TRAFFIC ACCIDENT RISK PREDICTOR

A PROJECT REPORT

Submitted in partial fulfillment of the requirements for the award of the degree of

Bachelor of Technology

in

COMPUTER SCIENCE AND ENGINEERING

BY

SAI KUMAR SILAPARASETTI
(17331A05F5)

PSV SARATH KUMAR
(17331A05C3)

PRATHIBHA YANDAVA
(17331A05H4)

VADIGINTI RAJU
(17331A05G9)

Under the Supervision of
Dr. B SRINIVAS
Associate Professor

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
MVGR COLLEGE OF ENGINEERING (Autonomous)
VIZIANAGARAM-535005, AP (INDIA)
(Accredited by NBA, NAAC, and Permanently Affiliated to Jawaharlal Nehru Technological University Kakinada)

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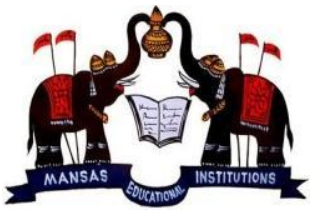
Maharaj Vijayaram Gajapathi Raj (MVGR) College of Engineering
(Autonomous)
Vizianagaram

CERTIFICATE



This is to certify that the project report entitled "**TRAFFIC ACCIDENT RISK PREDICTOR**" being submitted by **SAI KUMAR SILAPARASETTI, PSV SARATH KUMAR, PRATHIBA YANDAVA AND VADIGINTI RAJU** bearing registered numbers **17331A05F5, 17331A05C3, 17331A05H4, 17331A05G9** respectively, in partial fulfillment for the award of the degree of "**Bachelor of Technology" in Computer Science and Engineering** is a record of bonafide work done by them under my supervision during the academic year 2020-2021.

HOD CSE

Supervisor

Dr. B SRINIVAS
Associate Professor

External Examiner

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ABSTRACT

With the rapid development of urbanization, the boom of vehicle numbers has resulted in serious traffic accidents, which led to casualties and huge economic losses. The ability to predict the risk of traffic accidents is important in the prevention of the occurrence of accidents and to reduce the damages caused by accidents in a proactive way. However, traffic accident risk prediction with high spatiotemporal resolution is difficult, mainly due to the complex traffic environment, human behavior, and lack of real-time traffic-related data.

In this project we developed a system that predicts the risk of an accident occurring ,using a camera attached to capture live video of vehicles on road while driving and this video is processed in the software and licence plate number(vehicle registration number) of the vehicle is passed as a URL to check the challans recorded on the vehicle. We took the risk factors in the challan information and used it to assess the risk of the accident that can happen due to that vehicle and warn the user .

CONTENTS

List of Abbreviations

ML - Machine Learning

KNN - k-nearest neighbors' algorithm

OCR - Optical Character Recognition

OpenCV - Open Source Computer Vision Library

R-CNN - Region-based Convolutional Neural Network

VGG - Visual Geometry Group

RNN - Recurrent Neural Network

PNN - Probabilistic Neural Network

ROC - Receiver Operating Characteristic

ALPR - Automatic License Plate Recognition

LPLM - License Plate Localisation Module

MNS - Multimodal Neighbourhood Signature

DCNN - Deep Convolutional Neural Network

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CHAPTER-1

INTRODUCTION

1.1 About road accidents in India:

With only 1 per cent of the world's vehicles, India accounts for 11 per cent of global deaths in road accidents, the highest in the world, according to a report by the World Bank. The country accounts for about 4.5 lakh road crashes per annum, in which 1.5 lakh people die. There are many reasons for occurance of a road accident like over speeding, drunken driving, distractions to driver, red light jumping, avoiding safety gears like seat belts and helmets, non-adherence to lane driving and overtaking in wrong manner. Even Though the government is taking many actions in order to avoid road accidents, they are still out of control, so it is our responsibility to be careful while driving.

1.2 Problem Statement:

Traffic accidents are one of the major causes of death globally, cutting short millions of lives per year. They are creating unfillable void in the lives of my people throughout the world. Therefore, designing a system that can predict the occurrence of traffic accidents before inhand can potentially help the users to make decisions that help them to avoid accidents.

1.3 Objective:

In recent years, the demand for road traffic has continued to increase, but the casualties and economic losses caused by traffic accidents have also remained high.Accidents don't arise in a purely stochastic manner, their occurrence is influenced by a multitude of factors such as drivers physical conditions, car types, driving speed, traffic condition, road structure and

weather. Studying historical accident records and vehicle challan information would help us understand the (potentially causative) relationships between these factors and road accidents, which would in turn allow us to build an accident predictor. So our system predicts the probability of occurrence of a road accident in advance and warns the user based on the predicted result so that the user can take the necessary precautions to avoid the accident.

CHAPTER-2

LITERATURE SURVEY

There is a significant growing interest in the field of traffic accident risk prediction. There are many approaches in risk prediction. Most of them are machine learning models that are trained with historical data available. Different models have taken different parameters into consideration. Apart from these ML models there are other approaches also proposed based on real time scenarios. Every approach has its own set of parameters taken into consideration in order to predict the risk. Apart from different risk prediction studies the below literature survey also includes different vehicle number plate recognition methodologies.

H. Ren, Y. Song, J. Wang, Y. Hu and J. Lei (2018) Time-of-flight (TOF) detector systems based on plastic scintillation counters have been very powerful tools for particle identification in collider detectors.

With the rapid development of urbanization, the boom of vehicle numbers has resulted in serious traffic accidents, which led to casualties and huge economic losses. The ability to predict the risk of traffic accidents is important in the prevention of the occurrence of accidents and to reduce the damages caused by accidents in a proactive way. However, traffic accident risk prediction with high spatiotemporal resolution is difficult, mainly due to the complex traffic environment, human behavior, and lack of real-time traffic-related data. Based on the quantitative analysis of big traffic accident data, this paper first introduced an important characteristic of traffic accidents - the spatiotemporal correlation, and then constructed a high accurate deep learning model for traffic accident risk prediction based on spatiotemporal correlation pattern. The predictive accident risk can be potentially applied to the traffic accident warning system. The proposed method can be integrated into an

intelligent traffic control system toward a more reasonable traffic prediction and command organization.

Chandan R , Veena M (2020) proposed a mechanism for Vehicle Number Identification using Machine Learning & OPENCV.The proposed system involves five steps Pre-processing ,Gaussian filtering,Character Segmentation,License plate detection and Character recognition .For character recognition authors used KNN classifier.

Surveillance is important in most of the applications. Vehicle number plate detection is the major part of traffic surveillance. The detection of number plates has become more challenging and interesting in the past few years. The most challenging part of number plate detection is the varying size, shape and font styles of the number plates. The interesting part of number plate detection is its use in security applications. This project proposes a method to detect the vehicle number plate using methods like edge detection and morphological operations. The approach is performed in five steps. The First step is image acquisition which captures the image scene using a camera. Next step is preprocessing which involves conversion of an image to a different model and noise reduction. The next step is license plate detection which involves use of various edge detection algorithms. The final two steps are character recognition and character matching which involves knn classifier and finally the characters are compared with test samples and matched.

Ravi Kiran Varma P , Srikanth Ganta(2019) proposed a A Novel Method for Indian Vehicle Registration Number Plate Detection and Recognition using Image Processing Techniques.The proposed methodology consisting of three major phases viz., pre-processing, detection, and recognition.

Number Plate recognition, also called License Plate realization or recognition using image processing methods is a potential research area in smart cities and Internet of Things. Many of the existing automated number plate recognition systems work only in a controlled environment where images are captured from a straight angle with good illumination, clarity

and standard fonts. Another drawback of existing works is that they are based on UK number plates and may not suit for Indian number plates. This paper presents a novel image processing system for Indian number plate detection and recognition that can deal with noisy, low illuminated, cross angled, non-standard font number plates. This work employs several image processing techniques such as morphological transformation, Gaussian smoothing, and Gaussian thresholding in the pre-processing stage. Next, for number plate segmentation, contours are applied by border following and contours are filtered based on character dimensions and spatial localization. Finally, after the region of interest filtering and de-skewing, the K-nearest neighbor algorithm is used for character recognition. The proposed methods demonstrated promising results.

Ragini Bhat ,Bijender Mehandia(2014) proposed a method for recognition of vehicle number plate using MATLAB .At first plate location is extracted using morphological operation then separated the plate characters individually by segmentation.Finally template matching is applied with the use of correlation for recognition of plate characters.

Basically video surveillance systems are used for security purposes as well as monitoring systems. But Detection of moving objects is a challenging part of video surveillance. Video surveillance systems are used for Home security, Military applications, Banking /ATM security, Traffic monitoring etc. Nowadays due to decreasing costs of high quality video surveillance systems, human activity detection and tracking has become increasingly practical. Accordingly, automated systems have been designed for numerous detection tasks, but the task of detecting illegally parked vehicles have been left largely to the human operators of surveillance systems. The detection of Indian vehicles by their number plates is the most interesting and challenging research topic from the past few years. It is observed that the number plates of vehicles are in different shape and size and also have different colour in various countries.This work proposes a method for the detection and identification of vehicle number plate that will help in the detection of number plates of authorized and unauthorized vehicles.This work presents an approach based on simple but efficient morphological operation and Sobel edge detection method. This approach is simplified to segmented all the letters and numbers used in the number plate by using the bounding box

method. After segmentation of numbers and characters present on the number plate, template matching approach is used to recognize numbers and characters. The concentrate is given to locate the number plate region properly to segment all the numbers and letters to identify each number separately.

Divya Rastogi , Mohammad Shahbaz Khan at Al(2020) proposed a Real-Time Vehicle Number Plate Detection and Recognition System.The proposed work is implemented using TensorFlow and OCR-NET using DarkNet framework with python wrapper and the system is time depend on the input image detected by the system and if the threshold is increased recall rates will be low with higher FPS.

A number plate is a unique identification of a vehicle (car). A real-time plate detection system supported by image processing provides a definitive solution to the present problem. within this document, we proposed a real-time vehicle number plate recognition (RVNPR) system for the recognition of number plates which can extract the characters from the number plates of vehicles passing by a particular location using image processing algorithms, it's not necessary to put in additional devices like GPS or radio frequency Identification (RFID) to implement the proposed system. Using high-definition cameras, the system takes images of every passing vehicle and sends the image to the computer for processing by RVNPR software. The plate recognition software uses different algorithms like Yolo (You Only Look Once), segmentation and at last character recognition. The resulting data is applied to match with the records in a database if the vehicle has been detected as stolen then the system automatically notifies the police and sends the location of that vehicle.

N. Varshini , Sumedha Kasarla, Dr. Shaik Subhani(2019) .A Novel Approach to Vehicle Number Identification using Raspberry pi 3.The whole system is developed on Raspberry Pi desktop.When vehicle is identified, image of number plate gets captured and converted into text using software like OCR and OpenCV.

Vehicle Number Identification using Raspberry pi 3 is an image conversion technology which captures the license plate of a vehicle. The main aim is to make an effective and accurate license number plate identification system. This system is carried out and performed in the areas where traffic signals are present and the camera is placed on the signal which is

connected to raspberry pi and it sends signals to the server and it can also be used in apartments or residences for capturing all the vehicle numbers entering the building. This system at first detects the vehicle license plate and then captures it .It then converts the image into the text. The text of the license plate is displayed on the screen using the image conversion. Open CV and OCR are the two software's used for image capturing and conversion of that into text format respectively. The resulting data is then displayed on the screen and saved into a folder. The whole system is developed on Raspberry Pi desktop and its performance is used in real-time. It is observed from this experiment that the system mainly detects and captures the vehicle license plate, converts the image into text and displays it on the screen successfully.

jianzong wang , xinhui liu , aozhi liu , jing xiao3(2019) proposed a deep learning based method for vehicle license plate recognition in the natural scene. An image processing algorithm is applied for license plate adjustment. For license plate recognition, authors propose DCNN-RNN neural network to improve the accuracy of vehicle character recognition.

Vehicle license plate recognition in the natural scene is an important research topic in computer vision. The license plate recognition approach in the specific scene has become a relatively mature technology . However, license plate recognition in the natural scene is still a challenge since the image parameters are highly affected by the complicated environment. For the purpose of improving the performance of license plate recognition in natural scenes, we proposed a solution to recognize real-world Chinese license plate photographs using the DCNN-RNN model. With the implementation of DCNN, the license plate is located and the features of the license plate are extracted after the correction process. Finally, an RNN model is performed to decode the deep features to characters without character segmentation. Our state-of-the-art system results in the accuracy and recall of 92.32 and 91.89 on the car accident scene dataset collected in the natural scene, and 92.88 and 92.09 on Caltech Cars 1999 dataset.

Sourav Roy, Amitava Choudhury, Joydeep Mukherjee(2013) An Approach towards Detection of Indian Number Plate from Vehicle.An efficient less time consuming vehicle number plate detection method is proposed which is performed on complex image.

Vehicle number plate recognition is the most interesting and challenging research topic from the past few years. It is shown that the number plates are different shapes and sizes and also have different colors in different countries. In India the most common vehicle number plate used yellow or while as background and black used as foreground color. In this we proposed a system to localize the number plate mainly for the vehicles in West Bengal (India) and segmented the numbers to identify each number separately.We present an approach based on simple and efficient morphological operation and sobel edge detection method. We also present a simple approach to segmented all the letters and numbers used in the number plate. After reducing noise from the input image we try to enhance the contrast of the binarized image using histogram equalization. We mainly concentrate on two steps; one is to locate the number plate and second is to segment all the numbers and letters to identify each number separately. The project develops by using MATLAB7.4.0.

S M Sohel Rana , M. Humayun Kabir , Md. Shohel Rana , Sanjoy Kumer Sarker(2019) proposed an An Efficient Method of Vehicle Registration Number Plate Extraction and Recognition using Image.This research is able to process an input image of any format and successfully computed all the modules. Users can directly find the extracted alphanumeric characters in the result text file.

Due to the increasing population, the number of vehicles is growing day by day. These increased numbers of vehicles create various problems for traffic police such as signal light violations, parking problems, wrong lane violations and toll booth violations. This research will be helpful to control these traffic violations for traffic police. Moreover, it will also be helpful for the other number plate extraction and character recognition applications. We proposed in this research car registration number extraction and character or number

recognition. This research will be able to extract and recognize alphanumeric characters in a given image. The final output will be stored in a text file. This file will have extracted alphanumeric characters. This technology will be cost effective, fast and highly accurate. In this research we will try various algorithms and logics in MATLAB and find the best process to extract the number plate and recognition of each alphanumeric character. The main goal of this research is to reduce the manpower, cost, time and to make the process quick and highly available.

Andrew S. Agbemenu , Jepthah Yankey , Ernest O. Addo(2018) proposed An Automatic Number Plate Recognition System usingOpenCV and Tesseract OCR Engine.Their system is capable of using either Edge-detection or Template matching combined with mathematical morphology to extract the number plate from the input image. Character recognition is done by the open source Tesseract OCR engine.

Automatic Number Plate Recognition (ANPR) is a fairly well explored problem with many successful solutions. However, these solutions are typically tuned towards a particular environment due to the variations in the features of number plates across the world. Algorithms written for number plate recognition are based on these features and so a universal solution would be difficult to realize as the image analysis techniques that are used to build these algorithms cannot themselves boast hundred percent accuracy. We proposed an algorithm that is optimized to work with Ghanaian vehicle number plates. The algorithm, written in C++ with the OpenCV library, uses edge detection and Feature Detection techniques combined with mathematical morphology for locating the plate. The Tesseract OCR engine was then used to identify the detected characters on the plate.

Vahid Abolghasemi , Alireza Ahmadyfard(2007) proposed An edge-based color-aided method for license plate detection.The proposed method consists of two major parts. In the first part, They propose an algorithm to stretch image contrast in plate-like regions density. In the second part a novel fast method is proposed to filter out non-plate regions.

We considered the problem of license plate detection . Low quality images due to severe illumination conditions, vehicle motion, viewpoint and distance changes, complex background, etc. are some of the popular problems which have to be considered. In order to

alleviate these problems, two different image enhancement methods (using intensity variance and edge density) are proposed. The aim is to increase contrast of plate-like regions to avoid missing plate location especially in poor quality images. Furthermore, a novel match filter is designed to detect candidate regions as plates. This filter models the vertical edge density of the plate region regarding its neighborhood. As the filtering procedure is simple,this approach can be used for real-time applications. In the proposed method, we also use colored texture in the plate as a cue for plate detection. This feature is preserved under viewpoint change. In order to characterize the color information in plate, the MNS (multimodal neighborhood signature) method is used. A well-organized database, consisting of car images with different known distances and viewing angels have been prepared to verify the performance of plate detection algorithms. This database can be used to establish a precise evaluation of the proposed method and any other related work. The results of experiments on different types of car images in complex scenes confirm the robustness of the proposed method against severe imaging conditions.

Rayson Laroca, David Menotti at Al(2021) proposed An Efficient and Layout-Independent Automatic License Plate Recognition System Based on the YOLO detector.Authors propose a layout classification stage after LP detection. However, instead of performing both stages separately,they merge the LP detection and layout classification tasks by training an object detection network that outputs a distinct class for each LP layout.Once the LP has been detected and its layout classified, authors employ CR-NET for LP recognition.

Author proposed an efficient and layout-independent Automatic License Plate Recognition (ALPR) system based on the state-of-the-art YOLO object detector that contains a unified approach for license plate (LP) detection and layout classification to improve the recognition results using post-processing rules. The system is conceived by evaluating and optimizing different models, aiming at achieving the best speed/accuracy trade-off at each stage. The networks are trained using images from several datasets, with the addition of various data augmentation techniques, so that they are robust under different conditions. The proposed system achieved an average end-to-end recognition rate of 96.9% across eight public datasets (from five different regions) used in the experiments, out-performing both previous works and commercial systems in the ChineseLP, OpenALPR-EU, SSIG-SegPlate and

UFPR-ALPR datasets.In the other datasets, the proposed approach achieved competitive results to those attained by the baselines. Our system also achieved impressive frames per second (FPS) rates on a high-end GPU, being able to perform in real time even when there are four vehicles in the scene. An additional contribution is that we manually labeled 38,351 bounding boxes on 6,239 images from public datasets and made the annotations publicly available to the research community.

Rupali Gala , Shrey Doshi , Yash Jain(2017) proposed a system for Vehicle Number Plate Detection and Recognition.The proposed system will be using image processing for detection and localization of the number plate and neural networks for recognition of characters. The neural network has the learning ability to identify fancy number plates.

We present a new technique to use automatic number plate detection and recognition. This system plays a significant role throughout this busy world, owing to the rise in use of vehicles day-by-day. Some of the applications of this software are automatic toll tax collection, unmanned parking slots, safety, and security. The current scenario happening in India is, people break the rules of the toll and move away which can cause many serious issues like accidents. This system uses efficient algorithms to detect the vehicle number from real-time images. The system detects the license plate on the vehicle first and then captures the image of it. Vehicle number plate is localized and characters are segmented and further recognized with help of neural network. The system is designed for grayscale images so it detects the number plate regardless of its color. The resulting vehicle number plate is then compared with the available database of all vehicles which have been already registered by the users so as to come up with information about vehicle type and charge accordingly. The vehicle information such as date, toll amount is stored in the database to maintain the record.

Hui Li , Peng Wang , Chunhua Shen(2018)proposed a cascade using multiple CNN classifiers for detection and recognition,our method reads texts without character segmentation,based on recurrent networks,Their method achieves impressive performance on public car license datasets.

We tackle the problem of car license plate detection and recognition in natural scene images. We propose a unified deep neural network, which can localize license plates and recognize the letters simultaneously in a single forward pass. The whole network can be trained end-to-end. In contrast to existing approaches which take license plate detection and recognition as two separate tasks and settle them step by step, our method jointly solves these two tasks by a single network. It not only avoids intermediate error accumulation but also accelerates the processing speed. For performance evaluation, four data sets including images captured from various scenes under different conditions are tested. Extensive experiments show the effectiveness and the efficiency of our proposed approach.

T. S. Ibiyemi , J. S. Owotogbe , B. A. Adu(2020) . The ANPR system was implemented using MATLAB 2013a on Nigerian number plates.

The traffic management based on vehicle number plate recognition in Nigeria has not recorded the much expected result because it is manually done. Having studied the existing solution, it is opined that every nation has its unique vehicle number plate, and off – the – shelf automatic number plate recognition system developed for one nation is not likely to work optimally for another nation. Despite the fact that the new Nigerian number plate system was announced in 2011, it is observed that quite a large number of vehicles on Nigerian roads still have the old number plate system. However, the system that will detect and recognize both Nigerian number plate systems has not been announced. Hence, the need to develop a system to detect and recognize both Nigerian number plate systems. Therefore, the aim of this paper is to carry out a comparative study of existing vehicle number plate recognition systems, especially for Nigerian roads and also to carry out experimental studies on Nigerian number plate recognition systems. The methodology used includes the acquisition of 934 sample images of new Nigerian number plates and 567 sample images of

old Nigerian number plates. Then pre-processing of the acquired images, extraction of the identification on the number plate via character segmentation, character normalization (extracted characters reduced to 42 x 24 pixels), feature extraction and recognition of the extracted characters using template matching. From the study and analysis of the test, individual character recognition accuracy of 86% was obtained from the dataset, which shows that 791 sample images of new Nigerian number plates and 499 old Nigerian number plates were successfully recognized. Due to the errors encountered during implementation, it is recommended to create a new character template with the same font as that on Nigerian number plate for accuracy.

Ma'moun Al-Smadi , Khairi Abdulrahim(2016). The proposed systems perform three major operations that are vehicle detection, tracking and recognition.

Video-based analysis of traffic surveillance is an active area of research, which has a wide variety of applications in intelligent transport systems (ITSs). In particular, urban environments are more challenging than highways due to camera placement, background clutter, and vehicle pose or orientation variations. This paper provides a comprehensive review of the state-of-the-art video processing techniques for vehicle detection, recognition and tracking with analytical description. In this survey, we categorize vehicle detection into motion and appearance based techniques, varying from simple frame differencing and adaptive median filtering, to more sophisticated probabilistic modeling and feature extracting. We also discuss vehicle recognition and classification utilizing vehicle attributes like color, license plate, logo and type, and provide a detailed description of the advances in the field. Next we categorize tracking into model, region and features based tracing. Finally tracking algorithms including Kalman and particle filters are discussed in terms of correspondence matching, filtering, estimation and dynamical models.

Chuan Pratama, Suci Aulia, Dadan Nur Ramadan, Sugondo Hadiyoso(2020) proposed a method for Vehicle Licence Plate Detection for parking offenders using automatic licence plate recognition.For licence plate detection the first step is to find the location of the license plate in the image. In this step, several edge detection methods (Canny, Prewitt, Sobel, Robert,Laplacian of Gaussian (LoG), “approx.-Canny”) were tested on several camera

placement conditions to locate the plate license. The second step is to recognize the licenses as characters in text format.

Vehicles parked illegally on the highway can limit road space and result in congestion. Thus, illegal parking must be monitored and controlled. In this study, a prototype system for detecting the license plates of parking offenders based on image processing was implemented. The first stage in this system is detecting the license plate, then segmenting each character into a separate image. The next stage is converting the character from image to text format, referred to as automatic license-plate recognition. The goal is to send that detected plate license to the database of the authorities, so that the authorities can discover the identity of the parking offender to impose sanctions. In this study, several conditions of acquisition and variations of edge detection methods were tested. Based on the test results, an accuracy rate of 100% was obtained for license plate detection using the Canny method during the morning, with the camera position at 3 meters high, 2 meters of distance, and a 60 º angle.

HOANH NGUYEN(2005) proposes a strong technique for localisation, segmentation and recognition of the characters within the located plate. Images from still cameras or videos are obtained and regenerated into grayscale images.

We present a new approach for real-time license plate detection based on vehicle and text regions.Firstly, vehicle regions are extracted by single shot multibox detector (SSD) framework. Secondly, the multichannel maximally stable extremal regions (MSER) algorithm is used to generate character candidates in the vehicle regions. Using properties of vehicle regions, this method filters out false character candidates and then constructs license plate candidates with remaining character candidates. Then, false license plate candidates are eliminated by exploiting the correlation between dimension of vehicle and license plate. Finally, remaining license plate candidates are passed to a word/no-word classifier to keep the final license plate. To run in real time on embedded systems, this chooses the MobileNets architecture for deep CNN configurations. Experimental results on the public test dataset and new collected dataset show that the proposed approach can apply to different types of license plates with better performance than current state-of-the-art methods.

Christian Gerber , Mokdong Chung(2016)proposed a method to achieve improved number plate detection for mobile devices by applying a multiple convolutional neural network(CNN).

We propose a method to achieve improved number plate detection for mobile devices by applying a multiple convolutional neural network (CNN) approach. First, we processed supervised CNN-verified car detection and then we applied the detected car regions to the next supervised CNN-verifier for number plate detection. In the final step, the detected number plate regions were verified through optical character recognition by another CNN-verifier. Since mobile devices are limited in computation power, we are proposing a fast method to recognize number plates. We expect it to be used in the field of intelligent transportation systems.

MEERAS SALMAN AL-SHEMARRY , YAN LI(2018) proposed a Intelligent Transportation systems (ITSs) play a very important role in people's lives in many respects. One of the most important ITS applications is for automatic number plate recognition systems.

A licence plate detection (LPD) system is an important tool in several roadway traffic applications. This study aims to develop an advanced detection system that works well in complicated scenarios. It proposes a robust preprocessing enhancement method for accurately detecting the licence plates from difficult vehicle images. The proposed method includes the combination of a Gaussian filter, an enhancement cumulative histogram equalization method, and a contrast-limited adaptive histogram equalization technique. The local binary pattern and median filter with histogram of oriented gradient descriptors are used as powerful tools to extract key features from three types of licence plate resolutions. The extracted features are used as input to support vector machine classifiers. Processing methods, such as a position-based method are used with the detector to reduce unwanted bounding boxes, as well as false positive values. Four databases consisting of 2050 vehicle images under different conditions are used. Various detection metrics, object localization, and the receiver operating characteristic (ROC) curve are used to evaluate the performance of the proposed method. The experimental results on vehicles databases in several languages,

including English, Chinese, and Arabic number plates, show that the proposed method has achieved significant performance improvements. It outperforms the state-of-the-art approaches in terms of both the detection rate and the processing time. The detection rate when trained with 1520 LP images is 99.62% with a false positive rate of 1.675% for complicated images. The average detection time per vehicle image is 0.2408 milliseconds.

Seok Bong Yoo , Mikyong Han(2020).To improve the robustness of detection and recognition accuracy in the presence of motion blur and outliers, forward and bidirectional matching priors between consecutive frames are properly combined with layer structures specifically designed for plate detection.

In real-world intelligent transportation systems, accuracy in vehicle license plate detection and recognition is considered quite critical. Many algorithms have been proposed for still images, but their accuracy on actual videos is not satisfactory. This stems from several problematic conditions in videos, such as vehicle motion blur, variety in viewpoints, outliers, and the lack of publicly available video datasets. In this study, we focus on these challenges and propose a license plate detection and recognition scheme for videos based on a temporal matching prior network. Specifically,to improve the robustness of detection and recognition accuracy in the presence of motion blur and outliers, forward and bidirectional matching priors between consecutive frames are properly combined with layer structures specifically designed for plate detection. We also built our own video dataset for the deep training of the proposed network. During network training, we perform data augmentation based on image rotation to increase robustness regarding the various viewpoints in videos.

Ganta Vimi Sumali , DVR Mohan(2020)concluded that the license plate can be extracted well using neural networks. Detecting number is insufficient for blur and dark images. Different algorithms could be used to extract the number.

The use of vehicles is rising exponentially due to population growth. Automatic number plate reader system used for effective control of the security system. Automatic number plate reader system is an image processing technique that identifies the vehicle number plate without human involvement. It is a computer system that automatically recognizes any digital image on the number plate. The objective of this system is to design and develop

effective image processing techniques by localizing the identification plate in the captured image and identifying the characters using Recurrent Neural Network algorithm. This system is further designed to detect the unauthorized license plates along with the duration of the arrival of unlicensed vehicles. The details such as name of the owner, contact number, address, and aadhaar number of the owner would be displayed. This has been implemented by using Recurrent Neural Network in Python 3, Anaconda Prompt environment. Applications of this system are security control of highly restricted areas, highway speed detection, discovery of stolen cars, automatic fee collection systems.

Sheida Hadavi , Heleen Buldeo Rai, Sara Verlinde , He Huang , Cathy Macharis , Tias Guns(2020) worked on analyzing passenger and freight vehicle movements from the automatic number plate detection camera data**.**

Modern urban-transport planning requires evidence-based insights into current transport flows to better understand the needs and impacts of policy making. Urban transport includes passenger and freight vehicles, which have different behavior, and the need for such a separation is often ignored in research and practice [1]. New digital data sources provide an opportunity to better understand urban transport and identify where policy interventions are required. We review the literature on digital counting techniques to monitor transport flows, including loops, Automatic-Number Plate Recognition (ANPR) cameras and floating car data. We further investigate the potential of ANPR cameras, which are widely deployed, and which can be augmented with vehicle category information. This article presents the methodology that we follow for transforming raw augmented ANPR camera data into practical knowledge for city planners. Our aim is to provide a better understanding of passenger and freight vehicle movements and stops, identifying similarities and differences between vehicle categories. We demonstrate our methodology on a case study for the Mechelen-Willebroek district in Belgium, encompassing augmented data from 122 ANPR cameras for a period of two weeks. Additionally, we also look at the car-reduced zone and how time restrictions affect the different vehicle categories' actions. The findings are validated with GPS data from heavy-good vehicles in the same period.

Sarthak Tyagi , Ishaan Singh, Jyoti Sharma(2008) proposed a model that involved the steps of detecting the number plate,extracting text from the detected number plate and sending requests.

In India vehicle and its owner identification is an important and challenging problem because of the large number of registered vehicles. Vehicle license plate recognition for vehicle and its owner identification becomes necessary and the need of hour in case of suspected vehicles and their owners who break traffic rules and are involved in other illegal activities. There are multiple Vehicle License PlateRecognition systems but they are only restricted to the vehicle license plate recognition and the challenging task is the retrieval of vehicle and owner details because of unavailability of a public database. This involves the approach for vehicle license plate recognition as well as utilizing the vehicle license plate number for retrieving the vehicle and owner details which includes all the necessary details as vehicle owner name, vehicle registration date, vehicle model name, vehicle insurance details, vehicle fitness details, pollution validity and other necessary information.

Md. Atikuzzaman , Md. Asaduzzaman , Md. Zahidul Islam(2019) proposed a model that has three main phases like plate detection, class letter segmentation, and recognition.These phases are completed by adopting a HAAR Feature-based Classifier to detect license plate, class letter extractor with a proposed method, and Convolution Neural Network for recognizing class letters.

Real-Time Vehicle Number Plate Recognition(ANPR) has been a recurrent subject of research study as a result of many real-world implementations. Yet, numerous of today's works are still not Full-bodied and consistent in real-world circumstances and rely on various constraints. Our proposed method to detect and recognize license plates in real-time that is particularly designed to work on videos captured by a camera. It is a distinct approach that is composed of three main phases like plate detection, class letter segmentation, and recognition.These phases are completed by adopting a HAAR Feature- based Classifier to detect license plate, class letter extractor with a proposed method, and Convolution Neural Network for recognizing class letters. Our given method achieved captivating results in our collected dataset. Our dataset consisted of 5500 license plates and it achieved a successful

recognition rate of 91.38% with approximately 30 frames/second. We evaluate our License Plate Detection system performance with 390 test images and we get 96.92% accuracy and Class Letter Segmentation has achieved 94.61% with the same size of data. We achieved an overall successful recognition rate of 90.90% with real-time performance.

Jees K Denny , Jincy Denny , Anakha Satheesh P(2020) proposed a method having 3 modules Data collection and Data annotation,Vehicle Detection using pre-trained classifier Faster R-CNN,License plate Localization achieved by our license Module for Plate Localisation (LPLM).

We present a solution to find the license plates in a number of cases, such as multiple image license plates,non-uniform / poor lighting Conditions, variable angles, and low resolution. Initially, use Faster R-CNN fine-tuned classifier to detect input vehicle Image. Use our devised license plate in the next stage Localization Module (LPLM) for locating the license plate(s) that you are using Appear in the image of the input. The principal contributions of proposed analysis are set out below: Proposed a robust and cost-efficient solution for detection by integrating Faster R-CNN and License Plate Localization Module (LPLM) developed.Examine challenging PKU, categories G1~G5, which include, luminance variations, specific days and Overnight with numerous license plate. The solution proposed outperforms state-of-the-art standards the detection techniques are of considerable margin accuracy, precision, recall, and execution time.

Tushar Goel , Dr. K.C. Tripathi , Dr. M.L. Sharma(2020) proposed a model that finds License plate of the vehicle using various features of image processing library openCV and recognizing the text on the license plate using python tool named as tesserac.To recognize the license plate we are using the fact that License plate of any vehicle has rectangular shape.

License plate detection is an image processing technology that uses a license (number) plate for vehicle identification. The objective is to design and implement an efficient vehicle identification system that identifies the vehicle using the vehicle’s license plate. The system can be implemented on the entrance of parking lots, toll booths, or any private premises like college, etc. to keep the records of ongoing and outgoing vehicles. It can be used to allow access to only permitted vehicles inside the premises. The developed system first captures the

image of the vehicle's front, then detects the license plate and then reads the license plate. The vehicle license plate is extracted using the image processing of the image. Optical character recognition (OCR) is used for character recognition. The system is implemented using OpenCV and its performance is tested on various images. It is observed that the developed system successfully detects and recognizes the vehicle license plate.

G. Naveen Balaji , D. Rajesh(2017) proposed a model that has 4steps Pre-processing,Localization of license number plate region,Character Segmentation of license number plate,Character Recognition of license number plate.

Day by day the use of vehicles in our life is rising exponentially and as increasing vehicles are violating the rules of traffic, theft of vehicles, ingoing to restricted areas, abnormal number of accidents lead to upturn in the crime rates linearly. For any vehicle to be acknowledged, vehicle license plate detection will play a main significant job in this active world.The commonly used in field of safety and security system, LPDR plays a significant role and we need to identify vehicles registration number at an evident distance for finding the vehicle.The methodology which we have used is modest but appropriate. First the segmented of all characters in the image (LicencePlate). Ultimately, the recognition of each character is done. The pattern matching method is used for recognition of each character in the vehicle license plate.

Y. Harika , P Bhanu Prakash Reddy(2019) proposed a methodology that implements the working of the full VNPR system can be divided into two segments; they are the hardware segment and the software segment.

The vehicle number plate recognition system depends on image processing technology. It is one of the most fundamental systems invented to identify the vehicle number plate. In today's environment with the vehicle day by day, it's not possible to manually hold a document of the whole vehicle. With the growth of this vehicle number plate recognition system, it is simple to hold a document and manage it whenever needed. The main purpose of an effective vehicle number plate recognition system by using a vehicle number plate. The method first would obtain the image of the vehicle number plate as soon as the vehicle reaches the safety checking region. The obtained images are extracted by applying the

segmentation process. Visual character recognition is employed in letters. The method is executed and simulated on MATLAB and performance is examined on original images. This kind of method is extensively utilized in Traffic control regions, toll gates, parking zones, etc. This system is essentially planned for the view of the protection policy.

Wasif Shafaet Chowdhury , Ashikur Rashid Khan , and Jia Uddin(2017) proposed a method for detecting the license plate an improvised Sliding Concentric Window (SCW) algorithm has been developed to perform the segmentation process.

We present an image segmentation technique to segment out the Region of Interest (ROI) from an image, in this study, the ROI is the vehicle license plate. In order to successfully detect the license plate an improvised Sliding Concentric Window (SCW) algorithm has been developed to perform the segmentation process. In this proposed model, vehicle images were obtained and the SCW algorithm has been performed to segment out the ROI and then Morphological Image Processing techniques named erosion and dilation have been used to locate the license plate. In order to validate our proposed model, we have used a dataset where the images of the vehicles have been taken from a different angle that contains natural background and different lighting conditions. It has been observed that the proposed model exhibits 86.5% accuracy rate for our tested dataset. In addition to that, a comparative study has been carried out between two different techniques (Improved SCW and Modified Bernsen Algorithm) of ROI detection to illustrate their accuracy rate. It has been found that the accuracy rate of the proposed model of VLP detection is higher than some other traditional algorithms.

Li Yao1, Yingbin Zhao1, Jinghua Fan1, Min Liu1, Jianpeng Jiang1 , Yan Wan1(2015) proposed a model that implements the method based on character-specific extremal regions (ERs) and hybrid discriminative restricted Boltzmann machines (HDRBMs).

There are many types of vehicle license plates in China, including new energy license plates, large truck license plates, government vehicle license plates, and military license plates. The existing commercial license plate recognition system only targets common license plates and does not completely cover the full range of license plates. Therefore, we propose an SSD-based end-to-end license plate recognition system (LPR-SSD). The LPR-SSD network

architecture consists of upper and lower classification networks: the upper layer network is used for vehicle license detection and classification, and the lower layer network is used for license plate character detection and classification. In order to enhance the generalization performance of the LPR-SSD network, in addition to the real license plate image captured by the camera, this paper synthesizes 50K simulated license plates for each type of license plate according to the legal document [1]. Experiments show that LPR-SSD achieved a faster convergence speed during training. After the test set verification, the accuracy of license plate location detection and classification reaches 98.3%, and the character recognition accuracy rate reaches 99.1%.

S´ergio Montazzolli Silva , Cl´audio Rosito Jung(2018) proposed a model using Deep Learning (DL) methods that have been recently applied in the context of Automatic License Plate Recognition(ALPR).

Despite the large number of both commercial and academic methods for Automatic License Plate Recognition (ALPR), most existing approaches are focused on a specific license plate (LP) region (e.g. Eu-ropean, US, Brazilian, Taiwanese, etc.), and frequently explore datasets containing approximately frontal images. This work proposes a complete ALPR system focusing on unconstrained capture scenarios, where the LP might be considerably distorted due to oblique views. Our main contribution is the introduction of a novel Convolutional Neural Network (CNN)capable of detecting and rectifying multiple distorted license plates in a single image, which are fed to an Optical Character Recognition (OCR)method to obtain the final result. As an additional contribution, we also present manual annotations for a challenging set of LP images from different regions and acquisition conditions. Our experimental results indicate that the proposed method, without any parameter adaptation or fine tuning for a specific scenario, performs similarly to state-of-the-art commercial systems in traditional scenarios, and outperforms both academic and commercial approaches in challenging ones.

Tejendra Panchala , Hetal Patela , Ami Panchalb(2016) proposed a model of detecting the number of license plate using plate detection, character segmentation, and character recognition.

As the significance of open travel framework builds an Automatic License Plate Recognition has ended up being a critical exploration subject.ALPR furnished with numerous keen observation frameworks like, street activity administration, security administration, programmed toll gathering framework, and so on. Various systems have been offered for license plate recognition, every bearing its own particular points of interest and hindrances. The crucial step in the ALPR system is the precise confinement of the number plate, Segmentation, Recognition. Harris corner algorithm is proposed in this which ,ends up being robust in changing motion and illuminated lightning conditions. While the precision of License Plate restriction is fed forward to the Segmentation stage. The Segmentation is accomplished by a method of connected component analysis consolidated with Pixel count, Aspect ratio and Height of characters. Toward the end, the simulated results are shown with conclusion and future work.

van Heerden , Renier(2006) proposed a recognition method that uses vertical edge detection algorithm and a region-growing algorithm (RGA).The symbol segmentation can be achieved by only using a region growing algorithm.

Hidden Markov models for robust recognition of vehicle licence plates. In this dissertation the problem of recognising vehicle licence plates of which the symbols can not be segmented by standard image processing techniques is addressed. Most licence plate recognition systems proposed in the literature do not compensate for distorted, obscured and damaged licence plates. We implemented a novel system which uses a neural network/ hidden Markov model hybrid for licence plate recognition. We implemented a region growing algorithm, which was shown to work well when used to extract the licence plate from a vehicle image. Our vertical edges algorithm was not as successful. We also used the region growing algorithm to separate the symbols in the licence plate. Where the region growing algorithm failed, possible symbol borders were identified by calculating local minima of a vertical projection of the region. A multilayer perceptron neural network was used to estimate symbol probabilities of all the possible symbols in the region. The licence plate symbols were the inputs of the neural network, and were scaled to a constant size. We found that 7 x 12 gave the best character recognition rate. Out of 2117 licence plate symbols we achieved a symbol recognition rate of 99.53%. By using the vertical projection of a licence plate image, we were

able to separate the licence plate symbols out of images for which the region growing algorithm failed. Legal licence plate sequences were used to construct a hidden Markov model containing all allowed symbol orderings. By adapting the Viterbi algorithm with sequencing constraints, the most likely licence plate symbol sequences were calculated, along with a confidence measure. The confidence measure enabled us to use more than one licence plate and symbol segmentation technique. Our recognition rate increased dramatically when we combined the different techniques. The results obtained showed that the system developed , worked well, and achieved a licence plate recognition rate of 93.7%.

Tejas K, Ashok Reddy K, Pradeep Reddy D, Rajesh Kumar M(2017) proposed a model that tells us about preprocessing of obtained images,extraction of license plate region,segmentation and character recognition.

Vehicles play a vital role in modern day transportation systems. Number plate provides a standard means of identification for any vehicle. To serve this purpose, an automatic licence plate recognition system was developed. This consisted of four major steps: Pre-processing of obtained image, extraction of licence plate region, segmentation and character recognition. In earlier research, direct application of sobel edge detection algorithm or applying threshold were used as key steps to extract the licence plate region, which do not produce efficient results when captured image is subjected to high intensity of light. The use of morphological operations causes deformity in the characters during segmentation. We propose a novel algorithm to tackle the mentioned issues through a unique edge detection algorithm. It is also a tedious task to create and update the database of required vehicles frequently. This problem is solved by the use of ‘Internet of things’ where an online database can be created and updated from any module instantly. Also, through IoT we connect all the cameras in a geographical area to one server to create a ‘universal eye’ which drastically increases the probability of tracing a vehicle over having a manual database attached to each camera for identification purposes.

Meeras Al-Shemarry , Yan Li(2018) proposed a model that works with different data sets for the license plates for detection in terms of speed and accuracy.The method achieves a very high accuracy for detecting license plates number from one vehicle image.

A licence plate detection (LPD) system is an important tool in several roadway traffic applications. This study aims to develop an advanced detection system that works well in complicated scenarios. It proposes a robust preprocessing enhancement method for accurately detecting the licence plates from difficult vehicle images. The proposed method includes the combination of a Gaussian filter, an enhancement cumulative histogram equalization method, and a contrast-limited adaptive histogram equalization technique. The local binary pattern and median filter with histogram of oriented gradient descriptors are used as powerful tools to extract key features from three types of licence plate resolutions.The extracted features are used as input to support vector machine classifiers. Processing methods, such as a position-based method are used with the detector to reduce unwanted bounding boxes, as well as false positive values. Four databases consisting of 2050 vehicle images under different conditions are used. Various detection metrics, object localization, and the receiver operating characteristic (ROC) curve are used to evaluate the performance of the proposed method. The experimental results on vehicles databases in several languages, including English, Chinese, and Arabic number plates, show that the proposed method has achieved significant performance improvements. It outperforms the state-of-the-art approaches in terms of both the detection rate and the processing time. The detection rate when trained with 1520 LP images is 99.62% with a false positive rate of 1.675% for complicated images. The average detection time per vehicle image is 0.2408 milliseconds.

Akram A. Moustafa1 ,Mohammed-Issa Riad Mousa Jaradat(2021) proposes an intelligent LPDL system for captured images without considering the license plate color, size, style of font, size of text and the types of plates used.

License Plate Detection and Localization (LPDL) is known to have become one of the most progressive and growing areas of study in the field of Intelligent Traffic Management System (ITMS). LPDL provides assistance by being able to specifically locate a vehicle's number plate which is an essential part of ITMS, that is used for automatic road tax collection, traffic signals defilement implementation, borders and payments barriers and to monitor unlike activities. Organizations can deploy the number plate detection and recognition system to track their vehicles and to monitor each of them in their vital business activities like inbound and outbound logistics, find the exact location of their vehicles and organize entrance

management. A competent algorithm is proposed for number plate detection and localization based on segmentation and morphological operators. Thus, the proposed algorithm works on enhancing the quality of the image by applying morphological operators afterwards to segment out license plate from the captured image. No assumptions about the license plate color, style of font, size of text and type of material the plate is made of. The results reveal that the proposed algorithm works perfectly on all kinds of license plates with 93.43% efficiency rate.

C.N. Anagnostopoulos, I. Anagnostopoulos at Al (2012) proposed a license plate recognition algorithm for Intelligent Transportation System applications.A computer vision and character recognition algorithm for license plate recognition is used.The system analyzes the color and textural properties of LPs in images using a Support Vector Machine (SVM) and locates their bounding boxes by applying a Continuous Adaptive Mean Shift (CAMShift) algorithm. The combination of CAMShift and SVMs produced efficient LP detection.

We proposed a new algorithm for vehicle license plate identification on the basis of a novel adaptive image segmentation technique (Sliding Concentric Windows-SCW) and connected component analysis in conjunction with a character recognition Neural Network. The algorithm was tested with 1334 natural scene gray level vehicle images of different backgrounds and ambient illumination. The camera focused on the plate, while the angle of view and the distance from the vehicle varied according to the experimental setup. The license plates properly segmented were 1287 over 1334 input images (96.5%). The Optical Character Recognition (OCR) system is a two layer Probabilistic Neural Network (PNN) with topology 108-180-36, whose performance for entire plate recognition reached 89.1%. The PNN is trained to identify alphanumeric characters from car license plates based on data obtained from algorithmic image processing. Combining the above two rates, the overall rate of success for our LPR algorithm is 86.0%.

Chirag N. Paunwala , Suprava Patnaik(2011). Main advantage of the proposed method is, it is very simple in the skew correction of VLP images and gives accurate results.To solve the problem, a combined approach for skew correction of vehicle license plates (VLP) is proposed which is based on Harris corner detector and principal component analysis (PCA).

License plate recognition (LPR) is one of the most important applications of applying computer techniques towards intelligent transportation systems (ITS). In order to recognize a license plate efficiently, location and extraction of the license plate is the key step. Hence finding the position of a license plate in a vehicle image is considered to be the most crucial step of an LPR system, and this in turn greatly affects the recognition rate and overall speed of the whole system.This mainly deals with detecting license plate location issues in Indian traffic conditions. The vehicles in India sometimes bare extra textual regions, such as owner's name, symbols, popular sayings and advertisement boards in addition to license plates. Situation insists for accurate discrimination of text class and fine aspect ratio analysis. In addition to this additional care taken up in this paper is to extract license plate of motorcycle (size of plate is small and double row plate), car (single as well as double row type), transport system such as bus,truck, (dirty plates) as well as multiple license plates present in an image frame under consideration. Disparity of aspect ratios is a typical feature of Indian traffic. Proposed method aims at identifying regions of interest by performing a sequence of directional segmentation and morphological processing. Always the first step is of contrast enhancement, which is accomplished by using sigmoid function. In the subsequent steps, connected component analysis followed by different filtering techniques like aspect ratio analysis and plate compatible filter technique is used to find the exact license plate. The proposed method is tested on a large database consisting of 750 images taken in different conditions. The algorithm could detect the license plate in 742 images with a success rate of 99.2%.

Teik Koon Cheang (Author), Yong Shean Chong ,Tunku Abdul Rahman(2017) proposed a sliding window approach, a unified ConvNet-RNN model to recognize the captured license plate photographs.This model uses a combination of VGG-Net and a RNN, implemented using Torch, a well-developed deep learning framework.

While vehicle license plate recognition (VLPR) is usually done with a sliding window approach, it can have limited performance on datasets with characters that are of variable width. This can be solved by hand-crafting algorithms to prescale the characters. While this approach can work fairly well, the recognizer is only aware of the pixels within each detector window, and fails to account for other contextual information that might be present in other

parts of the image. A sliding window approach also requires training data in the form of pre segmented characters, which can be more difficult to obtain.we propose a unified ConvNet-RNN model to recognize real-world captured license plate photographs. By using a Convolutional Neural Network (ConvNet) to perform feature extraction and using a Recurrent Neural Network (RNN) for sequencing, we address the problem of sliding window approaches being unable to access the context of the entire image by feeding the entire image as input to the ConvNet. This has the added benefit of being able to perform end-to-end training of the entire model on labelled, full license plate images. Experimental results comparing the ConvNet-RNN architecture to a sliding window-based approach shows that the ConvNet-RNN architecture performs significantly better.

Meng Dong , Dongliang He ,Chong Luo,Dong Liu , Wenjun Zeng(2017) proposed an ALPR system which takes arbitrary image as input and output of the recognised license plate.We adopt a cascade structure comprising of a fast region proposal network and a R-CNN network.

We address automatic license plate recognition (ALPR) in the wild. Such an ALPR system takes an arbitrary image as input and outputs the recognized license plate numbers. In the detection stage, we adopt a cascade structure comprising of a fast region proposal network and a R-CNN network. The R-CNN network not only eliminates false alarms but also regresses corner positions for each detected plate. This allows us to estimate an affine transformation matrix to rectify the extracted plates. In the recognition stage, we propose an innovative structure composed of parallel spatial transform networks and shared-weight recognizers. The system is trained and evaluated on a Chinese license plate dataset with over 18K images. Results show that our detector performs better than faster R-CNN (VGG) which is 1.5x slower in testing and 57x larger in model size. The recognizer is also significantly better than existing solutions, reducing 57.5% of the errors of a state-of-the-art character sequence encoding scheme.

CHAPTER-3

THEORETICAL BACKGROUND OF THE PROJECT

The current project involves processing of video streams by splitting it into stream of images called frames. Different image processing operations are performed on these images in order to get the desired information in this case the vehicle registration number.

3.1 What is Image processing?

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in which input is an image and output may be image or characteristics/features associated with that image. Nowadays, image processing is among rapidly growing technologies. It forms a core research area within engineering and computer science disciplines too.

Image processing basically includes the following three steps:

- Importing the image via image acquisition tools;
- Analysing and manipulating the image;
- Output in which the result can be altered image or report that is based on image analysis.

There are two types of methods used for image processing namely, analogue and digital image processing. Analogue image processing can be used for the hard copies like printouts and photographs. Image analysts use various fundamentals of interpretation while using these visual techniques. Digital image processing techniques help in manipulation of the digital images by using computers. The three general phases that all types of data have to undergo while using digital technique are pre-processing, enhancement, and display, information extraction.

3.2 What is OCR?

OCR stands for Optical Character Recognition. It is a widespread technology to recognize text inside images, such as scanned documents and photos. OCR technology is used to convert virtually any kind of image containing written text (typed, handwritten, or printed) into machine-readable text data.

3.3 API

API is the acronym for Application Programming Interface, which is a software intermediary that allows two applications to talk to each other. Each time you use an app like Facebook, send an instant message, or check the weather on your phone, you're using an API.When you use an application on your mobile phone, the application connects to the Internet and sends data to a server. The server then retrieves that data, interprets it, performs the necessary actions and sends it back to your phone. The application then interprets that data and presents you with the information you wanted in a readable way.

3.4 Packages

3.4.1 OpenCV

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it easy for businesses to utilize and modify the code.The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to detect and recognize faces, identify objects, classify human actions in videos, track camera movements, track moving objects, extract 3D models of objects, etc

3.4.2 NumPy

NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays.It is the fundamental package for scientific computing with Python. It contains various features including these important ones:

- A powerful N-dimensional array object
- Sophisticated (broadcasting) functions
- Tools for integrating C/C++ and Fortran code
- Useful linear algebra, Fourier transform, and random number capabilities

Besides its obvious scientific uses, NumPy can also be used as an efficient multi-dimensional container of generic data.Arbitrary data-types can be defined using Numpy which allows NumPy to seamlessly and speedily integrate with a wide variety of databases.

3.4.3 Tensorflow

TensorFlow is an open-source end-to-end platform for creating Machine Learning applications. It is a symbolic math library that uses dataflow and differentiable programming to perform various tasks focused on training and inference of deep neural networks. It allows developers to create machine learning applications using various tools, libraries, and community resources.Currently, the most famous deep learning library in the world is Google's TensorFlow. Google uses machine learning in all of its products to improve the search engine, translation, image captioning or recommendations.

3.4.4 requests

Requests library is one of the integral part of Python for making HTTP requests to a specified URL. Whether it be REST APIs or Web Scraping, requests must be learned for proceeding further with these technologies. When one makes a request to a URL, it returns a response. Python requests provide inbuilt functionalities for managing both the request and response.

3.5 Algorithms

3.5.1 Character segmentation

This is the second major part of the License Plate detection algorithm. There are many factors that cause the character segmentation task difficult, such as image noise, plate frame, rivet, space mark, and plate rotation and illumination variance. We here propose the algorithm that is quite robust and gives significantly good results on images having the above

mentioned problems. The Steps involved in character Segmentation are: Preprocessing: Preprocessing is very important for the good performance of character segmentation. Our preprocessing consists of conversion to grayscale and binarization using a object enhancement technique. The steps involved are: Conversion to Grayscale, Binarization. Compared with the usual methods of image binarization, this algorithm uses the information of intensity and avoids the abruption and conglutination of characters that are the drawbacks of usual image binarization techniques. Object enhancement algorithm: The quality of plate images varies much in different capture conditions. Illumination variance and noise make it difficult for character segmentation. Then some image enhancement should be adopted to improve the quality of images. As we all know, the image enhancement methods of histogram equalization and gray level scaling have some side effects. They may have the noise enhanced as well. For character segmentation, only the character pixels need to be enhanced and the background pixels should be weakened at the same time. In fact, a license plate image contains about 20% character pixels. So these 20% character pixels need to be enhanced and the rest pixels need to be weakened. It is called object enhancement. The object enhancement algorithm consists of two steps: Firstly, gray level of all pixels is scaled into the range of 0 to 100 and compared with the original range 0 to 255, the character pixels and the background pixels are both weakened. Secondly, sorting all pixels by gray level in descending order and multiply the gray level of the top 20% pixels by 2.55. Then most characters pixels are enhanced while background pixels keep weakened. The following figure shows the result of object enhancement. It can be seen from the figure that after object enhancement the contrast of peaks and valleys of the projection is more significant than the original.

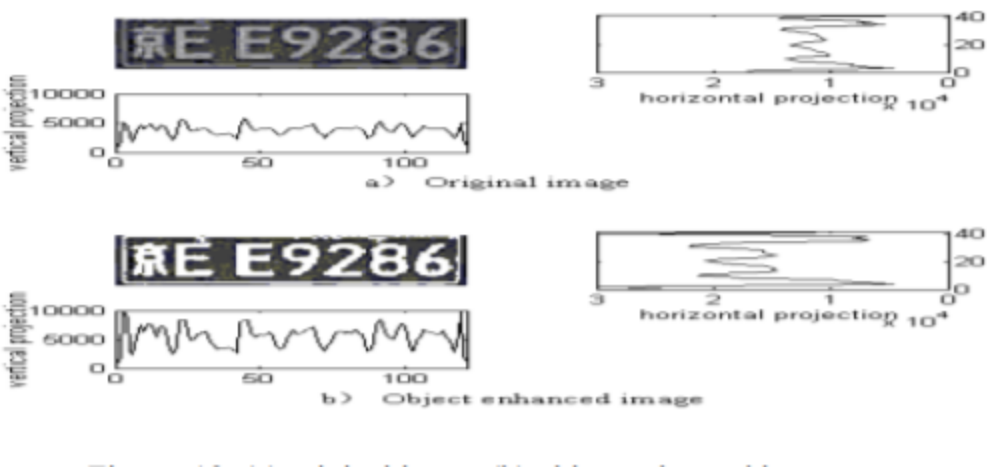

Fig 3.1 Number plate before and after enhancement

3.5.2 Subset sum algorithm

We receive challans paid by the vehicle owner as a single figure from the API. So, we make use of subset sum algorithm inorder to know what are different challans that are joined inorder to form the figure that is returned by the API. In the subset sum problem we are given a set of numbers and the expected sum value. Here the algorithm needs to find which set of elements are forming the sum.For example 1,2,3,4 are the list of elements and 7 be the required sum. Here 1,2,4 and 3,4 are different combinations that are forming the desired sum.

We made use of Dynamic Programming approach inorder to solve this problem. **Dynamic Programming** (DP) is an algorithmic technique for solving an optimization problem by breaking it down into simpler subproblems and utilizing the fact that the optimal solution to the overall problem depends upon the optimal solution to its subproblems.

Approach

1. Consider the last element and now the **required sum = target sum – value of 'last' element** and **number of elements = total elements – 1**
2. Leave the 'last' element and now the **required sum = target sum** and **number of elements = total elements – 1**

Following is the recursive formula for subset sum problem

isSubsetSum(set, n, sum) = isSubsetSum(set, n-1, sum) || isSubsetSum(set, n-1, sum-set[n-1])

Base Cases:

isSubsetSum(set, n, sum) = false, **if sum > 0 and n == 0**

isSubsetSum(set, n, sum) = true, **if sum == 0**

3.5.3 Gaussian Blur

Gaussian blur is the result of blurring an image by a Gaussian function. It is a widely used effect in graphics software, typically to reduce image noise and reduce detail. It is also used as a preprocessing stage before applying our machine learning or deep learning models.

blur = cv.GaussianBlur(img,(5,5),0)

Figure 3.1: Image before and after Gaussian blur

3.5.4 Otsu's thresholding

Otsu's method, named after Nobuyuki Otsu, is used to perform automatic image thresholding. In the simplest form, the algorithm returns a single intensity threshold that separates pixels into two classes, foreground and background. This threshold is determined by minimizing intra-class intensity variance, or equivalently, by maximizing inter-class variance. Different steps involved in automatic global thresholding are

1. Process the input image.
2. Obtain image histogram (distribution of pixels).
3. Compute threshold value T.
4. Replace image pixels into white in those regions, where saturation is grater than T and into black the opposite cases.

Different algorithms differ in step 3. In Otsu's approach the method processes image histogram, segmenting the objects by minimization of the variance on each of the classes. Usually, this technique produces the appropriate results for bimodal images. The histogram of such image contains two clearly expressed peaks, which represent different ranges of intensity values.

The core idea is separating the image histogram into two clusters with a threshold defined as a result of minimization the weighted variance of these classes denoted by $\sigma_w^2(t)$.

The Whole computation equation can be described as:

$$\sigma_w^2(t) = w_1(t)\sigma_1^2(t) + w_2(t)\sigma_2^2(t)$$

where $w_1(t), w_2(t)$ are the probabilities of the two classes divided by a threshold t, which value is within the range from 0 to 255 inclusively.
As it was shown in the Otsu's paper there are actually two options to find the threshold. The first is to minimize the within-class variance defined above $\sigma_w^2(t)$, the second is to maximize the between-class variance using the expression below:

$\sigma_b^2(t) = w_1(t)w_2(t)[\mu_1(t) - \mu_2(t)]^2$, where μ_i is a mean of class i.

The probability P is calculated for each pixel value in two separated clusters C_1, C_2 using the cluster probability functions expressed as:

$$w_1(t) = \sum_{i=1}^{t} P(i),$$

$$w_2(t) = \sum_{i=t+1}^{I} P(i)$$

It should be noted that the image can presented as intensity function $f(x, y)$, which values are gray-level. The quantity of the pixels with a specified gray-level i denotes by i. The general number of pixels in the image is n.

Thus, the probability of gray-level i occurrence is:

$$P(i) = \frac{n_i}{n}.$$

The pixel intensity values for the C_1 are in $[1, t]$ and for C_2 are in $[t + 1, I]$, where I is the maximum pixel value (255).

The next phase is to obtain the means for C_1, C_2, which are denoted by $\mu_1(t), \mu_2(t)$ appropriately:

$$\mu_1(t) = \sum_{i=1}^{t} \frac{iP(i)}{w_1(t)}, \qquad \mu_2(t) = \sum_{i=t+1}^{I} \frac{iP(i)}{w_2(t)}$$

Now let's remember the above equation of the within-classes weighted variance. We will find the rest of its components (σ_1^2, σ_2^2) mixing all the obtained above ingredients:

$$\sigma_1^2(t) = \sum_{i=1}^{t} [i - \mu_1(t)]^2 \frac{P(i)}{w_1(t)}, \quad \sigma_2^2(t) = \sum_{i=t+1}^{I} [i - \mu_2(t)]^2 \frac{P(i)}{w_2(t)}.$$

It should be noted that if the threshold was chosen incorrectly the variance of some class would be large. To get the total variance we simply need to summarize the within class and between-class variances:

$$\sigma_T^2 = \sigma_w^2(t) + \sigma_b^2(t),$$

where $\sigma_b^2(t) = w_1(t)w_2(t)[\mu_1(t) - \mu_2(t)]^2$.

The total variance of the image (σ_T^2) does not depend on the threshold.

Thus, the general algorithm's pipeline for the between-class variance maximization option can be represented in the following way:

1. calculate the histogram and intensity level probabilities
2. initialize $w_i(0), \mu_i(0)$
3. iterate over possible thresholds: $t = 0, ..., max\_intensity$

- update the values of w_i, μ_i, where w_i is a probability and μ_i is a mean of class i
- calculate the between-class variance value $\sigma_b^2(t)$

4. the final threshold is the maximum $\sigma_b^2(t)$ value

CHAPTER-4

DESIGN AND IMPLEMENTATION

4.1 Project process flow

The following figure represents the basic workflow of the project.

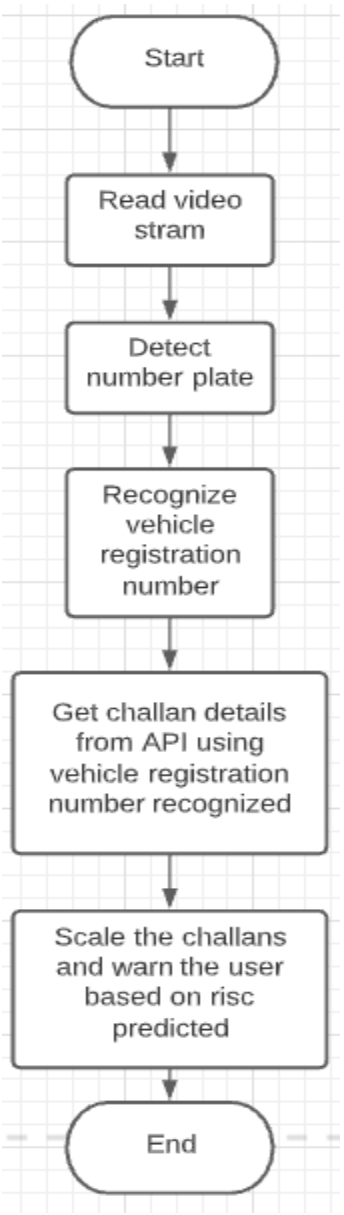

Figure 4.1 : Flow of Project

4.2 Methodology

- Video to be processed is read from a live stream.
- Image Preprocessing
    - We need to blur and convert into grayscale in order to reduce the noise.

Figure 4.2.1 : Color image to grayscale

- Find vertical edges of the image.

Figure 4.2.2 : Finding vertical edges in the image

- Binarize the image for revealing the plate.We make use of otsu's thresholding for binarization purposes.

Figure 4.2.3 : Binarizing image

- By applying closing morphological transformation we can reveal the rectangular white box.

Figure 4.2.4 : Revealing rectangular white box

- We make use of contours to detect the plate. Binarizing and morphing the image before finding the contours can help finding more relevant and less number of contours. Drawing contours on original image looks as shown below.For this we take the general average of 4500 and 30000 minimum and maximum respectively.

Figure 4.2.5 : Finding contours

- Then extract the valid contour.

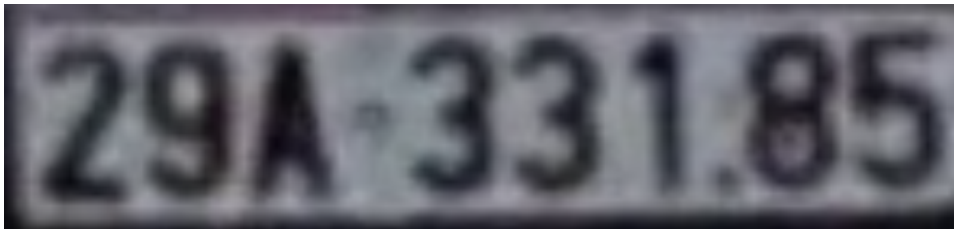

Figure 4.2.6 : Valid contour

- In order to recognize the characters on the license plate precisely we have to apply image segmentation.The first step in segmentation is extraction of the value channel.It would look like:

Figure 4.2.7 : value channel

- Now apply adaptive thresholding on the plate's value channel image to binarize it and reveal the characters. The image of plate can have different lightning conditions in different areas, in that case adaptive thresholding can

be more suitable to binarize because it uses different threshold values for different regions based on the brightness of the pixels in the region around it.

Figure 4.2.8 : Binarizing valid Licence plate

- After binarizing, apply bitwise not operation to find connected components.

Figure 4.2.9 : Licence plate after applying bitwise not operation

- Construct a mask and find contours in the mask. After that take the largest rectangle, find its bounding rectangle and validate side ratios.Find convex hull of contour and draw it on the character candidate mask.It would look like:

Figure 4.2.10 : Masking the image

- Find contours in the character candidate mask and extract these contour areas from plate's value threshold image.

Figure 4.2.11 : Finding valid contours

- Now we can recognize the characters one by one using OCR.

  An output of the OCR Will be the characters :

  29A33185

All these image preprocessing steps happen internally, input will be a video stream and the output will be only a combination of individual characters(vehicle registration number) .

- Recognised registration number is passed to the apiclub API.
- The API will return the total challan amount, challan number, challan date and all other challan related information registered on the corresponding vehicle in the json format as shown below.


```
{
    "code": 200,
    "status": "success",
    "response": {
        "vehicleId": "DL6CK0805",
        "challan_no": "HR8294200817114839",
        "challan_date": "2020-08-17 11:48:39",
        "challan_status": "Cash",
```

"amount": 500,

"payment_date": "2020-08-17 11:48:39”

}

}

- The response json object is processed and the challan registered with the corresponding vehicle is extracted.
- The challan amount extracted is made use inorder to get the probable combination of the constituent challans, based on the central RTO fines to different offences. We made use of the subset sum algorithm inorder to find this.
- Every offense issued by the RTO is associated with a risk factor.
- After finding a combination that satisfies the given sum the risk is calculated on the scale of 10 and the threshold is set at 5.
- If the predicted risk is above the threshold value then the system will warn the user with a beep sound and the image of the vehicle with more risk is popped up.
- Incase of multiple challans associated with vehicle risk is the mean of all individual challan risks.

CHAPTER-5

RESULTS AND DISCUSSION

Input

Video stream is fed to the system through live stream. System will detect the vehicle registration number plate through making use of different image processing techniques. The number plate detected is OCR which will recognize the vehicle registration number.

Fig 5.1 Input Video stream

Vehicle registration number found using OCR is passed to API which return the challan registered with the corresponding vehicle. The challan amount received is scaled using subset sum algorithm and the risk of accident is predicted. When the risk predicted is greater than the threshold the system will warn the user with a beep sound and the vehicle image with more risk will be popped up.

Output

Fig 5.2 Number plate detection

The below figure shows the image of the vehicle with predicted risc more then the threshold. Along with the popup the system will make a beep sound for 3 seconds which help the user to take necessary actions.

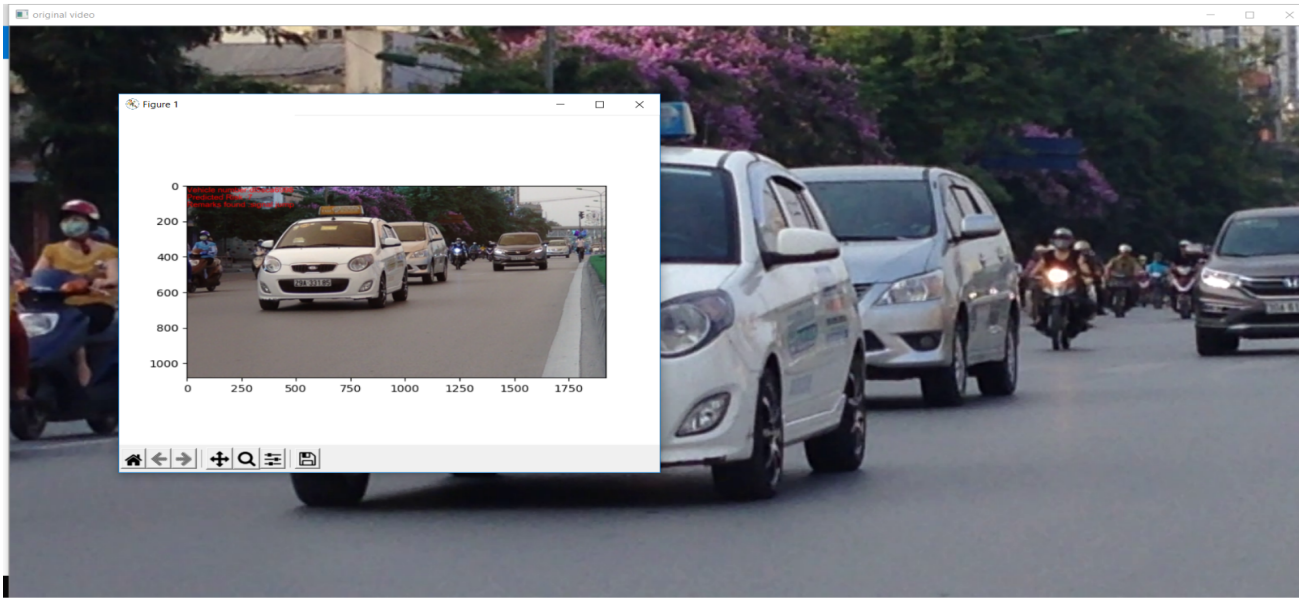

Figure 5.3 Warning raised at high risk

The image popup of the vehicle with high risk will remain for 5 seconds and will pop out. When there is no risk with the vehicle there is no action performed.

CHAPTER-6

CONCLUSION

The above research briefs us about the road accidents, different reasons for road accidents and different measures to avoid road accidents. This project describes a method to detect the probability of occurrence of a road accident and warn the user before so that the user can take necessary precautions in order to avoid an accident. The series of processes help in proper functioning of the tool are

- Reading video stream.
- Detecting vehicle number plate.
- Recognizing vehicle registration number from number plate.
- Getting challans booked on corresponding vehicle from API.
- Warn the user based on scaling of challans received from API.

There are different websites that give the challans details based on the vehicle registration number but it is not possible for the user to check these details and scale them parallelly with driving so this tool will help in automation of finding challans and scaling them.

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