calculations are for the most part separated in four stages:

i. Vehicle picture catching
ii. Number plate recognition

iii. Character division
iv. Character acknowledgment

The initial step i.e. to catch picture of vehicle looks simple yet it is very critical assignment as it is exceptionally hard to catch picture of moving vehicle continuously in such a way, to the point that none of the segment of vehicle particularly the vehicle number plate ought to be missed. By and by number plate discovery and acknowledgment preparing time is under 50 ms in numerous frameworks. The achievement of fourth step relies upon how second and third step can find vehicle number plate and separate each character. As there is the request of unmanned tag acknowledgment (LPR) framework, and the advancement of computerized cameras and machine vision calculations made conceivable programmed LPR. Clearly the programmed LPR framework ought to have couple of blunders. The framework is identified with verifications, making charges, and law authorizations which are not tolerant to blunders. Some LPR frameworks accomplished palatable correctnesses in limited conditions, and late examinations are endeavouring to expand the acknowledgment exactnesses and to decrease the confinements. Most programmed LPR frameworks comprise of tag confinement (LPL), character division (CS), and character acknowledgment (CR) modules as appeared in the figure given below.

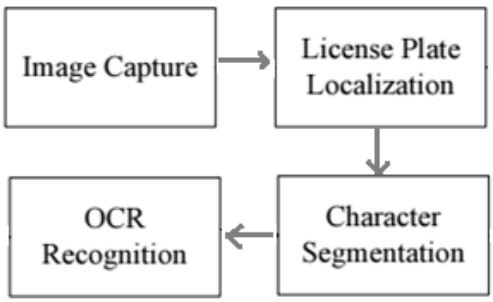

Fig. 1: Architecture of the License Plate Recognition system.

IV. Proposed Methodology

The proposed method replaces the traditional SVM with a more advance technique which incorporates the information provided by HOG Features with the computational power of Neural Networks.

The classifier is trained by using a 8-bit BMP image containing a list of alphabets. The alphabets are easily separated by computing their contours. Each position is assigned a label. The contours are fed to a HOG Descriptor which calculates its features. The new data and their labels are fed to a Neural Network. The network is expected to coverage before 5000 iterations.

One by one, images are feed to the model. The images must be cleaned before they are passed. First we need to identify the number plate inside the image. If there is no number plate, the algorithm waits. When a number plate is detected, its contours are detected and it is separated into different sections. HOG features of each section are computed separately and they are feed to the classifier one at a time. The final predictions by the model are printed.

In our approach the data is thoroughly tested and trained to perform and act better on various types of low or high quality images. These measures have been adopted to make this technique rigorous to work in better in every situation without comprising the quality of the results. The steps taken in testing and training are described below step by step in the upcoming text.

a) Testing

The image is captured of the vehicle and then after analysis takes place on that image to detect the number plate of that vehicle. After identifying number plate, contours of the segmented characters are detected. Later in this procedure HOG feature is calculated for each contour. Then after the characters of the number plate are predicted using classifier.

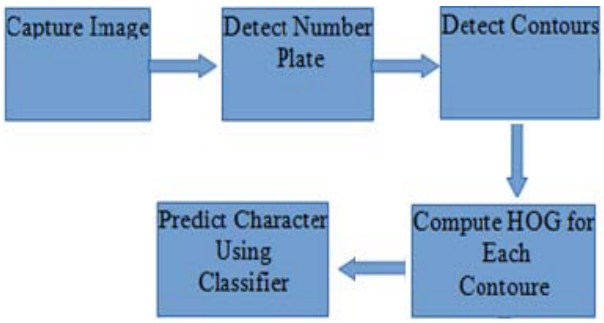

Fig. 2: Testing Procedure of Custom Neural Network Training.

The data is trained to act and work as it promises rigorously. First of all, in this process the image of the alphabet is loaded into the system later in this stage the contours of the characters are computed. Then-after the each contour is named. After labelling the each and every contour the HOG feature of all contours are computed. After calculating the HOG feature of each contour, the classifier is prepared to segment the character, using Neural Network.

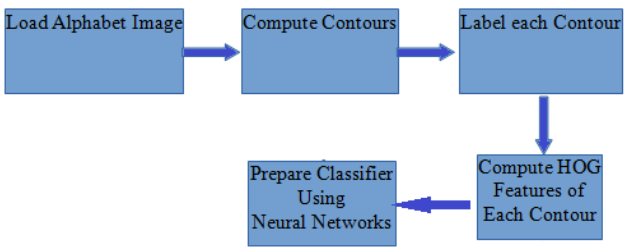

Fig. 3: Training Procedure of Custom Neural Network.

Neural network is parallel computing approach; this technique is used to provide the intelligence to a

computing device. The main aim is to produce a system to carry out several computing jobs faster than the classical systems. Neural network can be defined in easy terms as capability to learn, memorize and generalize, prompted research in algorithmic modelling of biological neural systems.

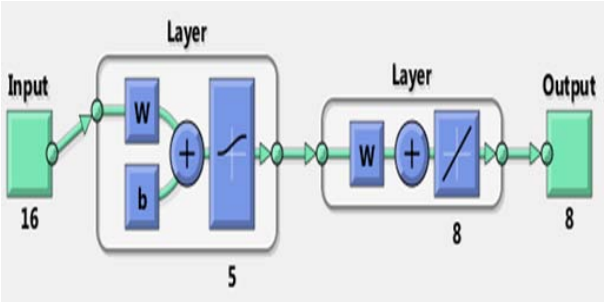

Fig. 4: Custom Neural Network of Proposed Method

Work Flow of Proposed Method.

- First of all the pre-processed images are fed into the system.
- The images that are converted from RGB to Greyscale images, then after normalization is applied for noise-removal; this is done for image enhancement and then these enhanced images are called pre-processed images.
- Plate region extraction takes place, in this step the image area other than number plate is discarded.
- After extracting the number plate region, the inversion of the localized plate is applied, after inversion of that region characters are appeared.
- Then-after segmentation is applied on each number and character to separate each and every number clearly.
- In this step HOG feature is extracted from segmented numbers and characters to properly recognise the number plate.
- Now, extracted features are recognized with the help of trained data.
- In this step, the characters are recognized with help of Neural Network, and the exact numbers are provided as output.
- Parameters i.e. Accuracy and Execution Time are calculated.
- These parameters are compared with existing SVM classifier, which proves that neural network technique is way better than SVM.s

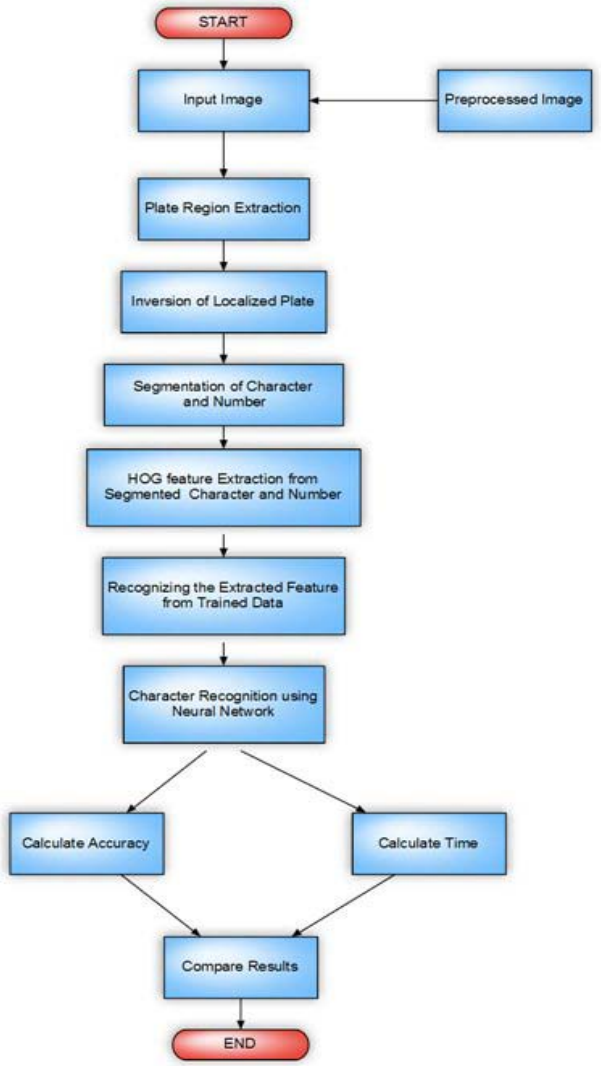

Fig. 5: Flowchart of Proposed Method.

V. Experimental Results

Several sample images have been utilized for this research procedure and to discover the outcomes. The information for image were extremely dimensional, and several attributes have been considered finally, on the basis of necessities. The image is tested using MATLAB and processed it with SVM Classifier and Artificial Neural Network one by one and outcomes are compared of both technologies.

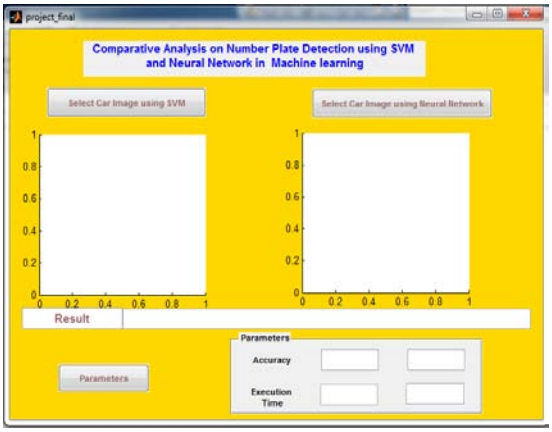

Fig. 6: GUI in Command Window.

This is command window to load, analyze and compare the results of images after running with SVM and ANN as well. Results are compared on 2 parameters accuracy of the result and total time taken to execute the image from start till end.

Fig. 7: Image after browsing with the SVM.

In the Figure 3, shown above, this is the preprocessed enhanced image which is browsed to detect the number plate with greyscale effect after that character and number will be segmented in separate images to detect the number plate recognition.

Fig. 8: Preporcessed Image after plate localization in SVM Classifier.

The above Fig 4, After the enhancement of the image only number and character are shown and all the part of image is blacked after that the only part of number plate is cropped.

Fig. 9: Cropped Image after plate localization.

After the contrast adjustment for number plate. The plate is cropped after that character and number are segmented in separate images to recognize the number plate.

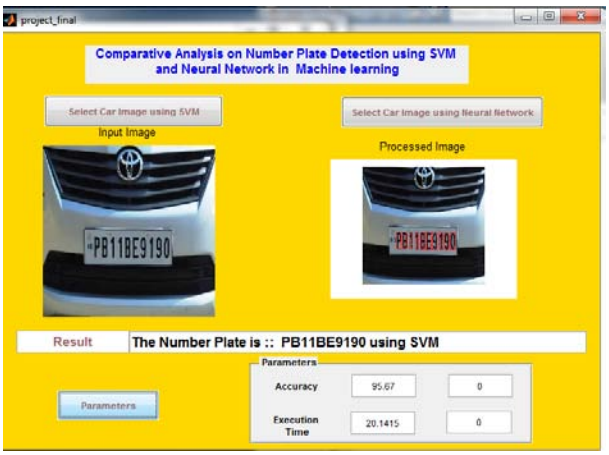

Fig. 10: GUI with results after detection of number plate using SVM.

In Fig 7, This is the GUI of code where we're running the code to detect the number plate after the running the first part of code which is using SVM classifier to recognize the number plate. The Result is showing that number plate is detected and also showing the processed image in which character and number are circled for recognition. And in this image parameter are showing in terms of accuracy and execution time. Accuracy is approximately 96% and execution time approximately 20 seconds. Now, we run the other part of the code for comparison.

Now we'll repeat the same procedure but this time the technology will be Neural Network with ML(Machine Learning).

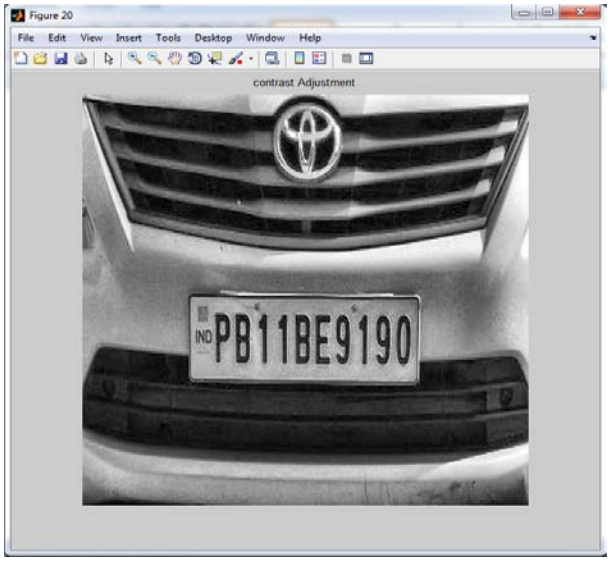

Fig.11: Histogram of Encrypted Image when after running Modified AES.

In the Figure 8, this is the preprocessed enhanced image which is browsed in proposed method to detect the number plate using neural network with greyscale effect after that character and number are segmented in separate images to detect the number plate recognition.

Fig.12: Preporcessed Image after plate localization in neural network.

Fig.13: Preporcessed Image after plate localization in neural network.

As shown in the Fig 4.11, After the contrast adjustment for number plate. The plate is cropped for neural network after that character and number are segmented in separate images to recognized the number plate.

After this the parameters of Neural networks were analysed and compared in terms of accuracy and time taken to execute the whole process.

Fig.14: GUI with results after detection using neural network.

This is GUI of code where we running the code to detect the number plate after the running the second part of code which is using neural network to recognize the number plate. The Result is showing that number plate is detected and also showing the processed image in which character and number are circled for recognition. And in this image parameter are showing in terms of accuracy and execution time. Accuracy is approximately 99% and execution time approximately 12 seconds. Now, it is obvious to say that neural network technique is better than SVM by analysing the above results.

a) Result

As it can be seen in the table 1 below and table 2 shown below that there is a big upgrading between both parameters. Neural Networks method is superior to the SVM technique as there is great improve in accuracy and total time taken to execute. In Neural Network method the execution time has been slashed by half. So it can be said that the Neural Network technique will give a huge improvement to the Image number plate detection technology.

Table 1: Analogy between SVM and ANN

Parameters	Using SVM Classifier	Using Neural Network
Accuracy	95.67 %	98.38 %
Execution time	20.141	11.9064

VI. Conclusion

Recognition of vehicles' number plate has always been in high demand as this technique is very vital to curb the incidents that were implemented by using car or motorbike. In this comparative study the two methods for plate recognition have been discussed so far. The two methods SVM and neural network some steps are common like pre-processing and normalization which are employed to improve the image quality to attain better and fast results. In neural network method, the method has been trained on more than 100 images so that the technique could work faster and accurate. The neural network method has been tested with several pictures, which resulted in good parameter factors.

Now this technique has begun to be used in some countries like- Germany, Canada and Dubai. And it helped them a lot to fight with rising graph of crime rate. This methodology has been applied at toll plazas to collect the toll fee, imposing the fine on people who violate the traffic rules or park their cars at an unauthorized space.

Although, many more researches are being done in this area but that are not up to the mark which could deal with real life problems. But this neural network technique is fulfilling the demands of real life situation, as it has been thoroughly tested and trained. The aim of this research is to deal with real life problems and deal with them without any hustle. Though, OCR is not a new technique but this research field is still not researched as it should have been. The benefits of this technique are enormous and can help to solve several problems if integrated with other techniques.

VII. Future Scope

The enhancements which can be introduced in this approach are – this analysis will be able to deal with videos and fast moving vehicles as well. As a future work of this approach the idea may be to enlarge suggested technique to include different language or to make this system language independent.

Following are the various possibilities which can be done in future.

1. This technique can be extended to be language independent character recognition system, as right now this system is working only with English alphabets and numbers. And we're working on the method which could identify Hindi language too.
2. Cursive character identification: There is great requirement for a recognition system which is capable of identifying cursive manuscripts and scripts as- Palm Leaves. Because this can actually avoid typing and font encoding as well.
3. Apart from this method can be made capable of recognising number from a live video.

Acknowledgement

This research has given me and in the coming future will helpful for each of us and all this could turn to reality with the help, assistance and direction provided by my guide, teachers and friends as well. The blessings and direction which enlighted my path, will give me motivation to take this research to the next level. I express my gratitude one and all who have been contributory in aiding me to finish this work.

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