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Automatic Traffic E Challan Generation using Deep learning

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ABSTRACT:

People's careless and reckless attitudes are causing a severe issue with traffic law infractions, which is weakening society's moral foundation. The human aspect in our existing system continues to be a burden and yields subpar outcomes when it might have produced far better results, despite the fact that our country's traffic rules have significantly improved over the previous several years. The evolution of technology has ushered in a new era of intelligent urban mobility management. Our project aimed to develop a system which is cost efficient and accurate in detecting the vehicles which violate the traffic laws and regulations made by Indian government. Deploying Convolution Neural Network (CNN) model in Raspberry pi4 board to perform real time image processing operations and with the integration of Canny Edge Detection (CED) which enhances the system accuracy by removing noise and delineating vehicle boundaries in even blurred images. The output image of CED algorithm is sent to Optical Character Recognition (OCR) to extract the number plate using OpenCV library.

Finally Global System for Mobile Communication (GSM) module springs into action issuing instant Short Message Service (SMS) notification to authorities for prompt E Challan generation. The proposed system is able to achieve 96% accuracy rate to detect the license number plate.

Keywords*-Deep Learning, Convolutional Neural Network, Raspberry pi4, Canny Edge Detection Algorithm, GSM Module, Camera, Python.*

1. INTRODUCTION

Despite the significant automation in detection and issue of challans in respect of speed and signal breaches utilising radars and back end technologies being deployed in industrialised nations, detecting and monitoring traffic offences has been a tough procedure [1]. If one considers infractions of other traffic regulations, such as improper packaging, failure to wear a safety belt or helmet, failure to carry required documentation, etc., there is still room for improvement in the automation of the corresponding administrative tasks and the issue of corresponding challans. There are a lot of cars on the road in India, so it's not easy to spot those who break the rules. It's also a lot of work for the traffic police to manage everything from tickets to accidents to even their own department's irregularities. The number plate itself is vulnerable to manipulation in the event of automated infractions that are often monitored by the plates. In order to identify the vehicle, this research provided a method for the issuance and settlement of challans that uses the chassis number. In order to decrease the likelihood of corruption in compliance, a target has also been set for the number of vehicles that the traffic police will scan, along with a bonus scheme for superior performance. There are 17 digits in a Vehicle Identification Number . The notation for numbers was first introduced in 1977 in ISO Standard 3779 and amended in 1983. The Vehicle Identification Number (VIN), sometimes known as the chassis number, is a unique number that appears on every single car that has ever been produced. The chassis number of a car cannot be changed, unlike the number on the number plate. The chassis number may be found on the vehicle's body frame or next to the engine, depending on the type and manufacturer. The firewall separates the passenger area from the engine compartment. Almost often, the VIN is either stamped or printed in the middle, at the top of the firewall, in the same colour as the paintwork. In contrast to VIN, licence plates may be altered or purposefully modified in fraud situations using a stolen plate, for instance. However, the

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driver's contacts with the constable do not have to be cordial all the time. In light of recent assaults on traffic officers, the police department has been stressing the need of keeping cool under pressure and not engaging in heated exchanges with motorists. Instead, officers are to photograph the offending vehicle's licence plate and submit the image to the Traffic Control Room so that an electronic challan may be issued [13]. The action comes after the Indian government increased the fines for traffic violations, which the police fear would lead to a rise in assaults on traffic officers. For instance, if the database of a sizable number of drivers is connected to them, the VIN and the E challan generating system in Bengaluru, India, may dramatically lower altercations between drivers and constabulary and attacks on police. Currently, when a traffic police officer takes a picture of an offending car, he saves it on his phone and sends it to the control centre either at the end of the shift or when he returns to the station. If the motorist knows the police officer, they may get out of a ticket by having the officer's photo removed from the report. Sending a challan via registered mail is a tedious operation, and the time it takes from the moment it is issued until it arrives might be lengthy. In general, the issuing of challan for various offences necessitates automation that may aid both law enforcement and those who have broken the law. In this work, we propose a system for the automated creation of E-challan to be used in the documentation and administration of traffic infractions. This project is based on a Programmable Logic Controller (PLC) and will correctly identify cars breaking the law within specific parameters and issue challan to their owners. The goal of this initiative is to lighten the load on traffic police so that they may concentrate on more serious offences, such as improper parking, driving on the wrong side of the road, or driving under the influence of alcohol or drugs. Moreover, evidence from other nations shows that drivers will begin to voluntarily comply with traffic laws when they are aware that their behaviour is being constantly monitored.

2. LITERATURE REVIEW

K.T. Ilayaraja et.al. presented a novel model for licence plate recognition utilising the robust ResNet Convolution Neural network. The innovative method is very effective at recognising car numbers and retrieving specific ownership information from the regional database. Even at speeds of up to 10 km per hour, it displays excellent precision. Character recognition is the major topic of this research because of its complexity and the vast untapped potential it has in the field of data analytics [2].

Shubham Kumar Chandravanshi et.al. proposed a model which covers People's cavalier and careless attitude towards breaking traffic laws which are tearing away the moral fabric of modern society. Despite the fact that country's traffic laws have dramatically improved over the last several years, the human element in current system still poses a risk and results in subpar results that might have been far better. The fact that traditional and electronic challans are distributed slowly and sometimes include errors also become a reason for encourages careless driving. This proposal automates the process of identifying traffic offenders using object identification and object tracking and producing the E-challans by instantly obtaining the vehicle information from the RTO following the extraction of number plate data number plate detection. An E-challan is promptly issued to the offender through email and text message once an infringement is reported. These adjustments will increase effectiveness, precision, and resilience to human error [3].

R Shreyas et.al. Proposed Automatic Number Plate Recognition (ANPR) system is built on top of existing image processing technologies. To identify cars committing traffic offences such as excessive speed and lane infringement at street traffic lights. The suggested system may be employed mainly for road traffic monitoring and can monitor every car for infractions of traffic rules and report them to the appropriate authorities so that they may take appropriate action, resulting in a more orderly flow of traffic and fewer accidents at intersections. It's possible that law enforcement may use this technology to track down cars that have been reported stolen. The proposed technology scans the area for cars infringing traffic regulations, and then photographs the vehicle in question. From the resulting picture, the area holding the licence plate will be extracted using image segmentation methods. In addition, optical character recognition is used to decipher licence plates [4].

Shaji Thorn Blue et.al. Proposed a research which would improve the precision of item detection by improving the quality of the boundary boxes formed around them. When it comes to object detection,(YOLO)v3 is a state-of-the-art, real-time solution. The proposed approach used YOLOv3 as a foundation model, which resulted in more precise border boxes around the items in the image. The proposed enhancements use edge detection, local pixel values, and the pretrained COCO dataset to enhance the accuracy of the border box enclosing the item. The proposed method significantly boosts border box accuracy in comparison to YOLOv3 [5].

Zhemin Liu et.al. This research recommends a completely automated pipeline for detecting unlawful parking from beginning to finish. You Only Look Once Version 3(YOLOv3), a deep learning-based object identification system, is used to swiftly and accurately distinguish cars. Error-tolerance measures are already used in movement tracking, which uses template matching and Intersection over Union (IoU) computations to determine how long the vehicle-infraction was stationary. Licence plates are read using Open ALPR. Results from real-world deployments show that licence plate collection works reliably, and that vehicle recognition and movement monitoring are also very accurate [6].

Richard G et.al. This research recommends the numerous segmentation methods are organised into four basic categories. The classical method, as it is commonly called, employs ways to segment the input picture into labelled parts. To dissect a picture is to try to separate its constituent parts so that they may be more easily categorised. The second group of methods sidesteps dissection in favour of segmenting images in one of two ways: either overtly, by classifying the picture according to specified windows, or implicitly, by classifying subsets of spatial information gleaned from the complete image. The third method integrates the prior two by utilising dissection and recombination processes to determine a segmentation boundary and then classifying the sub images to reduce the number of possible segmentation boundaries [7].

B. V Kakani et.al. presents an enhanced approach to OCR-based license plate recognition by utilizing a neural network trained with object features [8].

N.Palanivel et.al.presents a well-organized vehicle number plate detection system using techniques such as image segmentation, border detection, grey scale conversion achieving accurate license plate identification under varying illumination conditions and potential disturbances on Indian roads and restricted areas[9].

P.Srujana et.al. presented research on various edge detection algorithms and evaluated on digital images based on parameters like MSE, PSNR, and SNR [11].

R.Krishna moorthy et.al.The conventional manual approach to traffic monitoring faces challenges in preventing congestion and adhering to traffic rules. To address this, a pioneering method is introduced in this study, employing multiple Internet-connected CCTV cameras to automate traffic signal lights at road junctions. The method encompasses two core phases: Vehicle Detection System and Traffic Scheduling Algorithm [14].

N.Shigehara et.al. The Metropolitan Expressway Public Corporation (MEPC) implemented a computer-based traffic control system in 1973, later updated in 1985. The system processes data from vehicle detectors, automatically updates 400 variable message signs every minute with a three-minute maximum time lag, and employs CCTV cameras for real-time traffic monitoring [15].

3. METHODOLOGY

The Methodology section outlines the systematic approach employed in the development of the “Automatic Traffic E Challan Generation using Deep learning” .This study elaborates on CNN model, Canny edge detection , Data collection and pre-processing, Hardware setup and OCR for extraction, The process of the Automatic E-Challan Generation (AECG) system is divided into three main steps. Initially, images or videos are captured using a camera.

Flowchart

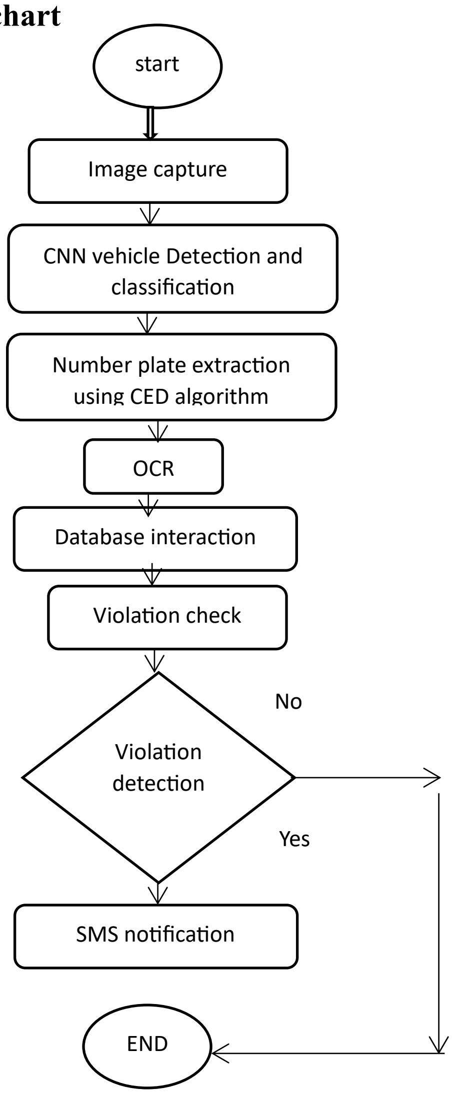

Fig1. Flow chart of AECG system

These captured images or videos are then forwarded to the CNN models, which are deployed on a Raspberry Pi 4 real-time computing board. The resulting outputs from the CNN models are obtained as a result of this stage. In the second step, the output image from the CNN model undergoes pre-processing using the Canny Edge Detection algorithm. After applying the CED algorithm, the image is smoothed, leading to the generation of another image. This newly generated image is then subjected to the Optical Character Recognizer to extract numerical information from the images.

Secondly the output image of CNN model is pre-processed by Canny Edge Detection algorithm and after smoothing the image another image is generated and this generated image is send to optical character recogniser to extract the numbers from the images [10].

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Volume 21 Issue 17, December 2019

Finally, the extracted numbers are cross-referenced with the data collected in the database to verify the details of the vehicle owner. If a match is found, an E-Challan is generated. The generated E-Challan takes the form of an SMS notification, which is sent to the relevant authorities or stakeholders.

3.1 Convolutional Neural Network

Widespread applications for image identification and categorization include convolutional neural networks. Convolutional neural networks are extensively used in the field of facial identification in addition to their pervasive use in scene classification and object detection [12].

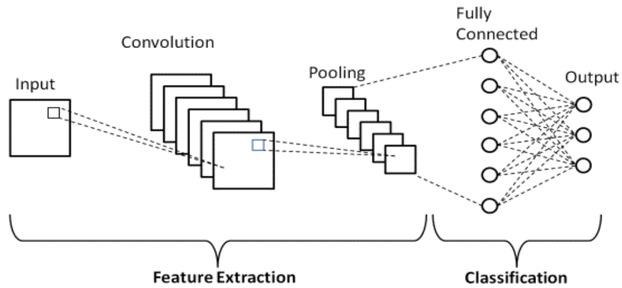

Fig2.CNN Architecture

3.1.1 Convolution Layer

Convolution layer initiates the process of the feature excretion by detecting edges, corners and textures within the groundwork for subsequent layers to identify foundational visual features.

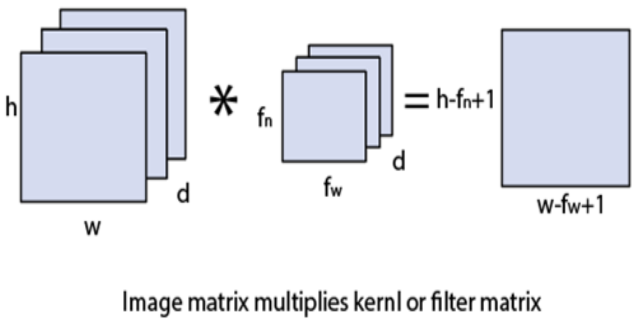

Fig3. Convolution Layer structure

3.2 Canny Edge Detection algorithm

Canny edge detection is cornerstone technique in computer vision. To overcome the limitations of CNN and achieve accurate boundary delineation, canny edge detection is applied to the candidate regions identified by the CNN model. This step isolates the edges of vehicles, irrespective of the presences of noise or challenging conditions .CED algorithm is 5 step processes where each step performs specific operations and tasks.

1. Gaussian Blur: The process begins with applying Gaussian blur to the image. This smooth's out noise and reduces detail, preparing the image for edge detection.
2. Gradient Calculation: Canny computes the image gradient to find regions with significant changes in intensity. This helps identify edges.
3. Non-Maximum Suppression: The technique eliminates weak edges while retaining strong ones. Only the local maximums along the edges survive, producing a thinner line.
4. Double Thresholding: Canny applies two thresholds: a low threshold to identify potential edges and a high threshold to finalize strong edges. This helps filter out noise.
5. Edge Tracking by Hysteresis: Canny links the edges to form complete contours by analysing the connectivity of adjacent pixels.

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3.3 Hardware setup

The foundation of our system rests upon the robust capabilities of raspberry pi4 single board computer, a high-resolution camera module, and necessary peripheral components. The camera module serves as the vital input source, capturing the real world vehicle images and GSM module to facilitate real-time Short Message Service (SMS) notifications. The hardware setup is shown below.

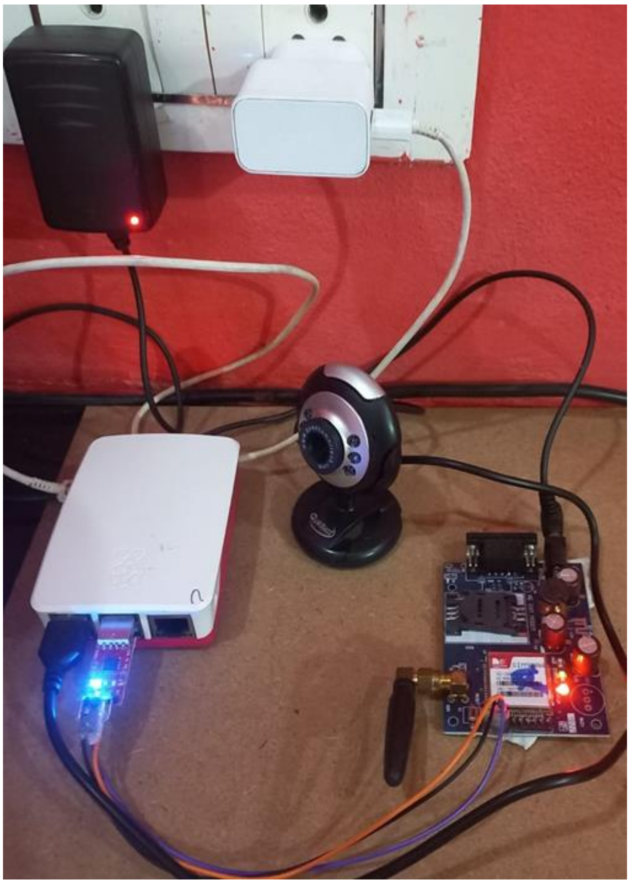

Fig4. Hardware Setup

4 EXPERIMENTAL RESULTS

The fundamental cornerstone of the project's
success lies in utilization of a comprehensive dataset. We have taken different images of car, bike, van trained our model and to prove that the system is cost efficient and accurate. In our experimentation, we simulated a real-world scenario by inputting two images into the Automatic E-Challan Generation (AECG) system. The first image represented a challenging condition, deliberately introducing blurriness to the image. The second image represented a clear and crisp scenario.

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Volume 21 Issue 17, December 2019

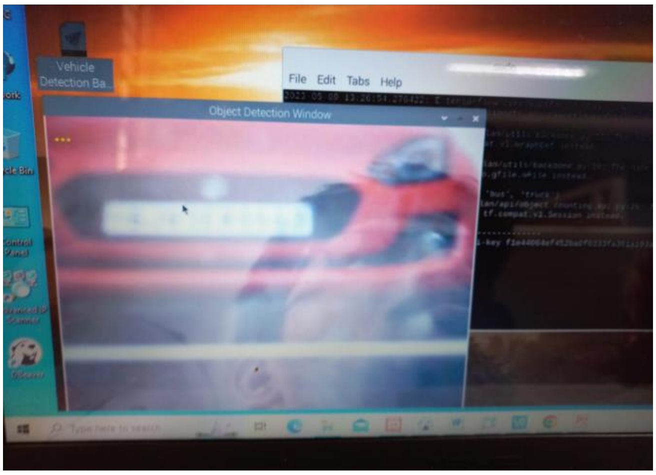

Fig5. Image input 1

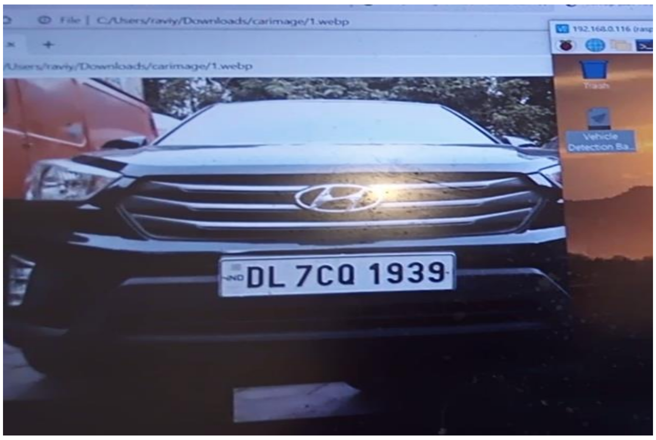

Fig6. Image input 2

Output

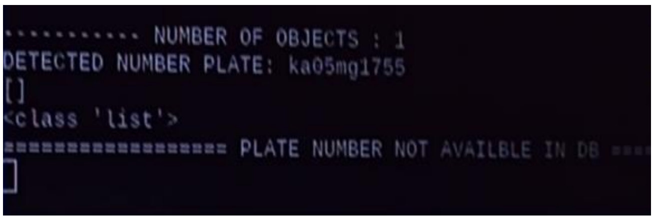

Fig7. Image output Results

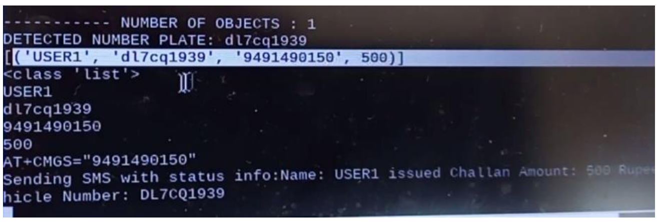

Fig8. Challan Generated

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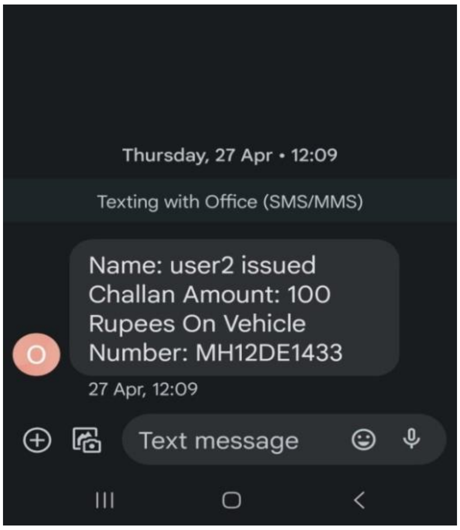

Fig9. Generated SMS for E challan

Upon analysing the results, the AECG system successfully identified the violations in both images and triggered the generation of an E-Challan.

5 CONCLUSION

The implementation of the Automatic Traffic E-Challan Generation system utilizing a blend of advanced technologies marks a significant step towards modernizing traffic violation management. The integration of Convolutional Neural Network for accurate vehicle detection, canny edge detection for effective image pre-processing, Raspberry Pi 4 for real-time processing, and the GSM module for instant SMS-based notifications has showcased the system's potential to revolutionize traffic monitoring and enforcement. The successful demonstration of the system's capabilities, as validated through experimentation on real-world images, substantiates its ability to identify violations, extract number plates, and generate timely e-challans. This holistic approach addresses challenges posed by blurred images, background clutter, and varying lighting conditions, ensuring robustness in different scenarios. The system's performance, achieved accuracy, and efficiency underscore its viability for application in traffic management, promoting safer roads and streamlined enforcement processes. As the roadways embrace automation and smart solutions, the Automatic Traffic E-Challan Generation system stands as a testament to the fusion of cutting-edge technologies with the imperative need for enhanced traffic regulation and enforcement.

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