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Classification & Detection of Vehicles using Deep Learning

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Abstract: The vehicle classification and detecting its license plate are important tasks in intelligent security and transportation systems. However, theexisting methods of vehicle classification and detection are highly complex which provides coarse-grained outcomesbecause of underfitting or overfitting of the model. Due toadvanced accomplishmentsof the Deep Learning, it was efficiently implemented to image classification and detection of objects. This proposed paper come up with a new approach which makes use of convolutional neural networks concept in Deep Learning.It consists of two steps: i) vehicle classification ii) vehicle license plate recognition. Numerous classicmodules of neural networks hadbeen implemented in training and testing the vehicle classification and detection of license plate model, such as CNN (convolutional neural networks), TensorFlow, and Tesseract-OCR. The suggestedtechnique candetermine the vehicle type, number plate and other alternative dataeffectively. This model provides security and log details regarding vehicles by using AI Surveillance. It guides the surveillance operators and assists human resources. With the help of the original dataset (training) and enriched dataset (testing), this customized model(algorithm) can achieve best outcomewith a standard accuracy of around 97.32% inclassification and detection of vehicles. By enlarging the quantity of the training dataset, the loss function and mislearning rate declines progressively. Therefore, this proposedmodelwhich uses DeepLearning hadbetterperformance and flexibility. When compared to outstandingtechniques in the strategicImage datasets, this deep learning modelscan gethigher competitor outcomes. Eventually, the proposed system suggests modern methods for advancementof the customized model and forecasts the progressivegrowth of deep learningperformance in the explorationof artificial intelligence (AI) &machine learning (ML) techniques.

Keywords: Convolutional neural network, Vehicle classification, Vehicle License plate Recognition, Deep Learning.

I. INTRODUCTION

Vehicle classification and detection have promising importance in the future. Because, it can be utilized in many aspects such as to analyze the urban traffic statistics, Advanced Driver Assistance System, againstvehicle robberies, broad parking guidance, against vehicle escape, advancementof the traffic routedataguidance, securitysurveillance systemof highway, automatic dataretrievingat toll gates, transportation service based enquiry and soon. The most unique functionsof recognizing objectsthrough theAI surveillance is to classify the customized objects present in the images. However, the vehicle classification and detecting its license plate still face a minor tremendous limitationdue to the statistic countof vehicle classesare higher and a fewfeatures of the vehicles are look-alike to classify them. So, the process of training the neural networksdesires an immense numberof features or attributes, which generally paves a way to underfitting & overfitting models.The outcomes of recognizing an object capable of getting an advanced degree ofconsiderable accuracy in the learning dataset, however a declineddegree of probabilityto get errors in the verifyingdataset.

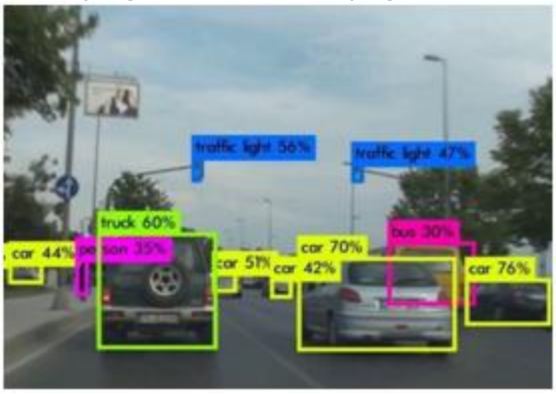

Fig 1: Classification of Vehicles

Inspite ofhavinglearning dataset asinsufficient in quantity to train the customized model, these deep neural networksthemselvesare unable to realize distinct changes of gradients while evaluating the prediction performance of theproposed modelbycorrelating true positive and false negativecaseswithalternativeearlier layers.These predominant motives for those existing models are due to limited enumerateddata inputs and lengthy processing period foralso these cramped networks.Because of Facing many practical problems, neural networks have been gradually integrated with theseadvanced techniques which come up in twenty-first century period, alike Convolutional Neural Networks, ResNet Architecture, TensorFlow. This typeof suggested models, which targetat contrasting tasks, distinctiveapproachesare frequentlydeveloped, and these are correspondinglyenforced tovariousstandards of human creativityskills.

In utmost cases, recognition of objectsis implemented using Feature extraction from CNN. License plate recognition uses Tesseract-OCR&detection of objectsis performed using Gradient descent functions. Eventually, theproposed modeltargetson classifying and recognizing the vehicles under any circumstances.

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Fig 2: License Plate Recognition

II. EXISTING SYSTEMS

The traditional methods of vehicle classification and detection are essentially based on the following methods: 1)Number Plate Recognition (NPR) method; 2) Feature matching and extractions using Scale Invariant Feature Transform (SIFT); 3) The traffic vehicle surveillance classification using SVM & HOG techniques; 4)TheGaussian mixture vehicle detection model. Based on these traditional methods, the neural network model gets lower recognition reference for detectingvehicle objects. So, these methods give the inaccurate results in which accuracy is limited to 85%only.

The above traditional algorithms have already obtained good results. Several shortcomings in the traditional methods have confinedtheir learning rate: 1)The unique view through front-wise, side-wise or backward of any images paves a way to unreliable prediction; 2) The immenseaffinityamongvehicle models obviouslyeffects the efficiency;3) These techniques frequently confide on such an images that are taken from particular coordinates; 4) A few vehicle models consists of only insufficient viewpointdataset. This proposed paper represents the abovespecified drawbacks and contributing fewschemeswhich are reliableforthe classification & detection operations.According to the above traditionaltechniques, this customized model or algorithm isstill optimized for the advanced outcomes of detection&classification algorithms. It applies these Deep learning (DL) Neural Networks algorithmfor classification and License plate detection of the vehicles and obtained a better recognition performance under different viewpoints or traffic conditions.

III. LITERATURESURVEY

[1] Chen, Z., Ellis, T., and Velastin, S. A., "Vehicle Type Categorization" A comparison of classification schemes In Intelligent transportation systems (ITSC), 14th international IEEEconference.

This Paper proposed the Vehicle detection and classification based on histogram of orientation gradients (HOG) approach which was presented by Zezhi Chen and Tim Ellis. This classifying activity is splitted into two tiny tasks: 1) Feature extraction;& 2) vehicle classifying prediction.

In this type of methodology, histograms of oriented gradients (differentiation) & the measurement build upon computedattributes are needed to implement the classifying operation of traffic vehicles into their prescribed classes:cars, college vans, bikes, trucks& buses.

For this classification model, they have used two classifiers.Those classifiers are coming under super-vised learning alike asSupport vector machines (hyperplane based) &Random Forest classifier (entropy based). Because of multi-classification complications, they taken a decision to utilize oneversus all methodology. With this approach, the betterthree-dimensionalcustomized model can be projected that helps to determinethe ground truth of vehicle type. But the attributesin-between these moving traffic vehicle classesare very typical to classify them. Mostlydesignsof some of the vehicles alike as car and trucks are being highly equivalent. This type of examples reveals that, these techniquesaretough to determine the vehicleclass type.

[2] Chang, S.-L., Chen, L.-S., Chung, Y.-C., and Chen, S.- W.,"Automatic license plate recognition" IEEE transactions on Intelligent TransportationSystems.

This paper proposed a license plate image technique consisting of two essentialtechniques: 1) Localization ofnumber plate region of a vehicle; &2) License number identification module. Specifically, the license plates croppedamong the localized vehicles are evaluated with ground truthforthe identification model to reduce the error rate. They used color edge detection to compute edgemaps.

But thisis limited toonly fourtypes of edges. By using the exclusivetheories, theseparameters of algorithmareconverted fromRGB mapping to HSIwhich represents the gray-scale colors as intensity, hue, saturationparameter values of an image pixels respectively.The identification module consists of two main stages, preprocessing and recognition. However, this identification model takes more time to recognize these characters and it is a complex process which needs to be modified. This model can detect theLicense plate, if and only if that license plate & charactersare inspecifiedcolor edges. This type of model can be usefulin a particularregion orplace.

[3] Farhat, A., Al-Zawqari, A., Al-Qahtani, A., Hommos, O.,Bensaali, F., Amira,A., and Zhai, X.,"Tesseract- OCRBased Feature Extraction and Template Matching Algorithms For Number Plate Recognition" In Industrial Informatics and Computer Systems(CIICS),International ConferenceonIEEE.

This kind of approach was developed by Farhatet. They have developed four algorithms for Numeric Automatic License Plate Recognition (ALPR) structure: 1) vector cross pattern;2) zone wise approach; 3) combination of zone &vector pattern; 4) correlating template technique. In these procedures somestrategies are built uponextracting attributes and thenlasting thing is applyingconfusion matrixfor computing correlation.By using vector crossing algorithm, they distinguished the ten characters (0−9) except the characters "2", "3" and "5".Since these characters have the same number of the vectors. By using Zoning method, contrast or intensityof the pictures are determined by these inline functions to recognize the numeric or alpha-characters or symbols

Possibly, next methodology was consolidation of two preceding techniques. By using this methodology, we can determine the intensity of pictures at their corresponding pixels. However, the recommended methodsare insufficient to computethedisturbance in the real-time images.

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This correlation indicates the linear relationship between each character with all other characters. Anyhow, the deficiencies of suchprocedures are very high.They can predict only ten numerical symbols and unable to predictthealpha-characters.
In case of adding extra templatesto the algorithms, the probability distribution curve of getting success is very low. Because of the equivalentalpha-numeric symbols, we are getting the equalintensities and same number of vectors for some of the symbols.

[4] Casey, R. G. and, E.,"A survey of methods and strategies incharacter segmentation", IEEE transactions on pattern evaluation and machineintelligence.

Lecolinet et al proposed a new algorithm for licenseplate identification. For faster detection of license plateregions, they developeda novel method called Sliding concentricsystems, which explains those irregularity presents in pictures that confide on error or probability statistics.
This detection of individual characterscomprises ofbelowtasks:1) The concentratedsystems likeX&Y weredesigned for the upper-left edge pixel valuesof an image; 2)Moderatequantityisattained from X & Y systems. Eventually, Region of interestis determined when the prediction of systems attains a signified weight.
Image masking, Binarization and correlations of the elementanalytic functions are executed in a particularorder. Conclusively, localization of number plate area is determined.
Whilenumber plate preprocessing period, thereis a creative strategy to cut and cropeach individual alpha-numeric symbols or patterns.
Eventually, the probabilitynetworksare implemented to predict the ground truth of alpha-numeric symbols in number plate.
Anyhow, this suggested scheme confides on illuminating specifications and reliable visibility ofthe number plates. In utmost cases, the trained algorithmunable to predict the localization of number plate because of the lightening or the quality of the plates.

IV. PROPOSED SYSTEM

This paper proposed an advanced vehicle classification and detection method based on deep neural networks. In this system, vehicle classification task is accomplished by Convolutional Neural Networks.
The vehicle region is segmented to discardthe unwanted disturbance to enhance the prediction of ground truthefficiency.
In this approach, theconvolutional neural network is used to accomplisheffective extraction of higher gradient features and to train the algorithm to learn with labeled traffic vehicle dataset of numerous road vehicles of specifiedtypes alike as bus, car, bike, bicycle.
As explained above, traffic vehiclescan be classified and able to determine vehicle classes from variousperspectives could becompleted.

Fig 3: Input Image to the Model

Besides, this paper also focuses on automatic detection of the vehicle License plates which can be accomplished by Tesseract- OCR (optical character recognition). It is used to recognize the characters and provides the text from the given image. So, the extracted License Plate is given to the tesseract-OCR which in return provides the characters of number plate for license plate recognition.

Fig 4: Output Image from Trained Model

Finally, this proposed model isevaluated based on selection efficiency, predictionefficiency& all realtime perfectionof the vehicle classification and detection process. While training the model for the detection of vehicle type and its number plate, the dataset must be split into train data and test data. The train and test data are statistically known as positive overlap range and negative overlap range respectively.
Thevehicle dataset is divided into 80:20 ratio for learning and verifying the prediction of the classification & detection operations of the deep learning algorithm. In this process, there will be twowell-known regions. They are: 1) negative overlap range region; & 2) positive overlap range region.The negative range parameteris the region where theoverall ratio of equivalent or overlapregion amongthe foreground, back-groundregions to vehicle or object labeled regions is less than 0.30.ThePositive Overlap Range parameter is the region where the overall ratio of equivalent or overlap region among theforeground, background regions to thevehicle or objectlabeled regionsis more than 0.07.The prediction performance of suggested model for detection and identificationof vehicles will be themaximum when compared to these traditional methods.

V. SYSTEMARCHITECTURE

The Schematic Diagram of recommended structure is represented as displayed below. ThisProposed block diagram is categorized into three parts. They are (i) System Framework, (ii) Software Requirements, (iii)Methodology

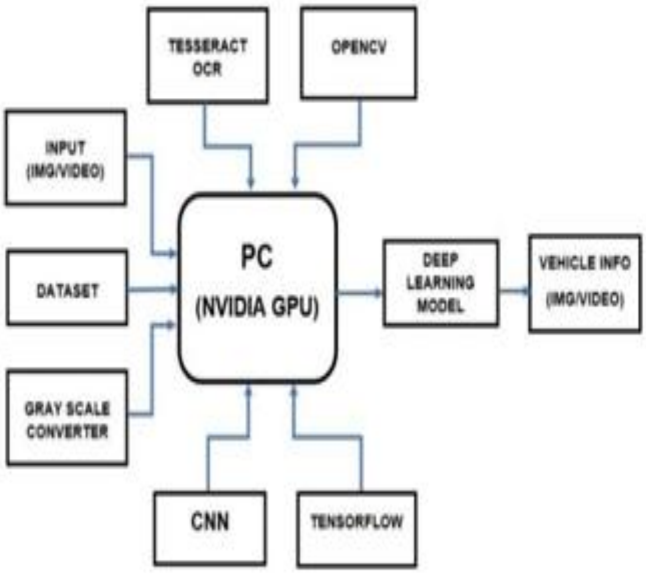

Fig 5: Block Diagram of Proposed System

A. SystemFramework

1. Vehicle classification& detectionconfided on Convolutional NeuralNetworks:

VehicleDetection:

In this system, picturesof the learning data are provided as the source which helps to determine the labeledregionof the requiredobjects alike vehicles by the convolutional neural networks (CNN). But there are some issues to build a deep learning model by using CNN. The first problem while training the deeper networks is, accuracy should be increased with an increasein depth until it attains the perfect gradient descent coefficients or weights which avoids under-fitting & over-fitting models.However, the drawbacks with the raising depth is the gradient coefficients of earlier learning layers can't be stored or saved to compare with further layers.Thus, the signs that wants to modify thosepre-trained coefficients which are attainedas final outcome ofthe algorithms by analyzingcorrect infowithattained outcomes.

This progressive analysis of model shows that, it is not necessary for learning origin-oriented layers. This is called a vanishing gradient. The other problem while training the deeper networks is, performing the improvementon enormousinput sources and then furtherconfiding bysummation ofall these layers which results in tremendouslearningfaults. This is called a degradation problem. In order to overcome these issues, Convolutional Neural Network uses ResNet Architecture to train the deepernetworks.

Currently, the suggested system adopted ResNet structure.This is an advanced structure which helps to avoidall gradient descent vanishing issues. The fundamental baseof this ResNet structure is a single Residual part. The ResNet structure as shown in Figure 6.

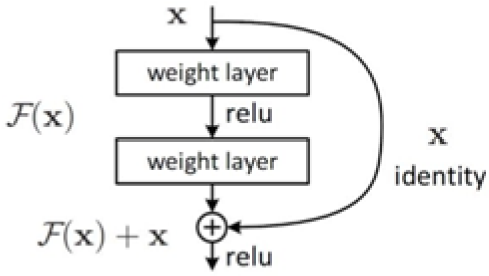

Fig 6: A Residual Block of Deep Residual Network

The proposed ResNet structure learns the functional mapping alike asy → F(y)+G(y), instead of learning the functional mapping as shown y → F(y). If the dimensional analysis of both sourcey& outcome F(y) is same, then the functional correlation can be represented as an identity function G(y) = y.Thus, this time savingassociation is well known asidentity connection. These identical functional mapsare trained by applying null to thosecoefficientsthat aresituated inmiddle layer whilelearning. Because of making out into zero is an effortlessapproach, instead of changing the coefficients to one.Else-if the dimensional analysis between source and outcome is different, then projection connection is employed.

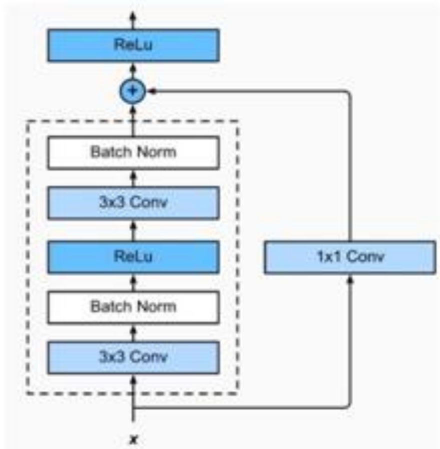

Fig 7: Projection connection of Residual Network

ResNet Architecture uses Rectified Linear Unit (ReLu) as an activation function of neural networks. This rectified Linear activation function is a piecewise linear function that gives the output as its input itself, if the input is positive. Otherwise, it gives output as zero if the input is negative. ReLu activation function reduces most large number of computations. It has become the default activation function for many types of neural networks because a model that uses ReLu is easier to train and often achieves better performance.The ReLu activation function is given as shown below.

$$F(x) = \begin{cases} X & \text{if } x > 0 \\ 0 & \text{if } x \leq 0 \end{cases} \quad \text{for all } x \in R$$

By using ReLU as an activationoperationwithout using it asformer function, then the statistics can be made clearforleading Progress. It is used to determine the inversecoefficients as gradients by making use ofthose partially computeddifferential functions. This evenprevents the suggests model from those complicated processing techniques alike as integrating& exponential functions.

In thoseintermediate layers whereneurons havingoutcomelesser than zero are removed to enlarge the deficiency and reduces the overfitting effect. The ResNet network structure isadjusted while verifying data and thedeterminedtraffic vehiclesregion is displayed as belowinFigure8.

Fig 8: Vehicle Detection

VehicleClassification:

The front-wise leading vehicle region is attained by detecting model of vehicles. Then the detected road vehicles should be recognized by making use of these convolutional neural networks. for vehicle recognition. This deep learning technique such as CNN utilizescustomized count of convoluted kernels for sliding over the sourcepictures with a prescribed valueof matrix to retrievethe attributes in that convoluted layers.

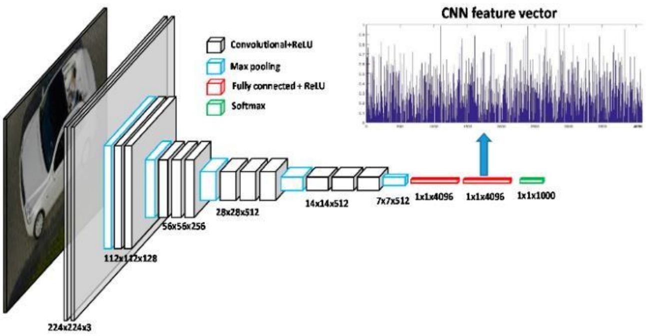

Fig 9: CNN Architecture

These retrievedattribute maps are provided to lower convolutedlayers. Therefore, theseprevious trainedlayers utilize a particularcount of those kernels to get those selectedattributesof top featuring maps.These tasks are very repetitive in this CNN approach to get maximum reduction of pixels for source images. This reduced pixel image is further computed for effective gradient coefficients. Finally obtained input weights helps the fully connected layer to perform the classifierfunction of vehicles.

By usingthis techniqueof (DL) neural networks, the attributes neglected by thoseexistingapproachescould beretrieved successfully. Therefore, the predictionperformanceisobviously increased to a significant value. Additionally, by computingvarious convoluted kernels for an input image helps to attain convolutedattributevisuals, as displayedin Fig 10. This ResNet architecture is almost equivalent to VggNet structure which containsutmostkernel specifications as three by threekernels.

Fig 10: Feature Map of Convolution Layer

Thus, by using this VggNet structure, the alternative shorternetwork is established to design a residual network. In order to overcome the issues such as vanishing gradient and degradation problems of the deep learning model which occurs during training the model.

2. Tensorflow:

TensorFlow is a library or module which is imported to learning algorithms to compute and understand the data analytic graphs to create several functions of the model.TensorFlow supports theprogrammers to buildhigher level networks with multi layers. This library is a neural network module which is primarily employed for thepredicting, analyzing, Classifying, finding, and Creative skills.

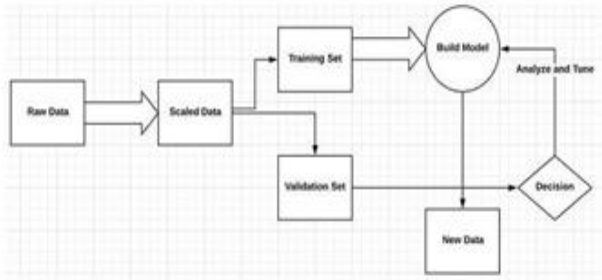

Fig 11: TensorFlow Architecture

TensorFlow architecture works in three parts. They are (i) Preprocessing the data, (ii) Build the model, (iii) To train and test a model. Initially, the raw data is scaled by normalizing the input and output features of a model. This preprocessed data splits into train and test dataset. This Building model is trained using train dataset. By analyzing the prediction performance of verifying datasetwith comparision of correct data, loss function of a model can be analyzed and tuned with hyper parameters. TensorFlow is usedfor fast numerical computations of neural networks. It is a foundation library that can be used to provide Deep Learning algorithmsprobablyby utilizingmodules alike as wrapping toshorten thecomplexity of model.

3. OPENCV:

OpenCV is also known as Open Source Computer vision. It is a cross-platform library of programming functions which mainly aims to develop the real-time computer vision applications. OpenCV was developed by Intel organization.This mainly focuses on image processing, video capture and analysis which include features such as face detection and object detection.

It supports some models from deep learning frameworks such as tensor-flow, Tesseract-OCR, PyTorch modules to build an effectivemodel.
The Integration of the OpenCV with the Tesseract-OCRhelps to extract the characters even from colored images with higher accuracy.

B. Softwarerequirements

1. TESSERACT-OCR:

The Character Recognition popularly referred as Optical Character Recognition (OCR). Tesseract-OCR is the software process of converting typed orhandwritten alpha-numeric documentsto assembly languageencrypteddocumentwhich could be accessed&manipulatedas a string (character array) data. This tesseract approachis one of the advanced and scope oriented research in the alpha-numeric symbols recognition.The OCRtechnique is functioning alike a classifier which is classifying 36 characters and definite symbols. To perform classifying function, visual attributes should be extracted from those input localizations of number plate images.Eventually, the alpha-numeric symbolscould be recognizedby using such attribute extractions using machine learning.So, thisis an advanced approach to deal with image to text operation with utmost possible perfection.

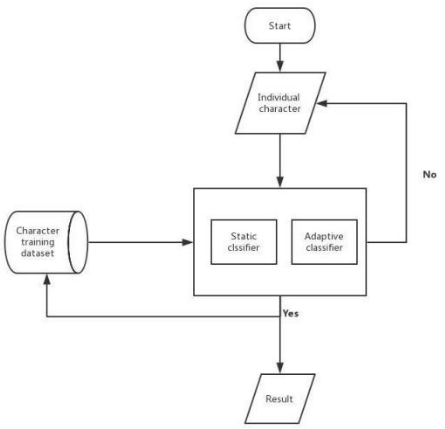

Fig 12: Flowchart of Tesseract-OCR Process

Alike as certain existing approaches, the imagepre-processing proceeds through one after onemethodology. The primary significant operation such as recognition which is divided into stages: 1) classifying adoption; 2) repetitive prediction of characters. By performing primary technique, everyalpha-numeric symbolis segmented & predicted in an order. In addition to this,those classified symbols and saved by the primary classifier symbolas the learning data.This classifierlearnsthe dataand distinguishes those symbols.Whenthe symbolsare unpredictablein the primary stage, there is an automatic repetition function to undergo classification again. This dual stepapproachmakes use of these methods to gethigher perfection andefficient model.

2. LabelIMG:

The Labelimg tool is apicture annotatingsoftware. This isinterfaced with programming languages and utilizes Qt for the user interface graphically. All these learning & verifying annotating labels are stored as extensible markup languagemedia files in a VOC (PASCAL) type specifications which is employed by ImageNet.Image Annotation could bethe process of building datasets for computer vision models. This helps machines to learn, how to automatically assign metadata into a digital image using captioning or keywords. This Labelimg tool is used to train our customizedmodel.
This technique is used for image retrieval systems to organize and easily locate particular images from a database. Labeling an images or picturesprovides the coordinates of the vehicle objects present inpictures. By using application program interface, there providesa finite number of entities which areused to determine or predict objects alike asplaces, living objects, activities, non-living objects, and so on. Every trainedlabel will be detected additionally with a score that indicates the probability orperfection of ML model according to itsrelevance.

3. ANACONDANAVIGATOR:

Anaconda Navigator is usedto launch applications and to manage conda packages, virtual environments, and programs without the use ofcommandline commands. In order to get theNavigator, download the Navigator Cheat Sheet and install Anaconda. It is a free open-source software which is associated with Python and R programming languages for scientific computing such as for data science, machine learning applications, large scale data processing, predictive analytics and so on. It aims to simplify package management and deployment.
Jupyter Notebook is a one of the IDE which have to be launched from the Anaconda Navigator to develop, execute, and debug the algorithms which performs Artificial intelligence tasks. It's easy to interface with artificial intelligence modules and python integrated development environment. Because, it helps to debug the errors by specifying the type of error that wasobtained.

C. Methodology

1. Data Collection& Datapreparation:

In this Project, dataset is prepared by the collection of vehicle images from Open source, CCTV cameras and from real time media. All these various sources of datasets or media like images & videos are utilized to teach and train the algorithm.Those datasets are retrieved under various views. This ensures that angle of surveillance will not affect the performance of the customized model under any traffic circumstances. Additionally, the disturbance present in the pictures are removed. The resultant picture of noise reduction process is provided to predict the vehicle identical details. The retrieved vehicle details are appended to document or log where the all vehicles data are going to be added when the vehicles pass through the gateway.
This involves data preprocessing, data analytics, data scaling to predefined pixels resolution. The sources for the dataset are collected by making use of a surveillancewith an auto-iris preprocessing method. It remains every image to a mean and constant illuminating value.Even it utilizes i-LIDS as a learning dataset which provides official videos of traffic vehicles of our society.

2. Edgedetection:

An edge based multi-stage detection is the main primary function to detect the vehicle and its license plate edges at their localization.

In this paper, license plate edges are detected from its real time picture withby determining their edges of the object.Locating the number plate regionis obviouslyaadvanced level functional work because of, those important changes present in thenumber plate illuminations, regions, colors, dimensions, noise levelspecificationsand partialorientedplatesand other defects and so on. So, three steps are employed at the preprocessing stage. They are (i) Gray Scale Conversion, (ii) Median Filtering, (iii) Contrast Enhancement.

Gray ScalingConversions:

By applying given formulation, the twenty-four-bitnon-gray scaled pictures are converted aseight bit gray-scalingimages.

Gray-scaling =(59%) ×R + (30%) ×G+ (11%) ×B

MediansFilter:

This computes the medians of gray-scalingspecifications of a pixel to their adjacent. This replaces the neighboring pixels values of a kernel to median values.Thisfilteringcanget rid ofdisturbancefrom the pictures.

ContrastingEnhancements:

Theequivalent histogrampattern is utilizedto modify and enhance thebright & contrasting ofpictures. The sum of pixels is N.The countof gray-scalingpixels n_k. The stretch grayscalingS_k is computedbygivenformulation.

S_k =

3. Functionalprocess:

This paper proposed an advanced vehicle classification and determined techniques confidedon deep learning approach. Here surveillance cameras are used for observing the vehicles at any specific region or area. These surveillance cameras are often connected to the Personal Computer (PC) or any recording device to provide those vehicle images or videos which are passing through that specific gateway or area. This vehicle data is taken as input to the Personal Computer (PC).

By using the i-Lids, real time camera and open source data a dataset is created. With the help of this dataset, the Deep Learning model is trained up- to a specified epoch. With the Increase of number of epochs, the loss function of the model is reduced. Finally, the trained model is tested with the new vehicle data to check whether the model is working effectively in vehicle classification and detection of their numberplates.

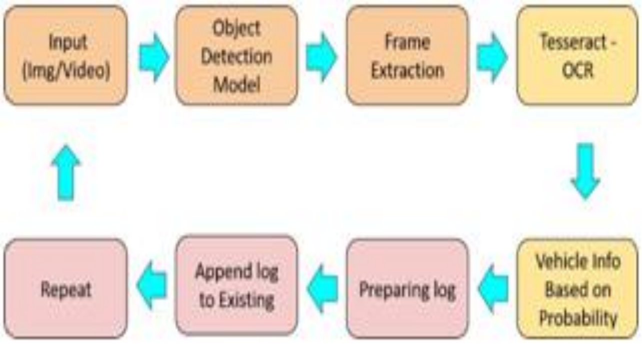

Fig 13: Functional Process of Proposed Scheme

In this system, Vehicle classification method is confidedon a CNN& automatic license plate recognitionof vehicles method is based on Tesseract-ocr. This Deep neural network model will detect the vehicle from the given image or video by using frame extraction.It also provides the classified type of vehicle whether it is bus or bike or bicycle or any othertype.

The model will detect the vehicle number plate if and only if there is number plate for that detected vehicle. The detected vehicle number plate is extracted as an image from the given data and simultaneously given to the Tesseract-OCR which is integrated with the OpenCV to recognize the characters present in that number plate.

The model will be instructed to detect and classify the vehicles, only when their detection probability is more than 0.90. This Probability approach will be useful to get the accurate vehicle info or effective results of the model. A log is created in the PC, to note the details of the vehicles.

This Info includes type of vehicle, its number plate and other info like time in & time out are tabulated accurately in the log. Every vehicle info is appended to its log. Finally, this model provides the accurate info of log regarding the vehicles that are passed through this Artificial IntelligenceSurveillance.

VI. FLOWCHART

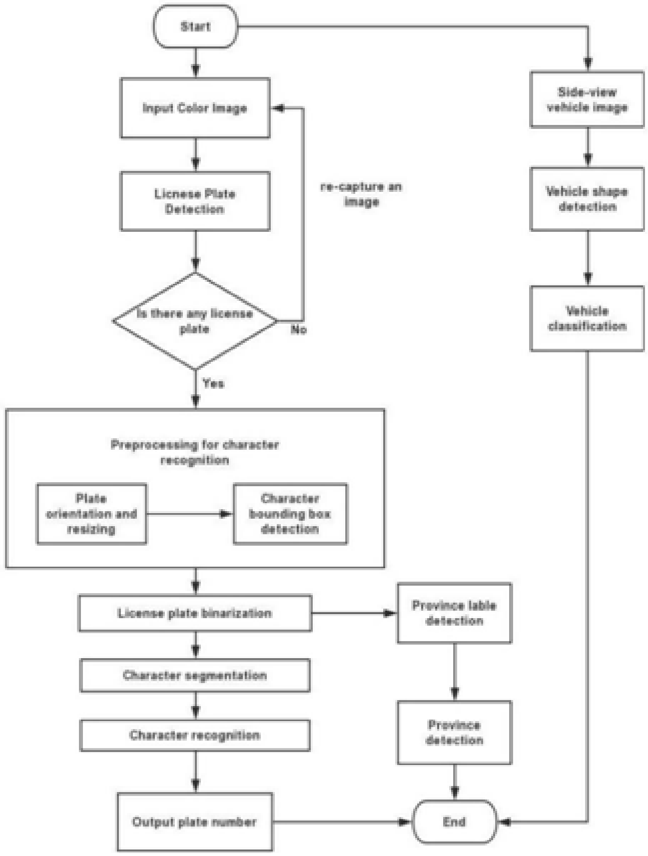

Fig 14: Flow Diagram of Suggested Process

Thisgiven flow Diagram of suggestedprocessillustrates procedure and sequence of Framework as shown above in figure 14.

VII. EVALUATION &DISCUSSION

For evaluating the proposed or implemented model, the perfectionofrecommended methodology is correlatedwith eachtraditionalarchitecture such as Vggnet-16, Resnet-50, Alexnet, Vggnet-19, Googlenet, Resnet-101.

After analyzingsignificantlearning&verifyingprediction outcomes, each accuracy of various CNN structures are compared with each other. Currently,proposed system uses ResNet101 architecture to train and test the deep learning Algorithm for vehicle classification and detection.The accuracy for different network architectures shownbelow.

$$CR(\%)=\frac{CN\ (correct)}{TN(\ CN\ (correct) + EN\ (error)\ )}$$

By applying above formulations where CN represents ascount of perfect predicted pictures& EN representsascount of imperfectpredicted pictures whichsigns the perfect analytic rate.

For analyzing prediction outcomes of distinct network structure outcomes, they are displayed as graphical representations of them as given below.

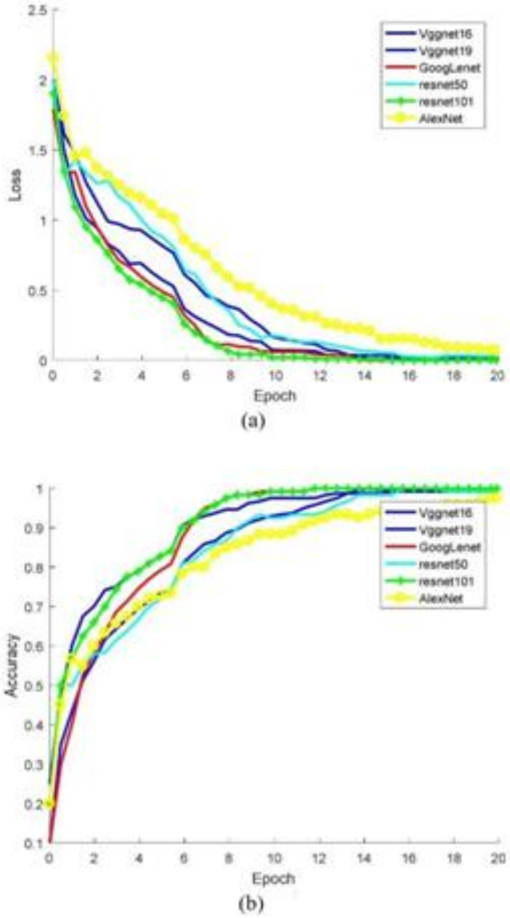

Fig 15 (a) lossy functionanalysis; (b) accuracyanalysis

A dataset with3500 pictures is collected and preprocessed with auto-iris functionwhich are utilized to analyze the learntalgorithms. The lossy function& perfection rateanalysis of each CNN network structure are convenient to figure outlearning procedure of each networkalgorithm. Because of this analysis, it's confirmed that Resnet-101 network structureis providingbetter flexibility& bestperformance as displayed in Figure 15.

Table 1: Comparison of Network Structures

Architecture	Accuracy	Year
AlexNet	82.6	2012
Inception-V1	88.4	2013
VGG	90.8	2014
ResNet-50	92.3	2016
ResNet-101	95.2	2018

Thisrecommended Resnet-101 architecture model is enforced to the real-time traffic which is learnt by picture dataset. Eventually, real-time traffic data is verified.

In this verification, it is observed that for prediction of real-time data, the learning dataset gets thebestperfection.

The perfection of experimentationoutcomesattained from thoselearning&verifying datais displayedas given tabulation. The figure 15 shows that, Resnet Network structure gives the higher accuracy for object detection and classification than the other network structures. By analyzing the testing performance with different number of layers in ResNet structure, it states that ResNet101 CNN network which achieves 95.27%.

VIII. RESULTS

Most probably, the experimentationoutcomes of suggested system have obtained with higher accuracy.The proposed technique had combined various techniques such as extracting features, generating boundary frames of vehicles, linear regression (ML) analysis,prediction of object type andLicense plate recognitionto provide a customized efficient model. By using this model, we can retrieve the vehicle info accurately. Even if there is background noise in the licenseplate, it will not degrade the perfection rate of the prediction. So, this customized model capable ofrecognizing all thosealpha-numeric symbolspresent on number plate accurately. Thus, comprehensive performance has been greatly improved. When compared to existing models, the current deep learning vehicle classification and detection neural network model has the rate of accuracy as very high. Therefore, the proposed model gives standard results.

IX. CONCLUSION

Based on CNN, this paper proposed the vehicle typeclassification and license plate recognition in urban traffic video surveillance. This Deep Learning model can do both Classification and Detection of vehicles simultaneously.This reduces the complexity of the processing which helps to increment the perfection rateof the trained algorithms to train & test the model. With the incrementof learningdata, the features & gradients will be updated. And ineffective algorithms are discarded and exchanges with effective algorithms. Therecommended advancementsmake the modelmore efficient and evaluated by appropriate experimentations. These experimentation outcomes proven that prediction rate of vehicle details isobviously incremented. Acomparative analysis, this vehicle classification & detection framework can get high accuracy with success rates which has been proposed to expose in a better performance than existingframeworks.

X. FUTUREWORK

In the future, we will implement this proposed model as a real-time hardware applicationwitha deep learning Framework which further improves the accuracy and robustness for the traffic vehicleclassification and detection.

In addition to this, there is little works which must be completed in the future such as creating user environment. This facilitates the user to utilize this project in a simplified way by creating templates with HTML, CSS, JAVASCRIPT frameworks.

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