

DEEP LEARNING BASED AUTOMATIC DETECTION OF BIKE RIDERS WITH NO HELMET

Submitted in partial fulfillment of the requirements for
the award of
Bachelor of Engineering degree in Computer Science and Engineering

by

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(DEEMED TO BE UNIVERSITY)**

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of KATIKI PRANEETH RI RAGHAVENDRA (37110335) who carried out the project entitled “**DEEP LEARNING BASED AUTOMATIC DETECTION OF BIKE RIDERS WITH NO HELMET**” under my supervision from November 2020 to March 2021.

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I KATIKI PRANEETH SRI RAGHAVENDRA (37110335) hereby declare that the Project Report entitled “**DEEP LEARNING BASED AUTOMATIC DETECTION OF BIKE RIDERS WITH NO HELMET**” done by me under the guidance of **Ms.E.Brumancia., M.E., (Ph.D)**, Department of Computer Science and Engineering at Sathyabama Institute of Science and Technology is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in Computer Science and Engineering.

DATE: 13-04-2021

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ABSTARCT

Riding motorbikes with a helmet is very essential and important as they may help prevent fatal head injuries in case of an accident. Helmet detection is an important and challenging vision task in traffic surveillance to avoid accidents for bike riders. As motorbike accidents have been growing in many countries due to the lack of traffic law power and mainly due to the negligence of the bike rider. With the help of the proposed method, we can detect bikers with no helmet and extract their license number plate for issuing a fine. This paper presents an automatic helmet detection method combining, Feature descriptor and DNN-classifier. Where the system is trained with predefined datasets and DNN (Deep Neural Networks) classifier is used to classify the objects. The proposed method work is as follows, Pre-processing, Feature extraction, and Classification. This paper proposes a method that classifies whether the person riding the bike is wearing a helmet or not. As for the robustness and effectiveness concerned, this method provides high accuracy detection rates.

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LIST OF ABBREVIATION

ANN	Artificial Neural Network
DNN	Deep Neural Networks
YOLO	You Only Look Once
LTP	Local Ternary Pattern
ALPR	Automatic License Plate Recognition
KNN	k-nearest neighbors
OCR	Optical Character Recognition
SMS API	Short Messaging Service Application Programming Interface
IP WEB CAM	Internet Protocol Web Camera

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

A helmet is essential for preventing traumatic brain injuries caused by impact and even death in a fatal accident. The negligence of the biker to not wear a helmet due to personal and other reasons may end up in serious injuries if meet with an accident. The risk of bikers getting injured in the head can cause permanent brain damage or even death, which is quite high. To reduce the risk of any type of head injury or even death due to an accident bike riders must be encouraged to wear a helmet for their safety. And the law must be very strict to fine who fail to do so. A system through deep learning an automatic helmet detection system has been proposed.

At present in India bikers without a helmet are fined manually by pulling them at checkpoints and check their documents for identification such as RC book, license card, insurance, etc., then the police officials would asking them the reason for not wearing a helmet while driving a two-wheeler. Since wearing a helmet while driving is a law, their reasons would not be taken for justification. Then they will be issued a receipt for the fine they have received for not wearing a helmet. They will also be given a choice to pay the fine on the spot through a debit/credit card or cash payment method or pay the fine in court within a particular period. Most of the people will choose to pay the cash on the spot, where others don't. So to eliminate the workload of the traffic officials and to implement strict law this proposed method can be used. So that bikers will be forced to wear the helmet while driving. This would also reduce the work of the traffic management department and provide safety for motorbike riders.

As of now, this system can be used by the traffic management department for monitoring traffic surveillance. Where the system detects bikers with no helmet and issues them a fine automatically. And send an SMS to the biker's number, who was detected for not wearing a helmet to notify them about the fine they have received.

1.2 IMPLEMENTATION OF DEEP LEARNING IN PROPOSED SYSTEM

The proposed system can be used in traffic management surveillance, where the system can be used to detect bike drivers with and without a helmet using neural networks based on deep learning. And then extract the license plate number to issue them fine with help of ALPR (Automatic License Plate Recognition). Deep learning is a subfield of machine learning methods that use artificial neural networks (ANN) or simply called Neural Networks to learn and make intelligent decisions on their own. The most common form of Machine, Deep Learning is Supervised Learning, Where a large form of a dataset is collected and used for Training the system. Deep-learning involves models which try to learn hierarchically the deep features of input data with very deep neural networks which is deeper than three layers. The network is turned into a supervised manner via unsupervised training. It utilizes both Structured and Unstructured Data for training. It is used in many industries from computer science to medicine.

Some of the examples of Deep Learning are Face Recognition, Computer Vision, Language Identification, Etc. Deep Learning can generate new features with less available training data sets. And can work on unsupervised learning techniques. It reduces the time required for extracting features from raw data. Deep learning architecture is adaptive and can work on diverse problems, with continuous training. The scope of improvement in the training process decreases because the entire training process depends on the continuous flow of data. An increase in the number of datasets increases the cost of computational training. A complete algorithm gets revised, in case of a certain fault to resolve the issue. Expensive resources i.e. Hardware for High-speed processing units and powerful GPUs are required for training datasets.

This system can be implemented in traffic surveillance and can be used to monitor and detect biker riders riding without and helmet to prevent life-threatening accidents or prevent form serious head injuries to the bikers. The biker who is detected for not wearing a helmet would be fined and an SMS notification could be sent to their number regarding there fine they have received.

1.3 RESEARCH AND SIGNIFICANCE

The primary aim of the proposed system is to detect biker riders without a helmet extract their license number plate and issue them a fine. The proposed system works and generates a lot of data in the process of detecting helmets, extracting license plates, and send an SMS noting the fine they have received. This system can be useful in the traffic management sectors as it can reduce the workload and the traditional way so entering data manually. This proposed system makes the traffic management process faster, much more efficient, and reliable. There are several intents of this proposed system. Some of them are as follows:

- The system provides understandable data to the traffic management department.
- The system has a database to store new datasets to learn and increase the production rate.
- It makes the whole process efficient.
- The process is based on digital visualization.
- It keeps the system secure.

The main purpose of this system is to detect biker riders with no helmet and extract their license plate number and issue them a fine through SMS notification. This is achieved through Deep Learning, Feature Descriptor Algorithm, and DNN (Deep Neural Networks). A feature descriptor is an algorithm or it is a method to classify objects or features of an object. And consists of two steps called interest point detection followed by descriptor computation. Deep Neural Networks (DNN) is an artificial neural network (ANN) that has multiple layers between the input and output layer which is used to classify objects by comparing the test data (extracted features of an object from a frame by Feature Descriptor) and the pre-trained datasets to determine the result and classify the object. Here helmet is the only trained dataset. The proposed framework works by the implementation of detection of bike riders with or without a helmet, by detecting the helmet using the pre-trained datasets. Furthermore, in the proposed framework ALPR is applied to recognize license plate and Extract the Characters (Alphabets and Numbers) from the license plate. Finally, a Notification alert regarding the fine issued for the biker will be sent

as a short message SMS to their mobile number registered in the system through an SMS service provider.

This proposed system intends to reduce the number of deaths/head injuries caused by motorbike road crashes due to the negligence of bike riders not wearing a helmet. Therefore the proposed method is designed to detect bike riders with no helmet and recognize their license plate and extract the characters from the license plate and send them a notification SMS to their registered mobile number regarding the fine they have received for breaking the traffic rule.

The rate at which accidents occurring will be greatly reduced and will have an impact on the traffic system. This system will report in digital visualization or computer vision format. The used and produced data are secured to eliminate and misuse of data. The system can also be used a two-way communication for issuing and paying the fine. But overall the system is better, fast, efficient and more reliable for daily use by the traffic management department. This proposed model will be helpful for the traffic management system and the people.

CHAPTER 2

LITERATURE SURVEY

2.1 LITERATURE SURVEY:

Aleksa Corovic, et al [1] presented a YOLOv3 algorithm for accurate object detection of traffic participants. The performance was tested in real-time under various driving conditions. This proposed YOLOv3 algorithm was based on CNN (Convolutional neural network). The algorithm extracts a single image for the input video in real-time and resizes the image and then represents it as input to the YOLO network. Then the objects are detected with a bounding box in real-time, based on comparing real-time data with trained datasets. The proposed YOLO algorithm was specialized for real-time detection and tracking of multiple objects. Under certain weather and lighting conditions, the system was not able to perform at its best. But it still performed with high precision and provided a solid base for object detection.

Duy-Nguyen Ta et al, [2] al presented an algorithm that can be used in real-time image recognition in a video. They have used few feature descriptors. Interest point and descriptor computation are the two consecutive steps found in many feature descriptor algorithms. The SURFTrac algorithm framework consists of Incremental Interest Point Detection, Tracking Interest Points, Motion Estimation, and Descriptor Computation. Then Real-Time Object Recognition and Tracking consist of Image Graph Organization and Initialization processes. Even though the proposed algorithm stands out to be the best, it has some limitations such as camera motion, size of search region, etc. The tracker fails in an outdoor environment when the camera detects an empty space between two buildings. The proposed framework has a large potential for improvement in an outdoor environment.

Jie Li, et al [4] proposed a method based on image processing and machine learning for practical safety helmet wearing detection. They have used the Vibe background modeling algorithm to detect moving objects under a fixed surveillant camera in a power substation. To describe inner human features HOG feature extraction is used. To classify pedestrians, SVM (Support Vector Machine) was used to train the system. Using color feature recognition, safety helmets were detected. The framework method consists of three phases, background modeling,

pedestrian classification, safety helmet detection. Regarding the error rate, this proposed method focuses on improving the speed and accuracy of detection of safety helmets wearing.

Kang Li, et al [5] proposed an automatic helmet detection framework that detects the safety helmet of ambulatory workers in power substations. This framework implements computer vision, machine learning, and image processing. This proposed framework is designed to detect the workers with and without a safety helmet. This system is divided into, moving object segmentation, pedestrian classification in a power substation, and finally safety helmet detection for detecting whether the worker is wearing a helmet or not. This framework was useful and detected up to a certain limit, and some drawbacks like distance, illumination, etc.

Rattapoom Waranusast et al, [6] proposed an automatic helmet recognition system for motorcycle riders and passengers. The proposed method was tested on a university campus in Thailand under light traffic scenes. They have used the KNN (key-nearest neighbor) algorithm and moving objects to classify objects and have used image vision and machine vision techniques to detect whether the rider and the passenger are wearing a helmet or not. Their system was able to detect helmet wearing at 74% for both lanes in a light traffic environment. But found some error recognition in the far lane, and when the moving touches the detecting line while overlapping with another object, and results in the wrong classification.

Romuer R. V. e Silva, et al [7] proposed a system for motorcycle classification and detection of motorcycle riders without a helmet. This study is divided into two stages, vehicle classification, and helmet detection. Wavelet transformer (WT) was used as the descriptor and for the classifier, they have used the random forest for the process of vehicle classification. The helmet detection process, Circular Hough Transformer (CHT), and the Histogram of Oriented Gradients (HOG) were applied to extract the image attributes. To classify the objects in the helmet detection process Multilayer Perceptron (MLP) was implemented as the classifier. Even though the results produced were promising there are still some improvements that can be done image capturing stage, where the system can be made to produce better quality images.

Shyang-Lih Chang, et al [9] proposed an ALPR method and several techniques to extract a license plate from a vehicle. Most of the proposed techniques worked under limited conditions, such as lighting, less number of vehicle speed, etc. This proposed LPR technique consists of two modules that formed the framework of the ALPR. They are license plate location and number identification modules. Many experiments were conducted for the respective modules and the results have been recorded, where the license plate location module had a success rate of 97.9%, and the license number identification module has a success rate of 95.6%. And the overall success rate of both modules combined was 93.7%. This proposed system had some drawbacks like it was able to work with only one specific countries license plate, and other factors such as illumination, reflectance, and depth images. This proposed method promises to improve the factor that is affecting the system.

CHAPTER 3

AIM AND SCOPE

3.1 AIM OF THE PROJECT

The primary aim of the proposed system i.e. "Deep Learning Based Automatic Detection of Bike Riders with No Helmet" is to detect bike riders driving with no helmet on the road and issue them a fine for breaking the law. The proposed system can also extract the license plate numbers and send an SMS notification to the biker who was detected for not wearing a helmet. The proposed system performs all of this in real-time.

3.1.1 Objectives:

The main objective of this project is to detect bikers with no helmet. This will help in surveillance applications and prevent many accidents. The proposed system is based on deep learning which makes the whole process efficient. The main objective is to detect biker riders with no helmet through a camera and issue them a fine. This will help in surveillance applications and prevents many accidents. The system will provide accurate detection of bikers riding a motorbike without a helmet and extract their license plate characters and issue them a fine for not following the traffic rule.

3.2 SCOPE:

The proposed system will help to detect bikers riding with no helmet in real-time which would be helpful for the traffic surveillance monitoring department. This system promises to make the surveillance monitoring process easy and efficient. And can make it more reliable for the traffic department. This proposed system will surely help to bring down the head injuries and deaths caused to bikers riding without a helmet and end up with an accident that would result in fatal injuries or death.

3.2.1 Advantages:

- Accurate detection of bike riders with and without helmets in real-time.
- The process of detecting helmets requires less time.
- Frame by frame detection in real-time.
- Cost-efficient and reliable for real-time vehicle and helmet detection.

3.3 REDUCTION IN TRAFFIC ACCIDENTS

Analyzing the current situation the proposed system promises to impact Traffic surveillance by reducing the on a high level by decreasing the injuries and deaths caused to the biker in road crashes. It greatly increases the prevention or the risk of ending in a life-threatening situation. Encouraging bikers to wear a helmet for their safety protection and giving proper education to people from a root level will also decrease the chance of biker risking their lives while driving without a helmet. Some of the reasons for bikers to no wear a helmet and drive are as follows:

- Wearing a helmet can be too hot inside on the head.
- Very sweaty during summer.
- Some bikers experience a lack of vision while driving.
- While some don't wear a helmet because they don't if they are traveling for a short distance.
- And some simply don't wear because of negligence.

People must be educated on the importance of wearing helmets while driving and how it can save their lives in case of an accident. Most bike accidents cause permanent head injuries more than deaths. Some of those head injuries result in severe brain damage which would last permanent or temporary. This proposed system can not only be used in traffic surveillance but also other places like companies, offices, colleges, malls, etc., can implement this system to monitor their employees, clients, customer, students, etc., to encourage them to wear helmets while driving.

If people learn the importance of wearing a helmet while driving instead of forcing it on them there would be a much-increased group of people who would follow it of their own will. This proposed system helps in monitoring a large number of data in a particular given time. Since it processes a large amount of data it is not necessary for the traffic surveillance management to be looking on to the screen and manually enter data. The system is more reliable in case of less manpower as it does most of the job by itself but still monitoring by a person would still be appreciated. This proposed system helps in building a secured monitoring system, to eliminate any misuse of data that is being produced such as a license plate number, biker's info, etc.

The traffic management will have full control of the system and can change its framework according to their needs. Some Traffic management departments would require only to make use of the license plate recognition or to detect the number of a bike rider, etc. The proposed system is flexible to work in any way that is possible and can adapt to different new scenarios with proper training with the newly provided dataset. The system is capable of learning with newly add or updated dataset so that the production rate increase from time to time. The process of detecting may differ from time to time due to various conditions, situations, etc. But the core objective will not change because of the designed framework.

CHAPTER 4

SYSTEM DESIGN & METHODOLOGY

4.1 EXISTING SYSTEM

The present method detects multiple bikers in a traffic scene and identifies how many of them are wearing a helmet in real-time or by input footage. Many methods have been implemented and worked as expected. But they had few drawbacks under different conditions. Many methods failed to detect helmets, which involved a different types of framework approaches. The existing frameworks for helmet detection use threshold segmentation, local ternary pattern (LTP), and object recognition-based focused features.

Thresholding segmentation is a technique used in OpenCV and python. The pixel values are assigned relationally to the threshold values provided. It is set to 0 if the pixel value is smaller than the threshold value. If it is not then it is set to maximum. It is a popular way to remove objects from their background. This technique is done in greyscale images in computer vision. Thresholding is a form of image segmentation, where the pixels of an image are changed to make the image easier to process and analyze. An image is converted to greyscale and it is used to identify objects by separating them from their background. The execution time is very less. Computation time and resources are needed to compute the new data set and takes up space in your memory image. It is used in image processing for object feature detection.

The process of combining neighboring pixels after thresholding is called the local ternary pattern. These patterns will be split into two while computing a histogram of these values. These are an extension of local binary patterns, it uses threshold constant to threshold pixels into three values. It had a lot of drawbacks in various conditions some of the factors that affected LTP are image noise, illumination, etc. It is mainly used for texture classification.

A technique to identify objects in images or video in computer vision is called object recognition. It is used to locate objects and identify them in a particular environment or scene. Object recognition falls under supervised learning. The focused feature is a method to train a system to identify certain objects in a scene

in a short time with high accuracy. But even though using this method with object recognition failed to detect or identify certain objects in restricted conditions. But this proposed system uses many different new advanced methods for the detection of helmets in real-time with a high accuracy rate and precision.

4.2 ARCHITECTURE OF PROPOSED SYSTEM

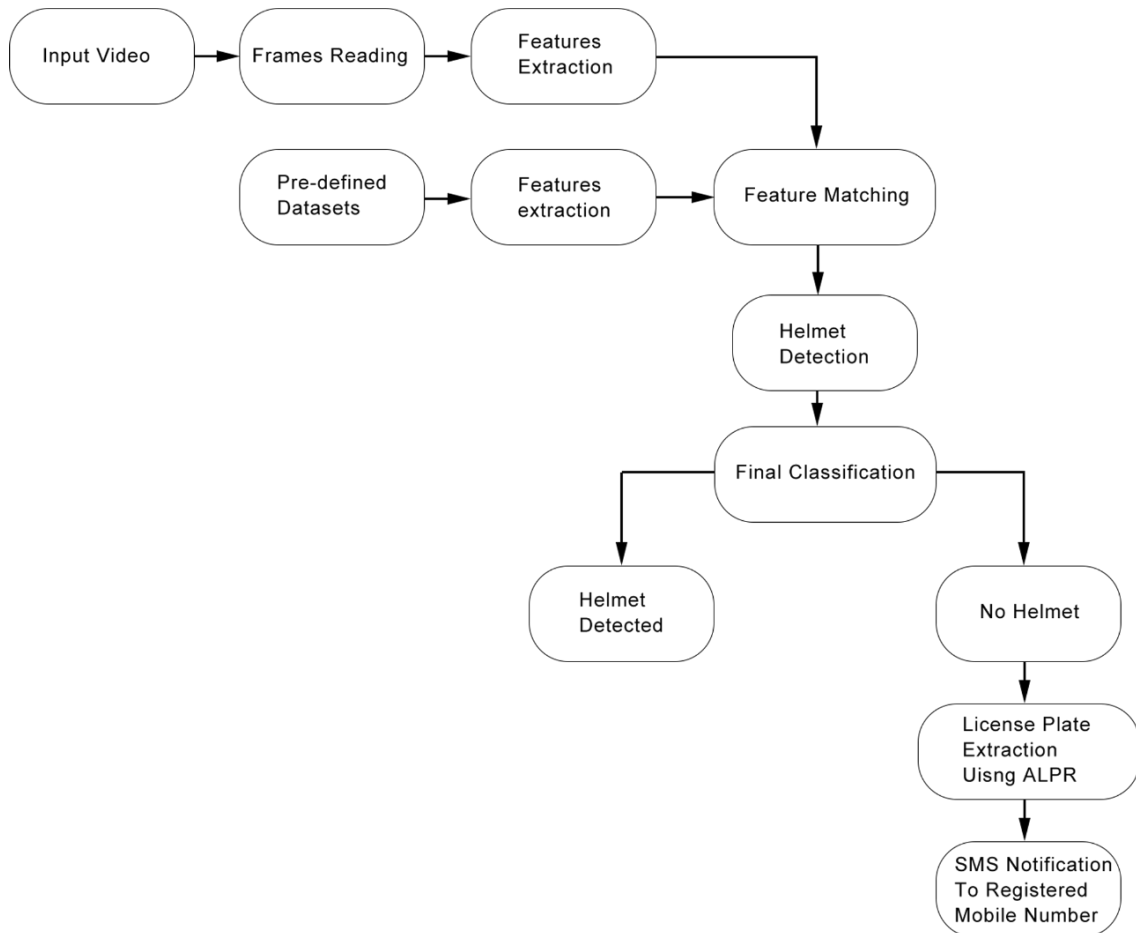


Fig 4.1 System Architecture

The input video is captured in real-time and a frame is analyzed for reading between each interval. The features of the object i.e. helmet are extracted and cross-checked with the features extracted from the pre-defined datasets, this process of comparing extracted features with pre-defined or pre-trained datasets is known as feature matching. Then with the implementation of the feature descriptor algorithm and DNN-classifier, the object's final classification is determined by the proposed system. The two possible outputs are helmet detected and no helmet. If the system detects a helmet on the biker in the input video it displays helmet detected, if it does not detect helmet on the biker in the input video it would display

no helmet on the output screen. Then the proposed system will move to the license plate extraction module which works on the ALPR framework to identify and recognize the license plate and the characters present in it. Finally, the proposed system will send an SMS notification to the biker's mobile number with the implementation SMS API.

4.3 PROPOSED SYSTEM

4.3.1 Overview of Proposed System:

The proposed system i.e. deep learning based automatic detection of bike riders with no helmet consists of advanced features that make this system efficient and a reliable way to monitor traffic surveillance. It is based on deep learning and neural networks. Where the system uses new methods, algorithms, etc. The system is designed to detect helmets. Once the system runs it tries to identify or detect an object. Then the features of the object are extracted and cross-checked with a pertained dataset which is the reference datasets. The extracted data is called real-time data or test data. The features are extracted through an algorithm known to describe the features of an object (feature descriptor). The test data and the reference data are cross-checked and processed to produce the output. The process method is called feature Matchmaking, where the features of the test data are compared with the features of reference datasets (pre-trained datasets) to determine the object as final classification. The final classification is done by Deep Neural Network-classifier, where it compares the features of test data and pre-trained datasets. This is applied to detect a person (biker) and the helmet (object). This is applicable for the detection of a biker's with and without a helmet.

For the license plate extraction process, the system uses ALPR (Automatic license plate recognition) an algorithm that is used to classify the characters i.e. numbers and letters present in a license plate. This ALPR system is based on the k-nearest neighbors (KNN) algorithm. That can be used to solve different classification and regression problems. There are 4 stages in an ALPR system and each country has a custom ALPR for their license plates. The four stages in an ALPR are Image acquisition, license plate extraction, license plate segmentation, and character recognition. These four combined perform the APLR process is where the license plate of the biker without a helmet can be extracted and can be used to

issue a fine for not wearing a helmet instead of the cop manually generating a receipted bill.

To notify the biker without a helmet an SMS will be sent to the mobile number of the biker. The SMS notification module works by using SMS API (Short Messaging Service Application Programming Interface). It is an interface that links the interaction between multiple software applications or hardware intermediaries. So, an SMS API is an interface between a system and an SMS service provider which is used to send SMS generated by the system to a particular client through the SMS service provider.

4.3.2 Working of the Proposed System:

The features of the proposed system make it different from the existing method. The proposed system has a different section, they are as follows:

Helmet Detection

In this section, the proposed system detects a biker (person) and checks the head region of the biker to identify whether the biker is wearing a helmet or not. A real-time input video is analyzed in real-time for the objects of a biker and helmet. Using YOLOv3 the system detects the objects with the precision level of the object and the name of the object in the real-time input video. The YOLOv3 module detects objects in real-time frame by frame, this proposed system is made to use 15 frames per sec to analyze and detect the object in real-time. The helmet detected will be show with a bounding box. Using feature descriptor extracts the features of all the objects detected and with the application of DNN-classifier it classifies the object and displays the output. If the biker detected by the system is wearing a helmet the output would be helmet detected in the output screen. If the biker detected by the system is not wearing a helmet then the output no helmet will be displayed on the output screen. The feature descriptor algorithm is designed to extract the feature of the objects detected i.e. biker and helmet. The DNN-classifier uses the features extracted by the feature descriptor and classifies the object as output. This process is the comparison of test data or extracted data with the pre-trained datasets (a group of data already learned by the system to differentiate objects) to determine the output.

License Plate Character Extraction

In this section of the proposed system, the license plate of the biker can be extracted with the implementation of ALPR, a license plate number extraction technology. In this proposed system the ALPR is based on a KNN- algorithm which consists of four stages or steps to extract the license plate number. They are as follows Input image processing, license plate extraction, license plate thresholding, character recognition.

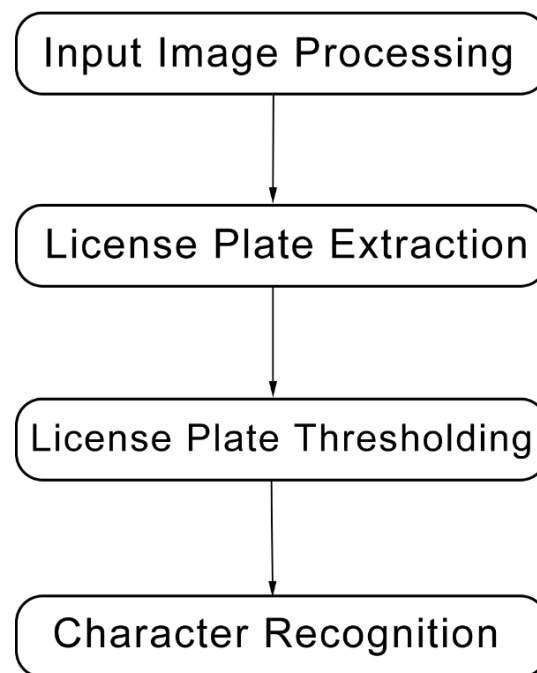


Fig 4.2 Stages in ALPR

In the input image processing stage, the input image is manually captured through an IP cam (mobile application) and stored in the system for processing. In the license plate extraction stage, the system identifies the license plate with a bounding box and extracts a cropped images of the license plate from the input image. In the license plate thresholding stage, the cropped image of the license plate is converted into a grey scaled image where the system would use it to extract the characters present in it. In the final stage of character recognition, the proposed system uses the pre-trained dataset present in the KNN- algorithm and classifies the characters present in the grey scaled image, and displays them on the output screen. Here the KNN-algorithm based ALPR uses pre-trained datasets to extract, recognize, and classify the characters present in the license plate.

SMS Notification

In this last section of the proposed system, the system sends a short SMS regarding the fine issued for the biker who was detected for not wearing a helmet while driving. SMS API is implemented for the SMS notification process. The SMS notification process can be divided into two parts Client-side and the Server-side, where the system is the server-side and the biker is the client-side. Once the license plate number extraction process completes the system would generate a short SMS and send it to the biker's mobile number registered in the system through an SMS service provider. The process of sending the system-generated SMS requires an internet connection. Once the SMS reaches the SMS service provider the SMS will be redirected to the biker's mobile number as a notification. The use of SMS API helps to interconnect a link between the SMS service provider and the system (server) to generate a short message and send that message to the client.

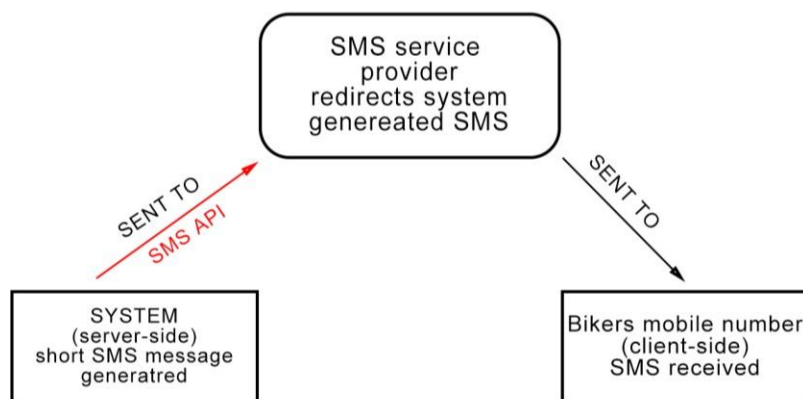


Fig 4.3 Server-side And Client-side

4.3.3 Application of Proposed System:

This proposed system can be used mainly in the traffic management department, where it would be easy to monitor and identify biker riders without a helmet. Furthermore, the proposed system can be used in the following application systems.

- *Video surveillance*: video surveillance is commonly used for monitoring purposes. The proposed system can be used in the Traffic management department for monitoring bikers riding without a helmet. Employee safety

monitoring where the system can be used to monitor workers and employees in civil proceedings or construction sites, power Substation, etc.

- *Object recognition systems*: The proposed system can also be used to detect multiple objects. The system can be trained to detect particular objects in both outdoor and indoor environments. The system can be used in fruit or vegetable detection, detection vehicles on the road, people, etc. Or can be used in offices to identify people by identifying their faces.
- *Security Process*: The proposed system can be used in tollgate checkpoints to identify and record the vehicle license plate number for security purposes or to track the number of vehicles traveling through that route every day. In case of any disaster, the data stored can be useful in the future. And it can also be used in public malls, supermarkets, stores, movie theaters, private companies, offices, schools, colleges, etc. Where the system can be trained to identify people, record data of the people activity or the service they are using, or the things they are buying, etc. These data can be useful in the future in case of disaster or a problem.

4.4 REQUIREMENT SPECIFICATION

This proposed system runs effectively on a computer system that has the minimum requirements. Hardware requirements are necessary for the system as the input capturing and processing performance depends on hardware usage. So the main need is to use appropriate equipment for the system. The requirements are divided into two categories, are as follows.

Software Requirements:

The basic software required for the system are:

- i. Microsoft Windows XP, Windows 7, Windows 10.
- ii. Python 2.7 and above
- iii. OpenCV packages

Hardware Requirements:

The basic hardware required for the system are:

- i. Hard disk space of 10 GB

- ii. RAM (system memory): Minimum of 2 GB RAM
- iii. Processor: Intel i3 process or higher / equivalent AMD processor
- iv. Graphics Card: Nvidia or AMD graphic card with at least 2GB of GPU memory
- v. Webcam (in build or external webcam) for input video and image.

4.5 METHOD OF APPROACH

The proposed system implements three methods that are responsible for the detection, identification processes in the system. The implemented methods are as follows:

4.5.1 Feature descriptor:

It is an algorithm and a method used to classify the object or features of an object. This is used to extract the features of an object present in the input video or image. This algorithm is designed in such a way that it extracts the features of an object precisely pixel by pixel and it is used by the system as input data or test data or extracted data. Later this data is used for comparison with the pre-trained data present in the system. so, this algorithm is responsible for detecting a person i.e. biker, helmet, and extract the features of those two objects in real-time, and use it as reference data or test data that is to be compared by the system with the pre-trained datasets and classify the output results. It is a part of computer vision in machine learning. Feature descriptors are used to correctly match extracted features with a large database of features (pre-trained dataset) to determine the output.

4.5.2 DNN-Classfier:

Deep neural networks-classifier is used to classify objects by comparing test data and pre-trained dataset and determine the object and display the output. Deep Neural Networks are used to classify objects by comparing real-time footage and object features extracted with the pre-trained data sets to identify the object. It is a neural network that has multiple layers and has been trained with a labeled dataset to perform classification on related and unlabeled data. It is used to classify the object and display the output. DNN-classfier is designed with deep neural networks which are a type of artificial neural networks that are capable of learning on their own with provided data. This classifier accurately identifies the object in less time or

in real-time with high precision. The proposed system uses this classifier to classify the objects and display output on the output screen. The classifier matches or compares the features extracted with the pre-trained datasets to determine the object in real-time. The proposed system provides input data for each frame in a real-time video and applies DNN-classifier to determine the object and display the output on the output window.

4.5.3 KNN-Algorithm:

The KNN-algorithm is used in the APLR which is used in the license plate extraction process. It is a simple, supervised machine learning algorithm that can be used to solve both classification and regression problems.

In the license plate extraction process of the proposed system, the KNN-algorithm is implemented for the detection, identification, classification processes of the license plate. It is used to classify, identify and extract the license plate from the input images used and it is used to extract and recognize the characters for (number and letters) present in the threshold image of the extracted license plate image. It also uses the extracted data or test data and compares it with the pre-trained datasets to determine the output. This is the most popular and accurate method for license plate extraction. It is used to display the output images for each stage present in the ALPR framework. Finally, it recognizes and classifies the characters present on the license plate.

4.6 MODULES

This proposed system consists of three different modules. They are the helmet detection module, license plate character extraction module, SMS notification module. Each module consists of different methods and sub-modules implemented into the system. The main task of the system is to detect bikers without a helmet, use APLR to extract the characters from their license plate, and finally, send those bikers a short SMS to notify them about the fine they received for breaking the traffic rule by riding a bike without a helmet.

4.6.1 Helmet Detection Module:

This module consists of the YOLOv3 (You Only Look Once) module and implements a feature descriptor algorithm and DNN-classifier method. YOLOv3 is a

module that uses a YOLO algorithm to detect objects i.e. helmet in real-time where the objects are shown within bounding box. YOLO is used for object detection and tracking in real-time in computer vision, and machine learning, etc. The YOLOv3 is used via OpenCV packages. The YOLOv3 consists of its previous versions YOLOv2 and YOLOv1. YOLOv3 is the most accurate and precise object detecting tool. YOLOv3 is an improvement over previous YOLO detection networks. Compared to previous versions, it features multi-scale detection, a stronger feature extractor, and some little changes in the loss function. In this system, it is used to detect helmets in the real-time input video captured through the webcam which show within a bounding box. Based on the graphic card and the ram available the system would detect a helmet per particular frame that can be checked by your computer system and display the precision level of the object in the real-time input video output screen. It also tracks objects i.e. helmet in real-time.

In the helmet detection module, YOLOv3 is used to detect and track helmet in real-time input video but the final classification of the object i.e. helmet is done by implementing features descriptor and DNN-classifier where the feature descriptor extracts the features of the object and the DNN-classifier uses it as input or test data and compares it with the pre-trained datasets to classify the object and display the output on the output window.

4.6.2 License plate module:

The license plate module consists of ALPR which is based on KNN-algorithm. The ALPR module is used to identify, classify, recognize and extract the characters present in the license plate. Automatic License Plate Recognition (ALPR) is a technology that reads license plate characters using OCR (optical character recognition). The ALPR is the most accurate and common method for license plate extraction. The framework of ALPR consists of four stages they are Input image processing, license plate extraction, license plate thresholding, and character recognition. These stages process data based on the KNN-algorithm. In the input image processing stage, the input image of the license plate is manually captured via IP cam, and the captured image is used as input by the proposed system. In the license plate extraction stage, the system identifies the license plate within a bounding box and extracts a cropped image of the input license plate image. Then

in the license plate thresholding stage, the cropped license plate image is converted into a grey scaled image by the system. And in the final stage i.e. character recognition stage the characters present in the threshold image of the license plate is identified by the proposed system using the implemented KNN-algorithm it recognizes the characters and extracts the characters and displays them as output.

4.6.3 Notification Module:

Finally in this module, SMS API (Short Messaging Service Application Programming Interface) is used by the proposed system to send a short SMS message to the biker without a helmet. An SMS API refers to a software integration interface that permits code to send short messages through an SMS API platform. It allows you to build a customized SMS channel for sending and receiving all of your messages. The proposed system divides into two sides namely server-side and client-side, where the system is server-side and the biker number is the client-side. The module is responsible for sending SMS notifications to the biker regarding the fine they have received for not wearing the helmet and breaking the law. The short SMS is sent in real-time by the system to the biker's mobile number registered in the system through an SMS service provider. The SMS API acts as the inter-link between the system and the SMS service provider to send and monitor SMS.

4.7 REAL-TIME OBJECT DETECTION AND CLASSIFICATION

The proposed system is designed to detect an object in real-time captured through a webcam which is used as the input image or video footage. The system is designed to detect multiple objects in a scene or environment. The system is designed for detecting objects in real-time so it is expected to perform with speed and accuracy. The system implements various methods that increase the performance process with high speed and precision. There are two main objects that the system is set to give high priority for identifying and classifying them in real-time, they are as follows:

4.7.1 Detection of Helmet:

The proposed system uses different methods implemented to detect helmets in real-time. The method modules that are responsible for the detection helmet in real-time are YOLOv3, feature descriptor, and DNN-classifier with the output. Out of these

methods, YOLOv3 is the main algorithm to detect, track the helmet, and display the output in real-time with less latency.

4.7.2 Properties of YOLOv3:

- **Speed:** It is the fastest object detection algorithm capable of detecting multiple objects
- **Accuracy:** It is the best algorithm for the detection of objects in real-time without too much loss in the detection process
- **Precision for small objects:** It has a high rate of average precision (AP) for smaller objects. It is almost pixel-precise.
- **Specificity of classes:** It can specify objects of different classes if the system is trained well with the datasets.
- **Detection of three scales:** It makes detection at three different scales, which can be used to detect the object more accurately.
- **Use of multiple anchor boxes:** It uses 9 anchor boxes in three different scales. So once the system is trained by your datasets. The object detection process becomes easy and fast.
- **Multiple bounding boxes per image:** It predicts more bounding boxes to detect objects if there are too many in a scene or environment.

4.7.3 Advantages and Disadvantages of YOLOv3:

Advantages:

- Fast enough and good for real-time object detection and processing.
- Object locations and predictions are made from a single system and can be trained to improve the performance and accuracy of object detection.
- It can be used in any environment and can be trained with specific datasets to detect specific objects.

Disadvantages:

- It struggles to detect objects if the input image is too pixelated or blurry or losses some resolution, and if it is small enough with quality loss the system can't even make a detection.
- It struggles to predict bounding boxes in new or unusual aspect ratios or resolutions.

- Incorrect localization is one of the main sources of error that this system commits.

4.7.4 Detection of the License Plate:

The proposed system implements ALPR (Automatic License Plate Recognition) based on KNN-algorithm. The proposed system used the KNN-descriptors and KNN-classifier which are in build in the ALPR system because of the ALPR system designed based on KNN. It uses the pre-trained dataset present in the KNN part of the ALPR framework. This can be used to identify the license plate, extract the license plate, convert it into a threshold image, and finally can be used to recognize characters.

4.7.5 Properties of ALPR:

- It uses optical character recognition (OCR).
- Speed: This is the fastest algorithm to perform the process of extracting or identifying license plates.
- Accuracy: This system has low accuracy results. Hence the system can't detect objects accurately without making mistakes.
- Precision: This system has low precision levels. The characters extracted and classified may look similar but the exact character may not be detected.
- It is capable of identifying trained dataset objects within a short time.
- Extraction of a particular object is accurate if trained well.

4.7.6 Advantages and Disadvantages of ALPR:

Advantages:

- It helps in monitoring and surveillance, it reduces the process of manually recording numbers.
- It works with both still and video footage.
- Makes the traffic surveillance work more efficient and easy in case if there are fewer men involved. The system provided a large number of input data and possible outputs to make use of.

Disadvantages:

- Extreme weather conditions affect the proposed system, making it hard to detect objects.
- Privacy concerns as the system record the Images and data that can be misused.
- The system can be trained.
- The angle of the camera or the photo or input video, use of third-party license plate fonts, size, color, style, position all have an impact on the license detection process.
- Very expensive and not reliable.
- There are too many conditions, factors that affect the process performance.

4.8 NOTIFICATION SYSTEM USING SMS API

The proposed system consists of an SMS notification method which is implemented in the ALPR section of the framework. Once the ALPR process completes the system would generate a short SMS and send it to the SMS service provider through SMS API (Short Messaging Service Application Programming Interface), the inter-link between the system and the SMS service provider. Once the Service provider receives the SMS it is redirected to the client i.e. biker's mobile number in real-time. The message redirected or sent from the service provider is in the form of a bulk SMS which would carry out the message of the fine issued for not wearing the helmet.

4.8.1 Properties of SMS API:

- It is a gateway for sending Short messages.
- It is used to bridge the gap between a system and carrier network.
- An inter-link to another system to send and receive messages.
- Can be used to generate multiple messages.
- It is a communication tool for the system and the service provider.

4.8.2 Advantages of SMS API:

- SMS API will allow personalizing our bulk SMS messages.

- It would allow us the option for two-way communication and enable OTP's (one-time passwords) if necessary.
- The SMS message can be changed at any given time.
- Using SMS API and using a bulk SMS service is cost-efficient and reliable.
- The SMS generated by the system will reach the targeted users within a fraction of a second after the APLR process completes.
- No matter what the location of the user is the SMS message will reach them.
- Using SMS API bulk messages is faster and quicker.

4.8.3 Disadvantages SMS API:

- It is not possible to know whether the sent SMS is read by the client or not, even though the system says SMS has been sent.
- Only short messages can be sent.
- Cannot generate SMS without internet connectivity.
- Network traffic affects the SMS from reaching the targeted users or clients.
- Need to pay for a particular period to continue using their service.

CHAPTER 5

RESULTS AND DISCUSSION

HELMET DETECTION OUTPUT:

Biker without a Helmet:



Fig 5.1 Real-Time Input Video without Helmet

```
*IDLE Shell 3.9.1*
File Edit Shell Debug Options Window Help
Python 3.9.1 (tags/v3.9.1:1e5d33e, Dec 7 2020, 1
D64) on win32
Type "help", "copyright", "credits" or "license()"
>>>
===== RESTART: C:\Users\Acer\Videos\project
No helmet
No helmet
No helmet
No helmet
```

Fig 5.2 No Helmet Detected

From the above two figures fig 5.1, fig 5.2, the input video is captured in real-time through a webcam. The output for no helmet detected is determined by the

proposed system by using YOLOv3 in the real-time input video to identify and track the object i.e. helmet. Using a feature descriptor algorithm the proposed system tries to extract the features of the helmet since the biker is not wearing a helmet the system continuously checks each frame with a particular interval in the real-time input video. The proposed system then applies DNN-classifier to compare the extracted features of the helmet i.e. test with the pre-trained dataset's since no feature for the helmet was available it concludes and displays the output as no helmet in the output window.

Biker with Helmet:

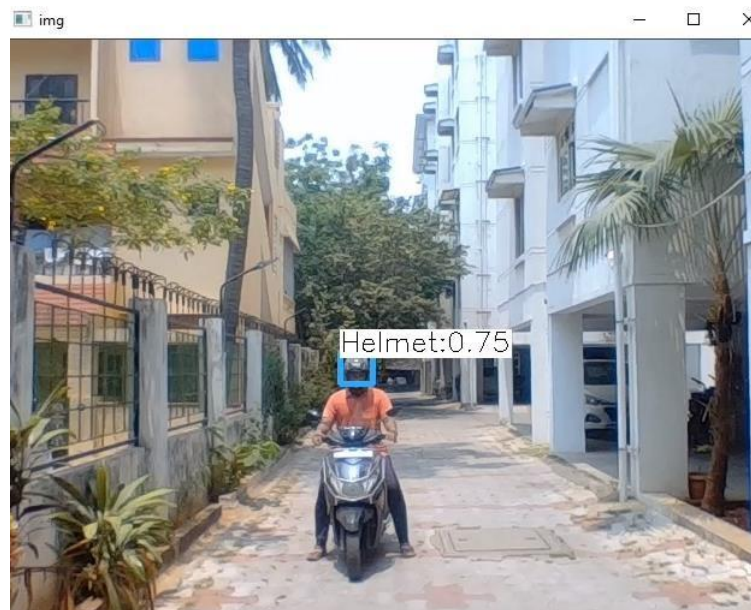


Fig 5.3 Real-Time Input Video with a Helmet

```
*IDLE Shell 3.9.1*
File Edit Shell Debug Options Window Help
Python 3.9.1 (tags/v3.9.1:1e5d33e, Dec 7 2020, 1
D64) on win32
Type "help", "copyright", "credits" or "license()"
>>>
===== RESTART: C:\Users\Acer\Videos\project
No helmet
No helmet
No helmet
No helmet
No helmet
Helmet detected
Helmet detected
Helmet detected
Helmet detected
Helmet detected
```

Fig 5.4 Helmet Detected

From fig 5.3, fig 5.4 the input video is captured in real-time through a webcam. YOLOv3 is used to detect the helmet in the real-time input video. The helmet is detected by showing it within a bounding box. And the precision level of the helmet detected is also displayed in the real-time input video screen. The proposed system uses a feature descriptor algorithm to extract the features of the helmet present in the real-time input video and implements DNN-classifier to classify the helmet. And displays the out as helmet detected in the output window.

LICENSE PLATE CHARACTERS EXTRACTION OUTPUT:



Fig 5.5 License Plate Characters Extracted

In the fig 5.5 the license plate character extraction is done by the implementation of APLR based on a KNN-algorithm. The proposed system works according to the four stages in APLR. The input license plate image is manually captured through an IP cam to use as the input data. The proposed system performs the input image processing step where the system first analyzes the image and identifies the objects present in the input license plate image. Then the system extracts a cropped image of the license plate in the license plate extraction stage. In the license plate threshold stage, the cropped image of the license plate is converted into a gray-scaled image. Then in the final stage of the ALPR frame the character recognition stage, the characters i.e. numbers and letters are recognized and identified by the system by the implemented KNN-algorithm which compares the test data characters extracted from the threshold image with the pre-trained datasets to classify the character and display it on the output screen.

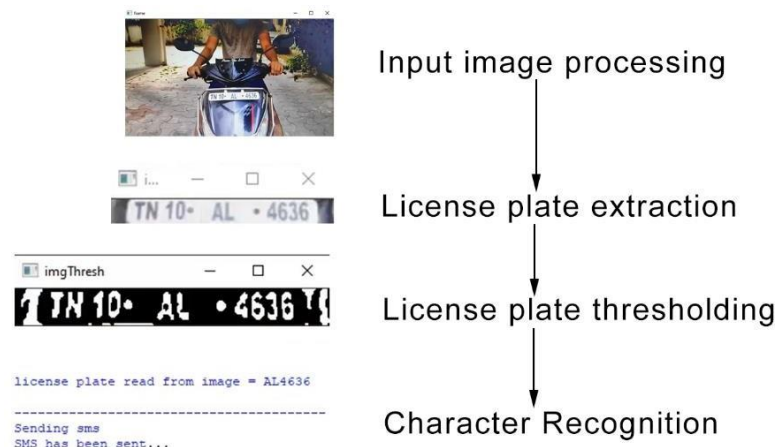


Fig 5.6 Outputs According To ALPR Stages

SMS NOTIFICATION:

In the below fig 5.7, Once the license plate character extraction process is completed, the proposed system will automatically generate a short SMS regarding the fine issued for not wearing a helmet, and sent it to the SMS service provider that is redirected to the biker through SMS API that is implemented in the system all in real-time. The SMS is sent in real-time with the use of SMS API. When the SMS service provider receives the SMS generated by the system it is converted into a bulk message and sent to the biker's mobile number registered in the system

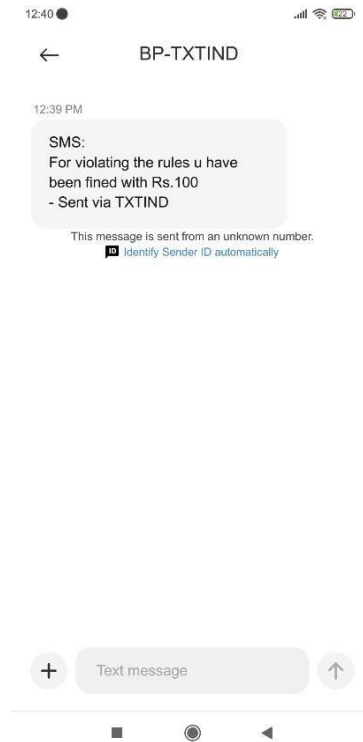


Fig 5.7 SMS Notification Received

CHAPTER 6

CONCLUSION AND FUTURE WORK

CONCLUSION

The proposed system for automatic detection of bike riders without a helmet can change the traffic management department with monitoring in the safest, most efficient way. This proposed system will greatly reduce the rate of deaths and injuries caused because of the absence of not wearing a helmet while driving a bike.

This can also change the way of issuing fine for people breaking the law from the traditional manual way to automated fine generated by system. Using different methods for each process increased the performance of the processes and the system. Even though the proposed system performs as expected it has some drawbacks which affect the outputs produced. Illumination, weather, etc., may affect the helmet detection process and license plate identification process. Furthermore, the use of third-party license plates, make it difficult for the system to recognize the characters present in the license plate. Low network signal and speed, etc., may affect the SMS notification process. The three system modules helmet detection module, license plate module, and notification module worked together to generate the desired output perfectly. The use of deep learning for detection, classification, identification tasks, and the framework mainly focused on the algorithms used to determine the output improve the performance of the proposed system.

FUTURE WORK

The future work of the proposed system will focus on working the helmet detection process and license plate character extraction process along with the SMS notification process together in a single framework and improve the detection, identification, extraction, and classification precision and accuracy of the system. It would make the system more efficient and flexible and the system would be made to run on a powerful computer system using powerful hardware components. In the traffic management department, they need not worry about monitoring every biker on the road is wearing a helmet or not, if the system detects some who is driving a bike and is not wearing a helmet it would alert them and performs the operation that is present in the proposed system.

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APPENDIX

A. Plagiarism report

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B. Paper

DEEP LEARNING BASED AUTOMATIC DETECTION OF BIKE RIDERS WITH NO HELMET

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ABSTRACT: Riding motorbikes with a helmet is very essential and important as they may help prevent fatal head injuries in case of an accident. Helmet detection is an important and challenging vision task in traffic surveillance to avoid accidents for bike riders. As motorbike accidents have been growing in many countries due to the lack of traffic law power and mainly due to the negligence of the bike rider. With the help of the proposed method, we can detect bikers with no helmet and extract their license number plate for issuing a fine. This paper presents an automatic helmet detection method combining, Feature descriptor and DNN-classifier. Where the system is trained with predefined datasets and DNN (Deep Neural Networks) classifier is used to classify the objects. The proposed method work is as follows, Pre-processing, Feature extraction, and Classification. This paper proposes a method that classifies whether the person riding the bike is wearing a helmet or not. As for the robustness and effectiveness concerned, this method provides high accuracy detection rates.

KEYWORDS: *Helmet Detection, License Plate Number Extraction, Feature Descriptor, DNN Classifier, Deep Learning.*

I. INTRODUCTION

A helmet is essential for preventing traumatic brain injuries caused by impact and even death in a fatal accident. To reduce the risk of any type of head injury or even death due to an accident bike riders must be encouraged to wear a helmet for their safety. In this paper through deep learning an automatic helmet detection system has been proposed. Deep learning is a subfield of machine learning methods that use artificial neural networks (ANN) or simply called Neural Networks to learn and make intelligent decisions on their own. The most common form of Machine, Deep Learning is Supervised Learning, Where a large form of a dataset is collected and used for Training the system. Deep-learning involves models which try to learn according to the level of importance of the deep features of input data with very deep neural networks. The network is turned into a supervised manner via unsupervised training [10]. It utilizes both Structured and Unstructured Data for training. It is used in many industries from computer science to medicine. Some of the examples of Deep Learning are Face Recognition, Computer Vision, Language Identification, Etc. Deep Learning can generate new features with less available training data sets. And can work on unsupervised learning techniques. It reduces the time required for extracting features from raw data. Deep learning architecture is adaptive and can work on diverse problems, with continuous training. The

scope of improvement in the training process decreases because the entire training process depends on the continuous flow of data. An increase in the number of datasets increases the cost of computational training. A complete algorithm gets revised, in case of a certain fault to resolve the issue. Expensive resources i.e. Hardware for High-speed processing units and powerful GPUs are required for training datasets.

The main purpose of this paper is to detect biker riders with no helmet and extract their license plate number and issue them a fine through SMS notification. This is achieved through Deep Learning, Feature Descriptor Algorithm, and DNN (Deep Neural Networks). A feature descriptor is an algorithm or it is a method to classify objects or features of an object. And consists of two steps called interest point detection followed by descriptor computation [2]. Deep Neural Networks (DNN) is an artificial neural network (ANN) that has multiple layers between the input and output layer which is used to classify objects by comparing the test data (extracted features of an object from a frame by Feature Descriptor) and the pre-trained datasets to determine the result and classify the object [3]. Here helmet is the only trained dataset. The proposed framework works by the implementation of detection of bike riders with or without a helmet, by detecting the helmet using the pre-trained datasets. Furthermore, in the proposed framework ALPR is

applied to recognize license plate and Extract the Characters (Alphabets and Numbers) from the license plate [8]. Finally, a Notification alert regarding the fine issued for the biker will be sent as a short message SMS to their mobile number registered in the system through an SMS service provider. This paper intends to reduce the number of deaths/head injuries caused by motorbike road crashes due to the negligence of bike riders not wearing a helmet. Therefore the proposed method is designed to detect bike riders with no helmet and recognize their license plate and extract the characters from the license plate and send them a notification SMS to their registered mobile number regarding the fine they have received for breaking the traffic rule.

II. RELATED WORKS

Shyang-Lih Chang, et al [9] proposed an ALPR method and several techniques to extract a license plate from a vehicle. Most of the proposed techniques worked under limited conditions, such as lighting, less number of vehicle speed, etc. This proposed LPR technique consists of two modules that formed the framework of the ALPR. They are license plate location and number identification modules. Many experiments were conducted for the respective modules and the results have been recorded, where the license plate location module had a success rate of 97.9%, and the license number identification module has a success rate of 95.6%. And the overall success rate of both modules combined was 93.7%. This proposed system had some drawbacks like it was able to work with only one specific countries license plate, and other factors such as illumination, reflectance, and depth images. This proposed method promises to improve the factor that is affecting the system.

Duy-Nguyen Ta et al, [2] al presented an algorithm that can be used in real-time image recognition in a video. They have used few feature descriptors. Interest point and descriptor computation are the two consecutive steps found in many feature descriptor algorithms. The SURFTrac algorithm framework consists of Incremental Interest Point Detection, Tracking Interest Points, Motion Estimation, and Descriptor Computation. Then Real-Time Object Recognition and Tracking consist of Image Graph Organization and Initialization processes. Even though the proposed algorithm stands out to be the best, it has some limitations such as camera motion, size of search region, etc. The tracker fails in an outdoor environment when the camera detects an empty space between two buildings. The proposed framework has a large potential for improvement in an outdoor environment.

Rattapoom Waranusast et al, [6] proposed an automatic helmet recognition system for motorcycle riders and passengers. The proposed method was tested on a university campus in Thailand under light traffic scenes. They have used the KNN (key-nearest neighbor) algorithm and moving objects to classify objects and have used image vision and machine vision techniques to detect whether the rider and the passenger are wearing a helmet or not. Their system was able to detect helmet wearing at 74% for both lanes in a light traffic environment. But found some error recognition in the far lane, and when the moving touches the detecting line while overlapping with another object, and results in the wrong classification.

Romuer R. V. e Silva, et al [7] proposed a system for motorcycle classification and detection of motorcycle riders without a helmet. This study is divided into two stages, vehicle classification, and helmet detection. Wavelet transformer (WT) was used as the descriptor and for the classifier, they have used the random forest for the process of vehicle classification. The helmet detection process, Circular Hough Transformer (CHT), and the Histogram of Oriented Gradients (HOG) were applied to extract the image attributes. To classify the objects in the helmet detection process Multilayer Perceptron (MLP) was implemented as the classifier. Even though the results produced were promising there are still some improvements that can be done image capturing stage, where the system can be made to produce better quality images.

Jie Li, et al [4] proposed a method based on image processing and machine learning for practical safety helmet wearing detection. They have used the Vibe background modeling algorithm to detect moving objects under a fixed surveillant camera in a power substation. To describe inner human features HOG feature extraction is used. To classify pedestrians, SVM (Support Vector Machine) was used to train the system. Using color feature recognition, safety helmets were detected. The framework method consists of three phases, background modeling, pedestrian classification, safety helmet detection. Regarding the error rate, this proposed method focuses on improving the speed and accuracy of detection of safety helmets wearing.

Kang Li, et al [5] proposed an automatic helmet detection framework that detects the safety helmet of ambulatory workers in power substations. This framework implements computer vision, machine learning, and image processing. This proposed framework is designed

to detect the workers with and without a safety helmet. This system is divided into, moving object segmentation, pedestrian classification in a power substation, and finally safety helmet detection for detecting whether the worker is wearing a helmet or not. This framework was useful and detected up to a certain limit, and some drawbacks like distance, illumination, etc.

Aleksa Corovic, et al [1] presented a YOLOv3 algorithm for accurate object detection of traffic participants. The performance was tested in real-time under various driving conditions. This proposed YOLOv3 algorithm was based on CNN (Convolutional neural network). The algorithm extracts a single image for the input video in real-time and resizes the image and then represents it as input to the YOLO network. Then the objects are detected with a bounding box in real-time, based on comparing real-time data with trained datasets. The proposed YOLO algorithm was specialized for real-time detection and tracking of multiple objects. Under certain weather and lighting conditions, the system was not able to perform at its best. But it still performed with high precision and provided a solid base for object detection.

III. PROPOSED SYSTEM

The system proposed in this paper is based on Feature descriptors and Deep Neural networks for object feature extraction and classification of an object. And implements some advanced methods and steps.

3.1 MODULES IMPLEMENTED:

YOLO v3:

You Only Look Once, is a method to detect objects in an image in real-time. It is an algorithm for object detection in real-time. It looks at the entire image once and classifies the object in real-time. Here it is used to detect helmets in a real-time input video through a webcam. It detects the object (helmet) by highlighting it in a colored box with the object name and the accuracy percentage of the object.

Feature descriptors:

It is an algorithm and a method used to classify the object or features of an object. This is used to extract the features of an object.

DNN-Classifier:

Deep Neural Networks are used to classify objects by comparing real-time footage and object features extracted with pre-trained data sets [3]. It is

a neural network that has multiple layers and has been trained with a labeled dataset to perform classification on related and unlabelled data. It is used to classify the object and display the output.

ALPR:

Automatic License Plate Recognition is a technology that is used to automatically recognize the license plate and read the characters in the license plate. It is used to recognize the license plate of the biker and extract the characters (letters and Numbers) present on the license plate. This is based on the KNN algorithm for the recognition, extracting, and classification of the characters.

SMS API (Short Messaging Service Application Programming Interface):

It is a software integration interface that allows sending short SMS messages through an SMS API platform (SMS service provider). Bulk SMS service API allows sending bulk messages in different formats and various networks. It is used to send a Short SMS notification message regarding the fine the biker has received for not wearing a helmet and breaking the law.

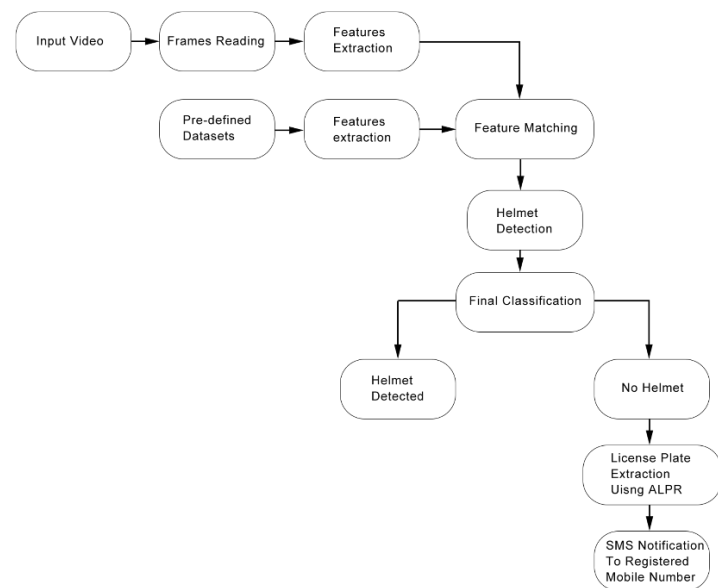


FIG 1 PROPOSED SYSTEM ARCHITECTURE

3.2 STEPS INVOLVED:

Detection of a bike rider with and without a Helmet:

At first, the input video is captured in real-time through a webcam the proposed system detects for a

bike rider and then for the helmet. If the rider is wearing a helmet, the area around the head of the bike rider will be detected or highlighted by a bounding box with the object name and the accuracy of the helmet detected [1]. Using feature descriptors, features are classified and extracted for the objects present in a frame of the real-time footage and the DNN-classifier compares the data produced with the pre-trained datasets and classifies the object. And once both datasets match, objects are classified and concluded. If the system detects the bike rider is not wearing a helmet it would display no helmet as output and conclude.

License plate Extraction using ALPR:

Using ALPR an input image of the biker's license plate is manually captured and the license recognition process begins. ALPR recognizes the license plate and extracts the characters i.e. number and letters present in the number plate using the K-Nearest Neighbour Algorithm. There are four steps present in ALPR for license plate extraction they are, Input image processing, license plate extraction, license plate thresholding, and character recognition [8]. These four components build ALPR.

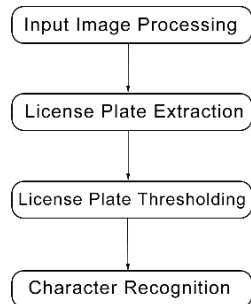


FIG 2 FOUR STEPS IN ALPR SYSTEM

SMS notification using SMS API:

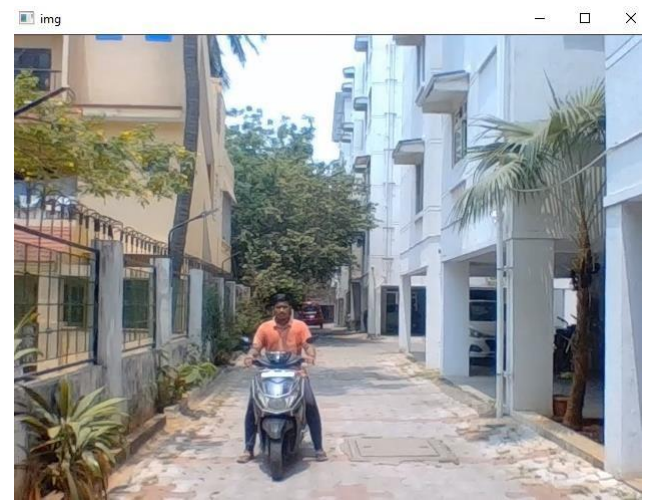
After the license plate extraction is completed, the system automatically sends a short SMS using SMS API regarding the fine issued for the bike rider without a helmet for breaking the law. The SMS is sent through an SMS service provided, to the mobile number of the biker registered in the system. This requires an internet connection.

IV. RESULTS AND DISCUSSION

4.1 HELMET DETECTION:

The proposed system uses feature descriptors and deep neural networks to classify objects or the features of an object and uses a DNN classifier to compare real-time footage with predefined datasets to identify or classify the objects present in a frame [2], [3].

YOLO algorithm is used by the system to detect the helmet by identifying the biker or a person first, then it checks the head of the biker for a helmet if the biker is wearing a helmet the system would detect the helmet by identifying it within a bounding box and tracking it in the real-time input video around the head area of the biker and with the helmet precision level [1]. Finally, the system uses feature descriptors to classify the features of the object (helmet) and with the help of DNN-classifier, it will compare the extracted data with per trained datasets and classify or finalize the object, and displays the output as Helmet detected on the output window. If the system does not detect a helmet on the biker, the system would display No helmet as output in the output window.

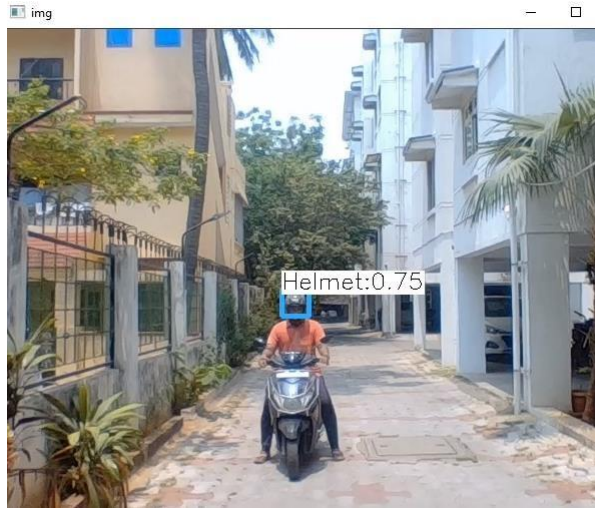


(a) Real-time input video without helmet



(b) No helmet detected displayed in output screen

FIG 3. NO HELMET DETECTED



(a) Real-time input video with helmet

```

*IDLE Shell 3.9.1*
File Edit Shell Debug Options Window Help
Python 3.9.1 (tags/v3.9.1:1e5d33e, Dec 7 2020, D64) on win32
Type "help", "copyright", "credits" or "license()>>>
>>>
===== RESTART: C:\Users\Acer\Videos\projec
No helmet
No helmet
No helmet
No helmet
No helmet
Helmet detected
Helmet detected
Helmet detected
Helmet detected
Helmet detected
  
```

(b)Helmet detected displayed in output screen

FIG 4. HELMET DETECTED

4.2 LICENSE PLATE CHARACTER EXTRACTION:

In this part of the proposed system, a license plate image is manually captured through an IP cam (mobile application) through the internet and it is used as input. Using ALPR based on K-Nearest Neighbour (KNN) algorithm, the license plate and its characters (numbers and letters) are extracted from the input image by the system. There are four steps in APLR, they are as follows.

- Input image processing - Analysing the image or identifying objects in an image ex: the vehicle, license plate, etc.
- License plate extraction - Here the license plate along gets extracted from the image.
- License plate thresholding - the characters present in the Extracted license plate image are converted to threshold image and filters are applied to identify the characters present in the number plate.

- Character Recognition - Using License plate segmentation images the characters present in the license plate is extracted. These four steps perform the entire license plate extraction process [8].

Finally, once the license plate character extraction is completed the system will automatically move to SMS Notification to send a short SMS.



(a) Input image processing



(b) License plate extraction



(c) License plate thresholding

```

license plate read from image = AL4636

-----
Sending sms
SMS has been sent...
  
```

(d) Character Recognition and SMS sent alert

FIG 5. LICENSE PLATE, CHARACTER EXTRACTION

4.3 SMS NOTIFICATION:

A short SMS is automatically sent to the biker's registered mobile number from the system. Regarding the fine, they have received for not wearing a helmet and breaking the law. The notification system is divided into two parts, client and server, where the server is the system and the client is the biker whose mobile number is registered in the system. With an internet connection, an SMS is sent from the system through an SMS service provider (using SMS API) to the mobile number of the biker registered in the system within a short time as soon as the license plate characters extraction process completes.

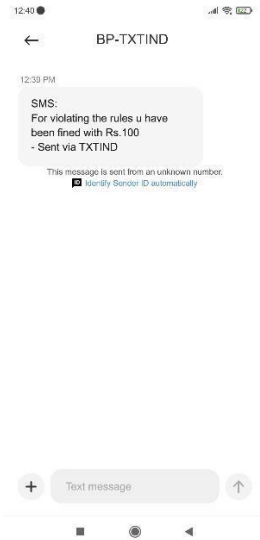


FIG 6. SMS NOTIFICATION

V. PERFORMANCE ANALYSIS

The proposed system work as designed. It uses YOLO for the input video for helmet detection and tracking in real-time, and a feature descriptor algorithm to classify the features of the helmet. Then Deep neural networks are applied to classify the entire object i.e. helmet with high speed and precision for the helmet detection process. ALPR based on KNN-algorithm performs the license plate extraction process with high speed and accuracy. SMS notification is sent within a short time by SMS API. Using different methods for the Classification of different objects makes it easy for the system to perform well. Accurate detections, identification, classification, or extraction of objects improves performance, the speed at which the data is processed, or the time taken to produce an output. The pre-trained datasets make the processing easy. Thus the detection of bike riders without a helmet is detected.

VI. CONCLUSION

The proposed system for automatic detection of bike riders without a helmet can change the traffic management department with monitoring in the safest, most efficient way. The system framework consists of three procedures rooted with different methods and algorithms helmet detection, license plate extraction, and SMS notification. YOLO, feature descriptor, and deep neural networks for helmet detection. KNN-algorithm based ALPR for license plate extraction. And SMS API were applied for SMS notification. Even though the proposed system performs as expected it has some drawbacks which affect the outputs produced. illumination, weather, the angle at which the camera is placed, or the angle at which the image is captured for processing, and the speed at which the biker is

traveling in the bike may affect the helmet detection process and license plate identification process. Furthermore, the use of third-party license plates, different font styles, font size, space between the characters present in the license plate, the position of the license plate make it difficult for the system to recognize the characters present in the license plate. Low network signal and speed, etc., may affect the SMS notification process. The use of deep learning for detection, classification, identification tasks improves the performance of the proposed system. The future work of the proposed system will focus on working the helmet detection process and license plate character extraction process along with the SMS notification process together in a single framework and improve the detection, identification, extraction, and classification precision and accuracy of the system.

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C. Source code

```
blnKNNTrainingSuccessful = DetectChars.loadKNNDataAndTrainKNN()

if blnKNNTrainingSuccessful == False:

print("\nerror: KNN training was not successful\n")

return

# end if

## imgOriginalScene = cv2.imread("LicPlateImages/3.png")

imgOriginalScene = cv2.imread("LicPlateImages/3.png")

print("\nerror: image not read from file \n\n")      os.system("pause")

return                                     # end if

listOfPossiblePlates = DetectPlates.detectPlatesInScene(imgOriginalScene)
# detect plates

listOfPossiblePlates = DetectChars.detectCharsInPlates(listOfPossiblePlates)
# detect chars in plates

cv2.imshow("imgOriginalScene", imgOriginalScene)

if len(listOfPossiblePlates) == 0:

print("\nno license plates were detected\n")

listOfPossiblePlates.sort(key = lambda possiblePlate:
len(possiblePlate.strChars), reverse = True)

licPlate = listOfPossiblePlates[0]

cv2.imshow("imgPlate", licPlate.imgPlate)

cv2.imshow("imgThresh", licPlate.imgThresh)

if len(licPlate.strChars) == 0:

print("\nno characters were detected\n\n")

return

drawRedRectangleAroundPlate(imgOriginalScene, licPlate)

print("\nlicense plate read from image = " + licPlate.strChars + "\n")

print("_____")

writeLicensePlateCharsOnImage(imgOriginalScene, licPlate)

cv2.imshow("imgOriginalScene", imgOriginalScene)
```

```

        cv2.imwrite("imgOriginalScene.png", imgOriginalScene)
# end if else
cv2.waitKey(0)
return

ALPR

bInKNNTrainingSuccessful = DetectChars.loadKNNDataAndTrainKNN()      #
attempt KNN training
if bInKNNTrainingSuccessful == False:
    print("\nerror: KNN training was not successful\n")
    return
# end if

##  imgOriginalScene = cv2.imread("LicPlateImages/3.png")
imgOriginalScene = cv2.imread("first.png")
if imgOriginalScene is None:
    print("\nerror: image not read from file \n\n")
    os.system("pause")
    return
# end if

listOfPossiblePlates = DetectPlates.detectPlatesInScene(imgOriginalScene)
# detect plates

listOfPossiblePlates = DetectChars.detectCharsInPlates(listOfPossiblePlates)
# detect chars in plates

if len(listOfPossiblePlates) == 0:
    print("\nno license plates were detected\n")
else:
    )

    listOfPossiblePlates.sort(key = lambda possiblePlate:
len(possiblePlate.strChars), reverse = True)
    licPlate = listOfPossiblePlates[0]
    cv2.imshow("imgPlate", licPlate.imgPlate)
    cv2.imshow("imgThresh", licPlate.imgThresh)

```

```

if len(licPlate.strChars) == 0:
    plate
    print("\nno characters were detected\n\n")
    return

drawRedRectangleAroundPlate(imgOriginalScene, licPlate)
print("\nlicense plate read from image = " + licPlate.strChars + "\n")
print("_____")
writeLicensePlateCharsOnImage(imgOriginalScene, licPlate)
cv2.imshow("imgOriginalScene", imgOriginalScene)
cv2.imwrite("imgOriginalScene.png", imgOriginalScene)
# end if else

SMS
cv2.waitKey(0)
if blnKNNTrainingSuccessful == False:
    print("\nerror: KNN training was not successful\n")
    return
# end if

## imgOriginalScene = cv2.imread("LicPlateImages/3.png")
imgOriginalScene = cv2.imread("first.png")
if
    print("\nerror: image not read from file \n\n")
    os.system("pause")
    return
# end if

listOfPossiblePlates = DetectPlates.detectPlatesInScene(imgOriginalScene)
# detect plates

listOfPossiblePlates = DetectChars.detectCharsInPlates(listOfPossiblePlates)
# detect chars in plates

cv2.imshow("imgOriginalScene", imgOriginalScene)
if len(listOfPossiblePlates) == 0:
    print("\nno license plates were detected\n")

```

```

listOfPossiblePlates.sort(key = lambda possiblePlate:
len(possiblePlate.strChars), reverse = True)

licPlate = listOfPossiblePlates[0]

cv2.imshow("imgPlate", licPlate.imgPlate)

    cv2.imshow("imgThresh", licPlate.imgThresh)

if len(licPlate.strChars) == 0:                plate

    print("\nno characters were detected\n\n") # show message

    return

    print("\nlicense plate read from image = " + licPlate.strChars + "\n") # write
license plate text to std out

    print("_____")

    if(licPlate.strChars==licPlate.strChars):

        print("Sending sms")

        url = "https://www.fast2sms.com/dev/bulk"

API_KEY = "xxx.xxx"

        to_num = "zzzzzz"

        payload = "sender_id=FSTSMS&message="+ "For violating the rules u
have been fined with Rs.100"+"&language=english&route=p&numbers="+to_num

        headers = {

            'authorization': API_KEY,

            'Content-Type': "application/x-www-form-urlencoded",

            'Cache-Control': "no-cache",

        }

        response = requests.request("POST", url, data=payload,
headers=headers)

        print("SMS has been sent...")

writeLicensePlateCharsOnImage(imgOriginalScene, licPlate)

    cv2.imshow("imgOriginalScene", imgOriginalScene)

cv2.imwrite("imgOriginalScene.png", imgOriginalScene)

    # end if else

cv2.waitKey(0)

    return

```