Konnect: An Internet of Things(IoT) based smart helmet for accident detection and notification

Conference Paper · December 2016

DOI: 10.1109/INDICON.2016.7839052

3 authors, including:

Sreenithy Chandran
Arizona State University

N. Edna Elizabeth
Sri Sivasubramaniya Nadar College of Engineering

Konnect: An Internet of Things(IoT) based Smart Helmet for Accident Detection and Notification

Sreenithy Chandran, Sneha Chandrasekar, Edna Elizabeth N
Department of Electronics and Communication Engineering
Sri Sivasubramaniya Nadar College of Engineering
Kalavakkam, India
sreenithy13097@ece.ssn.edu.in, sneha13095@ece.ssn.edu.in, ednaelizabethn@ssn.edu.in

Abstract—**The objective of the smart helmet is to provide a means and apparatus for detecting and reporting accidents. Sensors, Wi-Fi enabled processor, and cloud computing infrastructures are utilised for building the system. The accident detection system communicates the accelerometer values to the processor which continuously monitors for erratic variations. When an accident occurs, the related details are sent to the emergency contacts by utilizing a cloud based service. The vehicle location is obtained by making use of the global positioning system. The system promises a reliable and quick delivery of information relating to the accident in real time and is appropriately named Konnect. Thus, by making use of the ubiquitous connectivity which is a salient feature for the smart cities, a smart helmet for accident detection is built.**

Keywords—Accident Detection; Cloud Computing; Hypertext Transfer Protocol; Internet of Things; Sensor; Ubiquitous Sensing

I. Introduction

The Global status report on road safety 2015, reflecting information from 180 countries, indicates that close to 1.25 million people die every year as a result of road accidents [1]. Close to one fourth of the people involved in accidents are motorcyclists. The main cause of death in two-wheeler drivers is over speeding and careless driving. Numerous lives could have been saved if emergency medical service could get accident information and reach in time to the scene [2]. Up to 75% of all deaths occur within the first one hour of impact. Thus, in this crucial phase of time, if proper aid reaches the victims, mortality rates can be reduced.

This project aims to build an Internet of Things (IoT) application that leverages on ubiquitous connectivity, sensing and data analytics that are the basis of IoT applications. The IoT is comprised of smart machines interacting and communicating with other machines, objects, environments and infrastructures. The huge volumes of data thus generated, is processed into useful actions that can "command and control" things, to make our lives much easier and safer [3]. IoT applications introduce numerous benefits like the capability to remotely monitor, manage and control devices, and to get new insights and useful information from massive streams of real-time data. The foundation however lies on the intelligence of the embedded processor.

In order to realise the full potential of the cloud computing and the ubiquitous sensing, a combined framework of both is important. Thus, IoT application-specific framework should be able to provide support for the following [4]:

1) Reading data streams from sensors directly
2) Transparent and scalable processing of the data
3) When events of interest are detected, the predetermined set of actions has to be triggered by utilizing the various cloud computing applications.

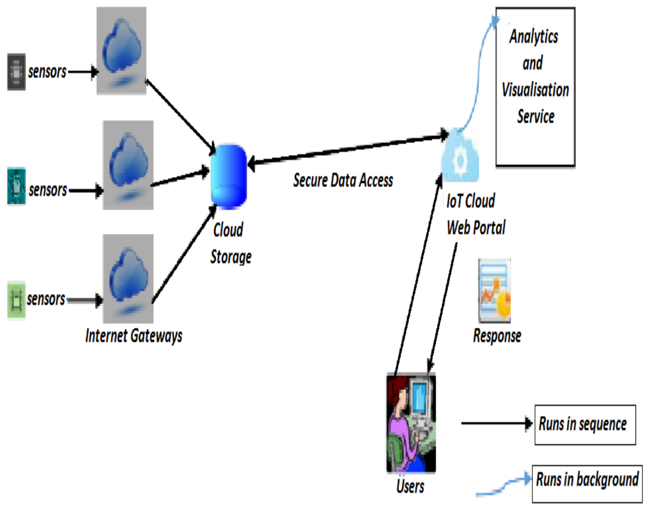


Fig. 1. The interaction between various stakeholders in cloud centric IoT framework.

II. Related Work

IoT and accident management are two areas in which fast progress is being made. White et al. focussed on using the smart phone for accident detection and notification [5]. Zhao [6] outlines the implications of location awareness on cellular devices, and utilising this for smarter accident monitoring systems in cars. However, cars are usually designed to reduce the force on the driver. Thus, the force experienced by a smartphone may not be proportional to the force experienced by in-vehicle sensors that are mounted insides the car. This may result in inaccurate detection of an accident. Moreover, power consumed by the GPS receiver in a smartphone is high, rendering the battery life to be reduced at a fast rate.

Numerous papers have dealt with the transmission of accident information [7], [8]. There have been many advances in the development of communication between vehicles (V2V technologies), also known as vehicular ad hoc networks (VANETs) [9]. The 802.11p working group approved the IEEE 802.11p standard [10], providing a viable solution for inter-vehicular security applications.

The U.S. Department of Transportation (DOT) has developed projects to improve traffic safety through the use of vehicular communication, based on testing the effectiveness and safety benefits of the wireless connected vehicle technology in real-world, multimodal driving conditions [11]. These experiments only include V2V communications.

The monitoring system proposed by Jung et. al. [12] includes non-intrusive active electrodes installed on the seats of the vehicle. The data collected is sent through a wireless PAN and data is processed to identify if the driver is stressed or not. However it can be seen that these approaches are too limited because of the very short communication range.

However, most of the existing technology has been designed for 4-wheeled vehicles and are limited in perspective in terms of its reach and cost. As the network of such systems expands, maintenance also becomes expensive [5]. Thus, there is a need for an intelligent vehicular safety system that ensures affordable safety and can be availed by all.

Thus, we present a simple design and implementation of a low cost and secure Internet-based smart helmet.

This paper is organized as follows:

Section II contains related work highlighting previous publications related to this topic. Section III enumerates the proposed scheme for the smart helmet and is divided into 2 parts. Part A explains the challenges associated in developing an accurate accident detection system. Part B elaborates the working principle of the system and focuses on the accident detection system, accident notification mechanism and the details about the custom API that is employed in the integration and transfer of data. Section IV outlines the results obtained from the proposed work. Section V consists of conclusions and future work.

III. Proposed Scheme for Smart Helmet - Konnect

This paper describes the prototype of the smart helmet-called Konnect. An integrated network of sensors, Wi-Fi enabled processor, and cloud computing infrastructures are utilised to build the smart helmet for accident detection and notification. The helmet is designed to detect an accident and immediately alert emergency contacts. A 3-axis accelerometer is used to continuously monitor the head orientation of the driver and the helmet's position and hence calculate the possibility of accident. When the threshold limit is exceeded a text message containing the location of the driver is automatically initiated to the emergency contacts. The text messages are automatically initiated at regular intervals to enable the contacts to locate the driver easily.

A. Challenges associated with automatic detection and notification of accidents

1. Need to prevent false positives from being triggered
   Network of sensors attached to the accident detection systems is utilised to determine if an accident has occurred. The change in acceleration is a key indicator. When the motorist accidently drops the helmet, there are chances of a false positive being triggered due to the abrupt changes in the accelerometer value. Since the notification about the accident is being sent to the emergency contacts it is important to suppress false positives. Else it will result in the faulty functioning of the system and wastage of resources on false incident reports.
2. Detection of the accident forces accurately
   Conventional accident detection systems rely on sensor networks embedded in the car. For example, the sensors detect airbag deployment, acceleration/deceleration etc., However it is not possible to get such vast amounts of data from two wheelers. Thus, with the available resources and limited logistical capability, accurate detection of accident is needed.
3. Delay in notification reaching the emergency contacts
   As soon as the monitoring system detects an accident, the information has to be securely transferred to the emergency contacts. In case the contact misses out the accident notification, then the system must be designed to recursively send the message until the message has been acknowledged.

B. Working Principle

The Konnect provides a cheap, effective accident detection and notification system to address the aforementioned problems. Though integrating sensors with a high-end microcontroller provides rapid accident detection, they are limited in terms of processing and notification capabilities. The TI CC3200 [14] is a Wi-Fi enabled controller, which is used to connect to a data network for accessing cloud services. This expands the computational and storage capabilities of the system. The system on the helmet communicates with the cloud based incidence response and notification system via a RESTful architecture over HTTP using JSON.

1. Accident Detection System

A tri-axial accelerometer, GPS, and microcontroller are present on the helmet. The on-board accelerometer BMA222 in the CC3200 detects variation in spatial components along 3 orthogonal directions x, y and z. A threshold value is predefined giving allowances for minor levels of head tilt not pertaining to an accident. When a sudden change exceeding the threshold value in all 3 directions is observed simultaneously, the change in resultant acceleration is calculated. Average variation of resultant acceleration values is calculated over varying windows of time and then compared with the acceleration threshold. If the value is exceeded, then the processor detects a crash [16].

2. Accident Notification System

The notification system can be divided into two parts the client and the server. The TI CC3200 micro-controller acts as the client and the server is a cloud-based web service. The monitoring system makes use of the accelerometer value and GPS to send information to the cloud based notification system.

A CC3200 device has the capability to behave as a station in a typical networking system. It can connect to access point and can use the Internet services via the same access point, if available. The usual steps involved include [15]:

1) Connecting to an access point.
2) Connect to a HTTP Server with and without proxy.
3) Perform POST, GET, PUT and DELETE.
4) Parse JSON data using “Jasmine JSON Parser.

3. Custom APIs

The increased complexity associated with integrating monitoring, deployment, and ticketing systems results in ineffectual delivery of alert, straining the competent working of the helmet. The major problems that needed to be overcome include alert fatigue, possibility of missing an event, sending the message to a wrong person, increased time for information transfer and incident resolution. In order to overcome these drawbacks, we make use of an incident resolution platform PagerDuty [13]. We make use of the PagerDuty REST API to inform the emergency contacts whenever an accident has been detected. The monitoring tools send PagerDuty a trigger event to report a new or ongoing problem. Incoming events that are sent via the API are routed to a PagerDuty service and processed.

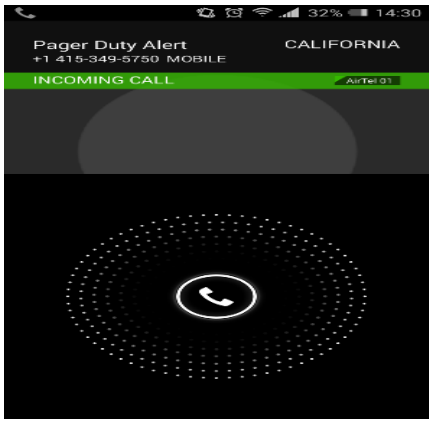
Usually a customized API is created by making the system make a simple HTTP call or run a command-line script. The REST (Representational State on Demand) is an architectural style based on which the protocols are designed. It is resource-based and the resources are identified by URIs. The representation is transferred between client and server in the form of either JSON or XML. PagerDuty REST API accepts JSON and form encoded content as input and the output is in JSON.

The various steps involved with triggering the incidence response and alerting service are listed as follows:

Step 1: Creating an account in PagerDuty.
Step 2: Generation of an API key.
Step 3: Sending a POST request to an API with the necessary credentials and parameters.
Step 4: Triggering an incident using API.

IV. RESULTS

As soon as the erratic variations are obtained, a trigger is sent to PagerDuty from the microcontroller. PagerDuty then initiates a call to the motorist’s phone number. This is shown in figure 2. The phone call gives the driver information regarding the service that caused the alert and some basic information about the alert, plus options to respond such as "Press 4 to acknowledge, 6 to resolve, or 8 to escalate”. If button 4 is pressed it implies driver wants to acknowledge the occurrence of the event. Button 6 implies it is a wrong trigger and the driver is fine thus the event has to be resolved completely. Button 8 means the next level of contacts are informed about this incident. If the driver does not respond for a period of 5 minutes after the first call is initiated, then the emergency contacts will be informed. The emergency contacts are alerted through e-mail, text, phone call until they acknowledge the incident. The details of users who will be alerted when incidents occur is assigned beforehand.



a.

Fig. 2. Screenshot of call being received by the motorist

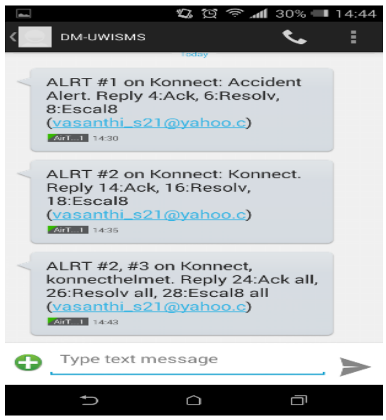


Fig. 3. Screenshot of Text Messages received by the motorist

In case the motorist does not pick up the call, a text message is sent to their phone number. This is shown in Fig. 3. The motorist is expected to reply by either acknowledging, resolving or escalating the alert. The text messages will be continuously sent for a period of 5 minutes, beyond which the accident notification is sent to the emergency contact. The email id of the emergency contact is also specified in the text.

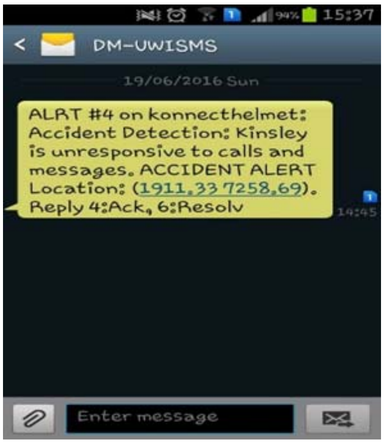


Fig. 4. The text message received by the emergency contact.

When the motorist does not resolve the alert he receives, within a period of 5 minutes, the accident notification is sent to the emergency contact. The accident alert received by the contact contains a predefined message, here the message reads “Kinsley is unresponsive to calls and messages, ACCIDENT ALERT”. Also the latitude and longitude of the location of the motorist is present. Fig. 4. shows the message received by the emergency contact. The text messages are sent every 2 minutes to the contact, until the contact acknowledges or resolves the notification.

V. CONCLUSIONS AND FUTURE WORK

The smart helmet developed is a smart and reliable piece of technology that is cheap to develop and operate and yet not compromise on safety. Additionally, it offers several advantages over the existing methods of accident detection and notification systems that rely heavily on the data collected from cellular devices of the drivers. Also, most of the systems that are available in the automobile market are designed for only four-wheeled vehicles. Thus, the Internet of Things based application- Konnect, proposed in this paper will prove to ensure greater safety for the motorists.

As a future extension of the work the smart helmet could be equipped to detect alcohol content in the breath of the motorist in order to keep a check on drunk and driving cases.

References

[1] World Health Organisation, "Global status report on road safety 2015", 2015.

[2] M. Fogue, P. Garrido, F. Martinez, J. Cano, C. Calafate and P. Manzoni, "Automatic Accident Detection: Assistance Through Communication Technologies and Vehicles", *IEEE Veh. Technol. Mag.*, vol. 7, no. 3, pp. 90-100, 2012.

[3] "Internet of Things (IoT) - ARM", *Arm.com*, 2016. [Online]. Available: https://www.arm.com/markets/internet-of-things-iot.php. [Accessed: 30-Jul- 2016].

[4] J. Gubbi, R. Buyya, S. Marusic and M. Palaniswami, "Internet of Things (IoT): A vision, architectural elements, and future directions", *Future Generation Computer Systems*, vol. 29, no. 7, pp. 1645-1660, 2013.

[5] J. White, C. Thompson, H. Turner, B. Dougherty, and D. C. Schmidt, “WreckWatch: Automatic Traffic Accident Detection and Notification with Smartphones,” Mob. Netw. Appl., vol. 16, no. 3, pp. 285–303, Jun. 2011.

[6] Yilin Zhao, "Mobile phone location determination and its impact on intelligent transportation systems", *IEEE Trans. Intell. Transport. Syst.*, vol. 1, no. 1, pp. 55-64, 2000.

[7] M. Fogue, P. Garrido, F. Martinez, J.-C. Cano, C. Calafate, and P. Manzoni, “Automatic Accident Detection: Assistance Through Communication Technologies and Vehicles,” IEEE Veh. Technol. Mag., vol. 7, no. 3, pp. 90–100, Sep. 2012.

[8] F. Abduljalil, "A framework for vehicular accident management using wireless networks", *2012 IEEE 13th International Conference on Information Reuse & Integration (IRI)*, 2012.

[9] H. Hartenstein and K. Laberteaux, ‘‘A tutorial survey on vehicular ad hoc networks,’’ IEEE Commun. Mag., vol. 46, no. 6, pp. 164–171, June 2008.

[10] *IEEE Standard for Wireless Accesss in Vehiular Environments(WAVE)-Identifier Allocations*, IEEE Standard 1609.12, 2016.

[11] U.S. Dept. Transp.– Research and Innovative Technology Administration (RITA). (2012). Safety Pilot Program Overview [Online].

[12] S. Jung, H. Shin, J. Yoo, and W. Chung, “Highly sensitive driver condition monitoring system using nonintrusive active electrodes,” in Proc. IEEE ICCE, Las Vegas, NV, USA, Jan. 2012, pp. 305–306.

[13] "API Reference · PagerDuty", *PagerDuty*, 2016. [Online]. Available: https://v2.developer.pagerduty.com/page/api-reference. [Accessed: 30-Jul- 2016].

[14] "SimpleLink Wi-Fi CC3200 LaunchPad - CC3200-LAUNCHXL - TI Tool Folder", *Ti.com*, 2016. [Online]. Available: http://www.ti.com/tool/cc3200-launchxl. [Accessed: 30- Jul- 2016].

[15] "CC32xx HTTP Client Demo - Texas Instruments Wiki", *Processors.wiki.ti.com*, 2016. [Online]. Available: http://processors.wiki.ti.com/index.php/CC32xx_HTTP_Client_Demo. [Accessed: 30- Jul- 2016].

[16] Bruce R. Donnelly, David G. Schabel, "Method and apparatus for automatic vehicle event detection, characterization and reporting", U.S.. Patent 6076028 A, June 13, 2000.

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 03 | Mar 2019 www.irjet.net p-ISSN: 2395-0072

Smart Helmet for Safety and Accident Detection using IOT

Akshatha[1], Anitha[2], Anusha[3], Prema[4], Rumana Anjum[5]

[1,2,3,4] B.E IV year, Department of CSE, Vidya Vikas Institute of Engineering & Technology, Mysuru, Karnataka, India
[5] Assistant Professor, Dept. of CSE, Vidya Vikas Institute of Engineering & Technology, Mysuru, Karnataka, India

---***---

Abstract - *Road accidents are increasing in our country, most of them are caused due to negligence of not wearing the helmet, drink and drive and over speeding which many leads to death or severe injuries due to lack of medical treatments provided to the injured person at right time. This motivates us to think about making a system which ensures the safety of biker, by making it mandatory to wear the helmet by the rider to prevent head injuries that may lead to immediate death, prevent drink and drive scenario by testing the breath of the rider before the ride, prevent over speeding and rash riding by alerting the rider and also to provide proper medical attention, if met with an accident by notifying the concerned person with the location details.*

Key Words: Accelerometer, Microcontroller, Alcohol detection, Accident detection, Notification.

1.INTRODUCTION

It is a well-known fact that young generation prefers bikes and motorcycle over four-wheeler. The riders avoid wearing helmet without any specific reason. Moreover, over speeding and drink and drive have become common issues. Due to the lack of experience or focus and violation of traffic rules, which leads to accidents. So, with the help of technology we made sure that traffic rules are followed, problems mentioned above are avoided and their effects are minimized. The idea of developing this work comes from our social responsibility towards society. In many accidents that occur, there is a huge loss of life. Many people die on roads every year that occur due to bike accidents. There are various reasons for accidents such as not having adequate ability to drive, defective two wheelers, rash driving, drink and drive, etc. But the main reason was the absence of helmet on the person which leads to immediate death due to brain damage. Therefore, it is important that there should be a facility to minimize the after effects of these accidents. However, the main goal of our work is to make it mandatory for the rider to wear a helmet during the ride, to prevent drink and drive scenario and over speeding or rash riding by motorcyclists and also provide proper medical attention when met with accident by alerting the concerned person which will provide solutions to other major issues for accidents.

1.1 Objectives

The main objective of this system is to design a helmet that provides safety to motorcyclist and to prevent drink and drive. It detects accident and alert the guardian about accident and prevents over speeding and to develop an android application to monitor motorcyclist and send alert SMS.

2. PROPOSED SYSTEM

This paper describes the prototype of smart helmet using IOT, which ensures the safety and security of the bike rider. Here the system is responsible for the following functionalities.

- The system will not allow the rider to start the vehicle, if the rider is not wearing the helmet.
- It detects the consumption of alcohol, if the rider has consumed alcohol, the bike engine will not start.
- The system alerts the rider when the speed exceeds the limited value.
- The fingerprint authorisation, provides security and prevents vehicle theft.
- When met with an accident it detects it and gives the notification to the registered contact with a location and picture information

3. SYSTEM DESIGN

This system consists of two modules that is user and admin module. User module consists of an android application where it used to send the notification to the guardians and nearby authorities. The admin module consists of two sections:

Helmet section
Bike section

3.1 Helmet Section:

This section consists of push button, alcohol sensor, accelerometer, micro controller, RF transmitter.

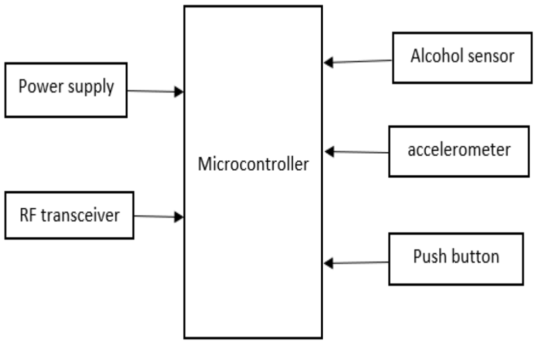


Fig 1 Helmet Section

3.1.1 Alcohol sensor:

Fig 2 Alcohol sensor (MQ-3)

It is a gas sensor which detects the presence of alcohol content gas concentration from 0.05 mg/L to 10 mg/L. it is an high sensitive to alcohol and a low cost semiconductor sensor which provides fast response and gives both digital and analog output.

3.1.2 Accelerometer:

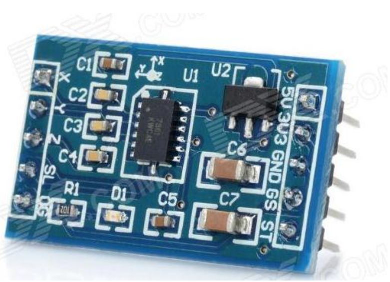


Fig 3 Accelerometer (MMA7361)

It is an integrated circuit which is used to measure the acceleration with respect to the object where this accelerometer is attached. Here we use this accelerometer for accident detection by placing it to helmet and can be detected by tilting of helmet with respect to ground.

3.2 Bike Section:

This section consists of RF receiver, Microcontroller, GSM module, decoder.

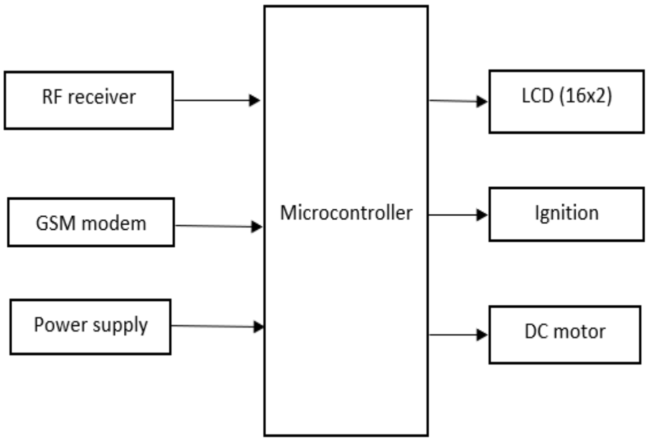


Fig 4 Bike Section

3.2.1 GSM modem:

Fig 5 GSM modem (sim900)

It consists of an sim card port where the sim has to be inserted and can be operated using a mobile operator where to communicate through mobile network. It is used by internet connectivity to send and receive the messages.

3.2.4 Microcontroller(P89V51RD2):

Fig 6. P89V51RD2 microcontroller

It is an 80C51 microcontrollers which consists of 64KB Flash a 1024 bytes RAM. It supports the 12 clock or 6 clock mode selection through software. The parallel programming and serial system programming are supported by flash program. It offers a program at high speed and also cost reduce programming.

4. IMPLEMENTATION

The implementation of this system provides a very cheap and effective accident detection. Notification is provided using the android app which is controlled by an admin module.

Helmet section:

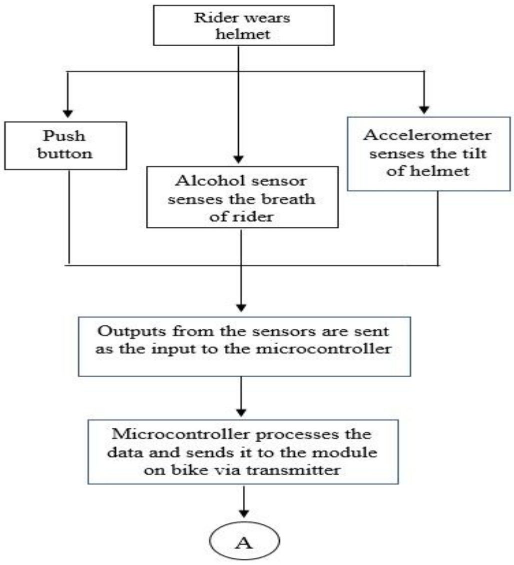


Fig 7. Flow chart of helmet section

When the rider has worn the helmet, the push button is pressed. [2] Alcohol sensor measures the presence of alcohol in rider's breath. Accelerometer measures tilting of the helmet. The output of these components will act as input for microcontroller which is on the helmet.

The microcontroller processes the data and sends it to the bike section using RF transmitter.

Bike Section:

RF receiver receives the data and the data is transmitted to the microcontroller. Microcontroller makes the decision according to the output of the helmet section.

There are two conditions to start bike ignition:

- Push button should be pressed when a rider wears the helmet.
- Rider should not be alcoholic.

When the output of the helmet section matches these two conditions, then the bike ignition will start.

If the rider exceeds the threshold speed, then the rider will get the alert message to slow down the speed.

- When an accelerometer measures the tilting of helmet with respect to ground as zero, it means that an accident has occurred. [3] Immediately accident notification will be sends to the registered contact number using GSM through "ACCIASSISTO" Application.

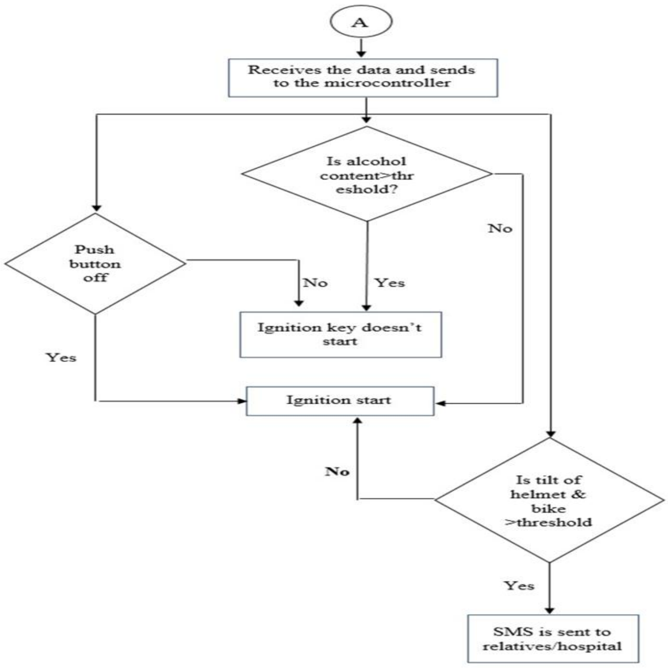


Fig 8. Flow chart of Bike section

The registered person will get the notification then he can request for the location and picture for more clarification.

Then they can provide the immediate medical requirement and they can also inform about the incident to the police station. If the accident is minor then the rider can abort the accident notification to the registered number.

ACCI ASSISTO:

It is an android application used to send the notification to guardians or nearby authorities. It consists of two side application one is guardian side application and the other is IOT side application where the person met with an accident.

IOT side application:

It is a user side application, here we have registered some emergent contact number.so that, it sends the alert notification to the registered contact number about the information of accident occurs and location area of the accident.

Fig 9 IOT side application

Guardian side application:

In Guardian side application, here it receives the alert notification of accident information. So, the Guardian request the location area and image of accident occurs. By entering the user number who had met with an accident.so that guardian receives the accident information and location area of accident occurs.

Fig 9 Guardian side application

5. RESULT

The system makes sure that the rides ware the helmet before the ride. The push button installed at the top of the helmet will provide signal to the microcontroller that the helmet is worn by the rider, if the signal from the push button is not received by the bike section the ignition of engine of the bike will not turn on. If the rider removes the helmet during the ride ignition of the bike will turn off.

The results show the system was able to detect the accident 275 times out of the 290 times in which 15 were false positives i.e. an accuracy of 94.82% was reached and sends the notification with the correct and current coordinates 96.72% (266/275) of the time. This accident detection result is based on the tilting of the helmet.

The alcohol sensor detects for the presence of alcohol in the breath of the rider, if the alcohol content is detected the bike ignition will not turn on. The results show that the system detected the presence of alcohol in the breath of the rider 225 times out of 250 times.

6. CONCLUSIONS

The system designed provides safety and reduces the after effects of the accident, notifying about the accident will provide timely care and treatments to the victim reducing the severe impacts on the person. The fingerprint authorisation prevents vehicle theft and provides security. The alcohol detection will prevent drink and drive scenario and the effects of drink and driving to public and the rider himself. Android application built for the system will ensure the smooth functioning of the system. Speed monitoring of the vehicle will prevent over speeding rash riding and violation of traffic rules.

REFERENCES

[1] S. Chandran, S. Chandrashekhar, E. Elizabeth N, "Konnect: An Internet of Things (IoT) based Smart Helmet for Accident Detection and Notification", India Conference (INDICON), 2016 IEEE Annual.

[2] Jennifer William, Kaustubh Padwal, Nexon Samuel, Akshay Bawkar, Smita Rukhande "intelligent Helmet" International Journals of Scietific & Engineering Research, volume 7, issue 3, March-2016.

[3] Shoeb Ahmed Shabbeer, Merin Melleet "Smart helmet for accident detection and notification" 2nd IEEE international conference on computational systems and information technology 2017.

[4] Syan Tapadar, Arnab Kumar Saha, Dr. Himadri Nath Saha, Shinjini Ray, Robin Karlose "Accident and Alcohol detection in Bluetooth enabled Smart Helmets for motor bikes".

[5] Nitin Agarwal, Anshul Kumar Singh, Pushpender Pratap Singh, Rajesh Sahani, "SMART HELMET", International Research Journal of Engineering and Technology, Volume 2, issue 2, May 2015.

[6] Professor Chitte P.P., Salunke Akshay S., Thorat Aniruddha, N Bhosale, "Smart Helmet & Intelligent Bike System", International Research Journal of Engineering and Technology (IRJET) Volume: 03 Issue: 05, May-2016.

Helmet Detection using Machine Learning and Automatic License Plate Recognition

Lokesh Allamki[1], Manjunath Panchakshari[2], Ashish Sateesha[3], K S Pratheek[4]

[1,2,3,4]*BNMIT, BENGALURU*

Abstract - *Motorcycle accidents have been rapidly growing through the years in many countries. In India more than 37 million people use two wheelers. Therefore, it is necessary to develop a system for automatic detection of helmet wearing for road safety. Therefore, a custom object detection model is created using a Machine learning based algorithm which can detect Motorcycle riders. On the detection of a Helmetless rider, the License Plate is extracted and the Licence Plate number is recognized using an Optical Character Recognizer. This Application can be implemented in real-time using a Webcam or a CCTV as input.*

Key Words: **Automatic License Plate Recognition (ALPR), Deep Neural Network (DNN), Helmet Detection, Machine Learning, Mean Average Precision (mAP), Optical Character Recognition (OCR), You Only Look Once (YOLO).**

1. INTRODUCTION

The main safety equipment of motorcyclist is the helmet. The helmet protects the motorcyclist against accidents. Although the helmet use is mandatory in many countries, there are motorcyclists that do not use it or use it incorrectly. Over the past years many works have been carried out in traffic analysis, including vehicle detection and classification, and helmet detection. Intelligent traffic systems were implemented using computer vision algorithms, such as: background and foreground image detection to segment the moving objects in scene and image descriptors to extract features. Computational intelligence algorithms are used too, like machine learning algorithms to classify the objects.

Machine learning (ML) is the field of Artificial Intelligence in which a trained model works on its own using the inputs given during training period. Machine learning algorithms build a mathematical model of sample data, known as "training data", in order to make predictions or decisions and are also used in the applications of object detection. Therefore, by training with a specific dataset, a Helmet detection model can be implemented. Using this helmet detection model helmet-less riders can be easily detected. Based one the detected classes the license plate of the rider is cropped out and saved as an image. This image is given to an Optical Character Recognition (OCR) model which recognizes the text and gives the License Plate number as output in the form of Machine encoded text. And it can also be implemented in real time using a Webcam.

The objective of this paper is to develop a system to enforce helmet wearing with the help of CCTV cameras. The developed system aims in changing unsafe behaviors and consequently reducing the number of accidents and its severity.

2. RELATED WORK

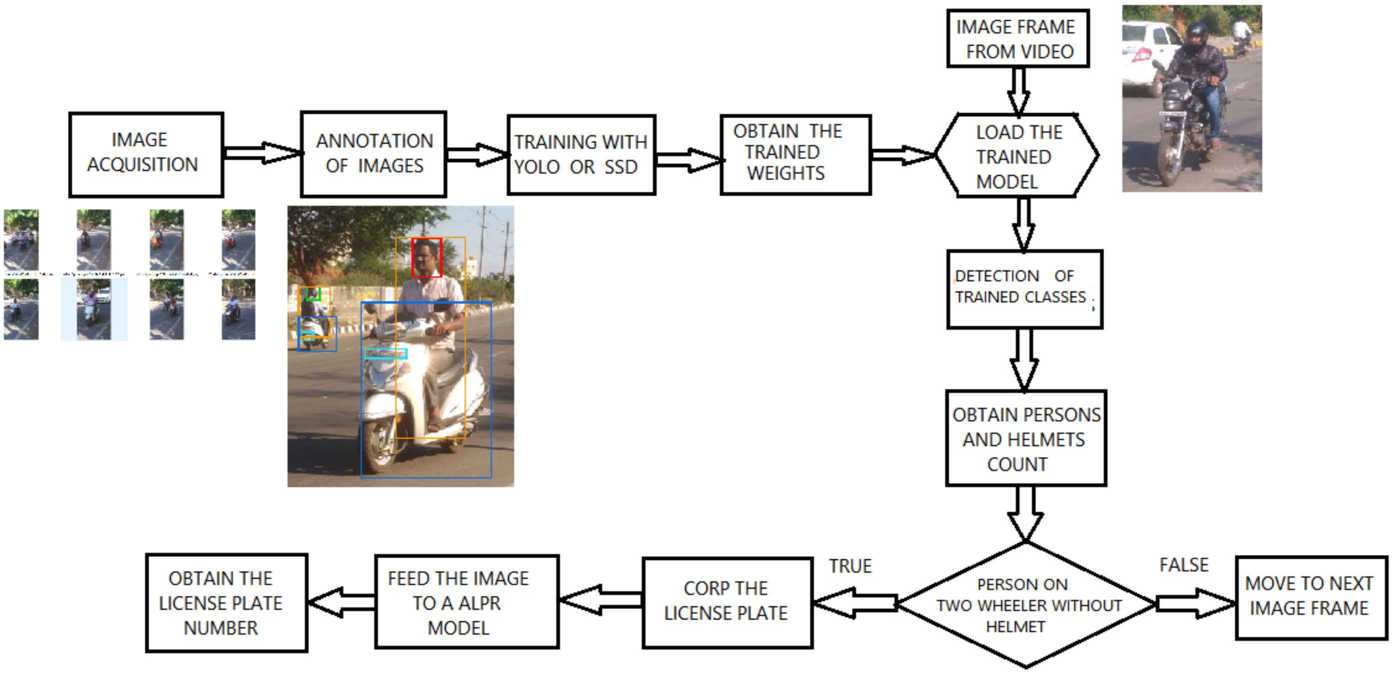
Over the past years, multiple approaches have been proposed to solve the problem of helmet detection. The authors in [7] use a background subtraction method to detect and differentiate between moving vehicles. And they used Support Vector Machines (SVM) to classify helmets and human heads without helmets. *Silva et al.* in [9] proposed a hybrid descriptor model based on geometric shape and texture features to detect motorcyclists without helmet automatically. They used Hough transform with SVM to detect the head of the motorcyclist. Additionally, they extend their work in [10] by multi-layer perception model for classification of various objects.

Wen et al. [10b] uses a circle arc detection method based upon the Hough transform. They applied it to detect helmet on the surveillance system. The drawback of this work is that they only use geometric features to verify if any safety helmet exists in the set. Geometric features are not enough to find helmets. In [11b] it proposes a computer vision system aiming to detect and segment motorcycles partly. A helmet detection system is used, and the helmet presence verifies that there is a motorcycle. In order to detect the helmet presence, the edges are computed on the possible helmet region. The Canny edge detector [12b] is used.

Waranusat et al. [11] proposed a system to detect moving objects using a k-NN classifier over the motorcyclist's head to classify helmet. These models were proposed based on statistical information of images and had a limitation to the level of accuracy that could be achieved.

With the evolution of neural networks and deep learning models there was further improvement in the accuracy of classification. *Alex et al.* [13] introduced a convolutional neural network (CNN) based method for object classification and detection. *A. Hirota et al.* [12] use a CNN for classification of helmeted and non-helmeted riders. Although they use CNN, their helmet detection accuracy is poor with limitations to helmet color and multiple riders on a single motorcyclist.

3. PROPOSED METHODOLOGY



For real-time helmet detection, there is a need for accuracy and speed. Hence a DNN based model You Only Look Once (YOLO) was chosen. YOLO is a state-of-the-art, real-time object detection system.

YOLOv3 is extremely fast and accurate and is a huge improvement over the previous YOLO versions. It also makes predictions with a single network evaluation unlike systems like R-CNN which require thousands for a single image. This makes it extremely fast, more than 1000x faster than R-CNN and 100x faster than Fast R-CNN [4].

Object detection is the craft of detecting instances of a certain class, like animals, humans and many more in an image or video. The Pre-Existing Object Detection API makes it easy to detect objects by using pretrained object detection models. But these models detect several Objects which are of no use to us, therefore in order to detect the necessary classes a custom object detector becomes necessary.

In order to implement helmet detection and number plate recognition and extraction, 5 objects need to be detected. The objects are – Helmet, No Helmet, Motorbike, Person (sitting on the bike) and License Plate.

There is a need to create a custom object detection model that is capable of detecting these objects. A collection of images containing the objects of the classes to be detected are used as a Dataset. This dataset is then used to train the custom model. Once the model has been trained, it can be used to detect these custom objects.

The training is done by feeding all the captured images with their annotations. The model extracts the features of each class from every image with the help of ground truth of the required classes. For extracting the features and storing them to recognize those features from other images, we use a deep learning, classifier based on the convolutional neural networks. When an image is given to this trained model the detection of the pretrained class is necessary. A few images are taken as an example to show the detection capability of the custom trained model.

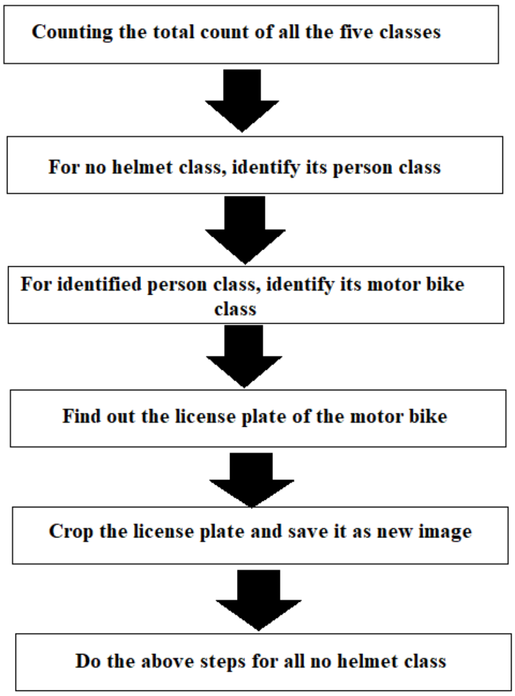
3.1 Helmet Detection

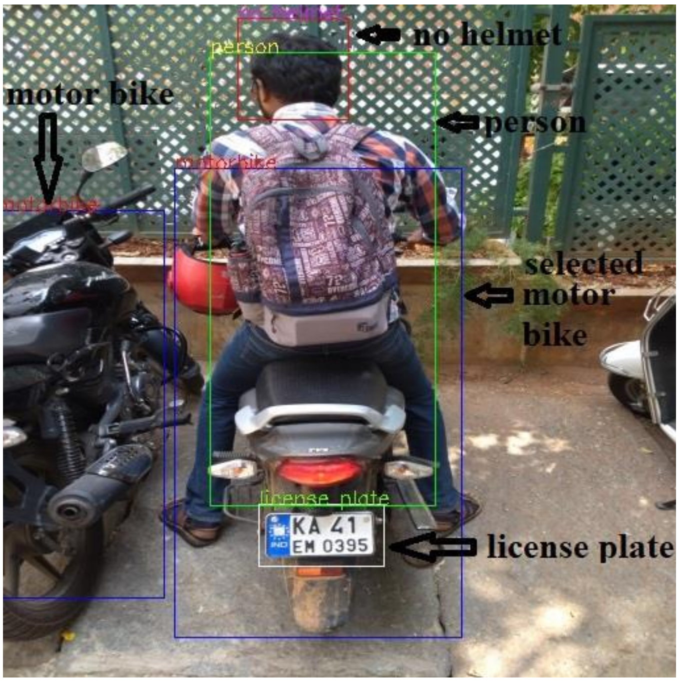
The annotated images are given as input to YOLOv3 model to train for the custom classes. The weights generated after training are used to load the model. Once this is done, an image is given as input. The model detects all the five classes trained. From this we obtain the information regarding person riding motorbike. If the person is not wearing a helmet, then we can easily extract the other class information of the rider. This can be used to extract the license plate.

3.2 License Plate Extraction

Once the helmetless rider is detected, the associated person class is detected. This is done by finding whether the co-ordinates of the no helmet class lie inside the person class or not. Similarly, the same steps are followed to detect the associated motorbike and license plate. Once the coordinates of the License plate are found, it is cropped and saved as a new image.

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 12 | Dec 2019 www.irjet.net p-ISSN: 2395-0072





3.3 License Plate Recognition

The extracted license plate is given to an Optical Character Recognition (OCR) model. The OCR recognizes text in the given image and outputs the recognized strings in the machine-encoded text. The OCR module within will output a list of predicted license plate numbers along with a confidence value. The confidence value indicates how confident it is in recognizing the given license plate accurately. Then, the license plate recognized with highest confidence value is stored in a text file for further use.

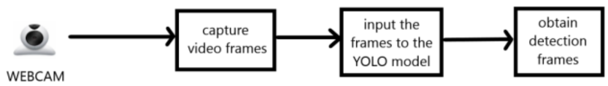
Plate #1

	Plate	Confidence
-	KA41EM0395	89.353058
-	KA41M0395	80.161301
-	KA416M0395	79.876579
-	KA41KM0395	79.874893
-	KA41BM0395	79.874687

4. REAL TIME IMPLEMENTATION

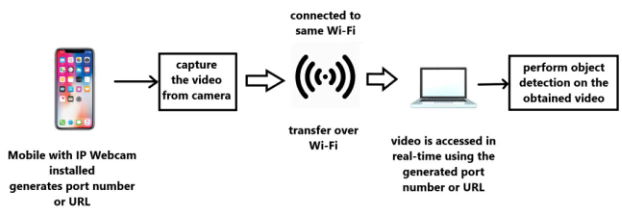
4.1 Using Webcam

The webcam can be used as the input device to receive the image frames for object detection in real-time. Since we are using YOLOv3-tiny model, it supports up to 220 fps processing speed.



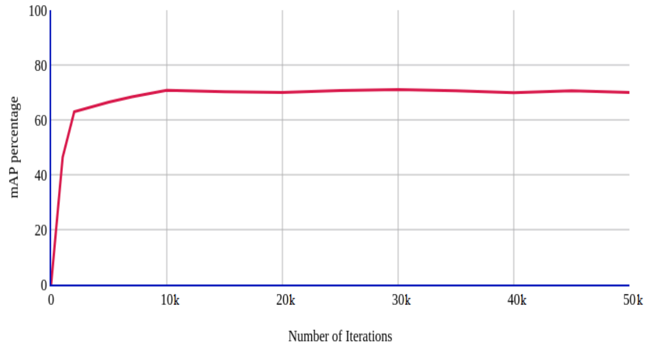
4.2 Using IP Webcam for Mobile

Mobile camera can be used as the input rather than using the webcam. This can open up a lot of possibilities as mobile can be carried and can cover different angles. Doing all this in real-time is an added advantage. So, from this not only CCTV footages but a handheld device can be used for obtaining the footage. Also, the footage from mobile being up-close can provide a clearer and more readable number plate for the OCR to give out an accurate number.

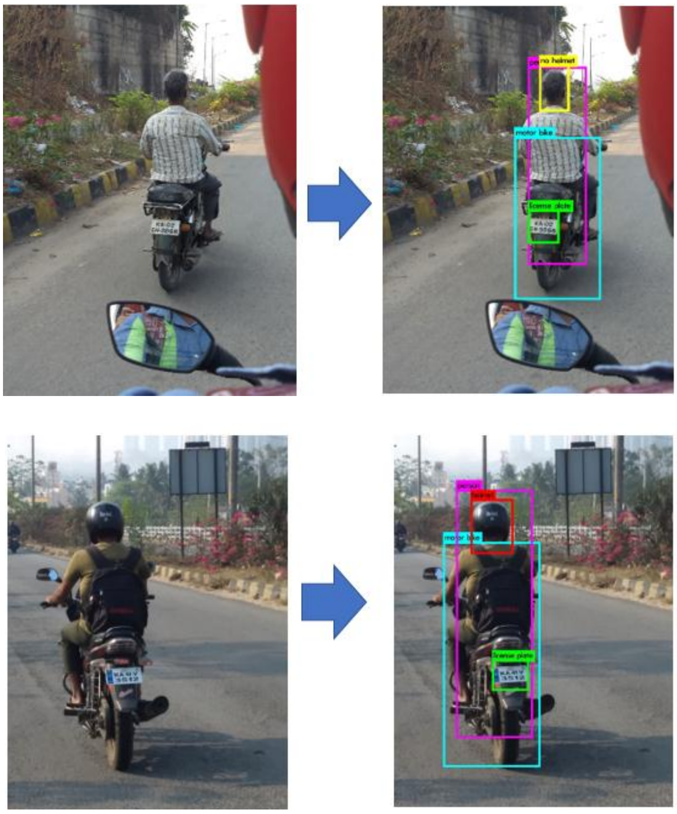


5. RESULTS

The model was trained on tiny YOLOv3 for 11,000 images on 5 classes for 50,000 iterations. The detections of all the objects classes was obtained with high precision value and the mean average precision (mAP) reached a constant max value of 75% hence the training was stopped at 50,000 iterations.

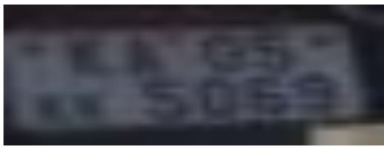


A few examples of the input image and the output object detector are shown in the figure below



The code extracts the License plate from the Object detector output. The License plate extraction code extracts only from the motor bikes which has a rider who is not wearing helmet and discards the License plate of the motor bikes whose rider has helmet.

The OCR model is able to detect and recognize the License plates present in an image with an accuracy up to 85 percent. An example of the recognized license plate are shown in the following figure.



6. CONCLUSION

From the results shown above it is evident that the YOLO object detection is well suited for real-time processing and was able to accurately classify and localize all the object classes. The proposed end-to-end model was developed successfully and has all the capabilities to be automated and deployed for monitoring. For extracting the number plates some techniques are employed by considering different cases such as multiple riders without helmets and designed to handle most of the cases. All the libraries and software used in our project are open source and hence is very flexible and cost efficient. The project was mainly built to solve the problem of non-efficient traffic management. Hence at the end of it we can say that if deployed by any traffic management departments, it would make their job easier and more efficient.

REFERENCES

[1] Viola and Jones, “Robust Real-time Object Detection”, IJCV 2001.

[2] Navneet Dalal and Bill Triggs, “Histogram of oriented gradients for human detection”.

[3] Ross, Jeff, Trevor and Jitendra “Rich feature Hierarchy for Accurate object Detection”.

[4] Shaoqing Ren, Kaiming He, Ross Girshick, Jian Sun, “Fast R-CNN” (Submitted on 4 Jun 2015 (v1), last revised 6 Jan 2016 (this version, v3)).

[5] Joseph Redmon, Ali Farhadi, “YOLO9000: Better, Faster, Stronger”, University of Washington, Allen Institute Of AI.
[6] Joseph Redmon, Ali Farhadi, “YOLOv3: An Incremental Improvement”, University of Washington, Allen Institute of AI.

[6] Wei Liu, Dragomir Anguelov, Dumitru Erhan, Christian Szegedy, Scott Reed, Cheng – Yang Fu, Alexander C. Berg, “SSD: Single Shot MultiBox Detector”.

[7] A. Adam, E. Rivlin, I. Shimshoni, and D. Reinitz, “Robust real-time unusual event detection using multiple fixed-location monitors,” IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 30, no. 3, pp. 555–560, March 2008.

[8] AlexeyAB, https://github.com/AlexeyAB/darknet#requirements.

[9] C.-Y. Wen, S.-H. Chiu, J.-J. Liaw, and C.-P. Lu, “The safety helmet detection for atm’s surveillance system via the modified hough transform,” in IEEE 37th Annual International Carnahan Conference on Security Technology., 2003, pp. 364–369.

[10] C.-C. Chiu, M.-Y. Ku, and H.-T. Chen, “Motorcycle detection and tracking system with occlusion segmentation,” in WIAMIS ’07, USA, 2007

[11] A. Hirota, N. H. Tiep, L. Van Khanh, and N. Oka, *Classifying Helmeted and Non-helmeted Motorcyclists*. Cham: Springer International Publishing, 2017, pp. 81–86.

ATLANTIS PRESS
Advances in Computer Science Research, volume 44
3rd International Conference on Wireless Communication and Sensor Network (WCSN 2016)

Smart Helmet with Emergency Notification System–A Prototype

S. Sasirekha, I. Joe Louis Paul
Department of Information Technology, SSN College of Engineering, Chennai, Tamil Nadu, India
E-mail: sasirekhas@ssn.edu.in, joelouisi@ssn.edu.in

S. Swamynathan
Department of Information Science and Technology, Anna University, Chennai, Tamil Nadu, India
E-mail: swamyns@annauniv.edu

Gokul. Y, Kirthana.P
Department of Information Technology, SSN College of Engineering, Chennai, Tamil Nadu, India

***Abstract*-Motorcycles have higher rates of fatal accidents than any other automobiles in India. Hence, wearing a helmet alone is not sufficient to prevent accidents and save victims. Helmet wearing alone is not sufficient to save the life of a motor cyclist. The solution proposed in this work to address this life-threatening problem, is the Smart Helmet with Emergency Notification System (SHENS). This helmet not only protects the head of its rider but also his/her life by alerting the emergency service or an emergency contact when the rider has met with an accident. This smart helmet has the potential to act independently without any human intervention during road accidents. With the help of advanced sensors such as an infra-red sensor, impact sensor and accelerometer sensor, this smart helmet is also capable of detecting the consciousness of the accident victim and indicating the precise location of the accident. The alert to the emergency service is sent with the help of Global System for Mobile (GSM) module as a Short Messaging Service (SMS) containing the Global Positioning System (GPS) coordinates which indicate the location of the accident to which the emergency team is expected to reach to offer medical assistance. Thus, this smart helmet can be used to save millions and millions of lives by helping them to get timely medical attention in case of accidents.**

Keywords-smart helmet; smart helmet with emergency notification system (SHENS); global system for mobile (GSM); global positioning system (GPS); accident notification; emergency notification

I. INTRODUCTION

The increase in population is the cause of many socio-economic problems and is the biggest challenge for the commuters worldwide. Being home of one-sixth of the human population, road travel in India is tedious and tiresome. In the current run, India has about 19.75 million vehicles registered [1] which accounts for the heavy and congested traffic on the roads. Due to this heavy count and poor road conditions, accidents tend to happen every day. It has been recorded that everyday about 400 people die in road accidents in India. Another important factor influencing the accident death rate is the lack of social responsibility of an individual. The proposed system aims to tackle all the problems as mentioned above by acting autonomously during the accident and by serving as a helping hand to the accident victim, ultimately, helping the victim to get swift and timely medical assistance.

Internet of Things (IoT) is emerging as a boon to humankind by offering a vast variety of reliable services using the embedded hardware, software and data processing [2]. The proposed smart helmet with the emergency notification system is also an IoT solution to eliminate the loss of lives due to road accidents. This proposed system, being powered by sensor networks and communication module that handles various data intelligently before executing a specified module. The algorithm depicted in the implementation section explains how the system reacts during the times of road accident, thus highlighting how this system can be a promising IoT solution to prevent the loss of lives in accidents. Moreover, this proposed system can also become a day to day gadget like cell phones since it has the greatest scope and importance of saving a person's life during road accidents.

In the remainder of the paper, Section II briefs about some of the related works carried out. In Section III, the system model of SHENS is illustrated. Then in Section IV, the implementation steps are discussed and in Section V, the test results obtained, and their inferences are elaborated. Finally, Section VI concludes.

II. RELATED WORKS

Several studies are being carried out in this crucial era of road accidents to help the victims or to create an accident-free road travel totally. Some of them are discussed below. The research work to enhance the emergency notification during accidents using machine-to-machine (M2M) technologies [3], the accident notification to the emergency service is carried out with the help of M2M technology without any human intervention. When an accident occurs, the system proposed in [3] categorizes the severity of the accident that occurred, into major, minor and moderate according to the motion of the sensor. The speed of the vehicle is determined with the help of Global Positioning System (GPS) module. However, the system in [3] has certain limitations. The accelerometer sensor is mounted on the surface of the vehicle, and so the severity of the condition of the accident victim is not taken into consideration. Since it has the cloud integration, data services, and Internet connectivity is very much needed for this system, thereby, it may result in latency to forward the message in the areas of weak reception.

Likewise, the research work in [4] deals with the concept of determining the severity of the accident depending on the severity of the vehicle. The impact and pressure sensors are embedded on the surface detect the impact of the hit. Based on this, accident notification is sent to the emergency service. The severity of the accident is calculated using the concept of data mining by estimating the impact of the accident, determining the status of airbags and arriving at a theoretical prediction that an accident has occurred. The medical assistance can be sought immediately using this approach. The study of Wang Wei and Fan Hanbo in [5] aims at providing accident notification in case of car accidents. The vibration sensors embedded on the vehicle senses the shock during the accident and alerts the emergency service using the Global System for Mobile (GSM) module with the GPS coordinates.

Therefore, it is understood from the above illustration that many works are carried out to design a system which helps in times of emergency. Especially, with the advancement in the new advent technology, IoT, it has gained more attention [6-10]. Hence, in this work a Smart Helmet with Emergency Notification System (SHENS) based on IoT solution is proposed. The proposed system also uses GSM module for communication than cloud computing methodologies which are used in the works of [2] and [3], since mobile data or the Internet may not always be available on the roads.

III. SYSTEM MODEL FOR SHNES

The smart helmet contains a network of various sensors and modules embedded in it. The infra-red sensor, impact sensor, accelerometer sensor, the GPS module and a GSM are the main components of this Smart Helmet with Emergency Notification System (SHENS). The infra-red sensor is embedded inside the helmet to ensure that the person is wearing the helmet and only after that the entire helmet gets activated. The infra-red sensor also prevents the helmet from getting activated, when the helmet gets dropped accidentally. Next, the impact sensor is employed to determine the amount of impact with which the helmet hits the ground during the accident. When this impact crosses the particular threshold, the determination of which is explained in Section IV, the accelerometer sensor is employed to see if any head movements are found on the victim. In the meantime, the person can safely turn the system off if the emergency medical attention is not needed. If the victim is injured severely, the GPS module senses the exact location of the accident and the details of the location are sent as an SMS to the emergency medical service with the help of GSM module.

The proposed system is componentized into various modules in order to provide effective and immediate notification in case of accidents. The various processes that take place in SHENS are given as follows: Step 1: Helmet activation using the infra-red sensor, Step 2: Impact determination using impact sensor, Step 3: Consciousness detection using accelerometer, Step 4: Determination of location of the accident and Step 5: Notification to the emergency service.

The interrelationship among these modules can be well understood by the flow diagram which emphasizes the series of processes that take place within the SHENS system, as given in Fig. 1.

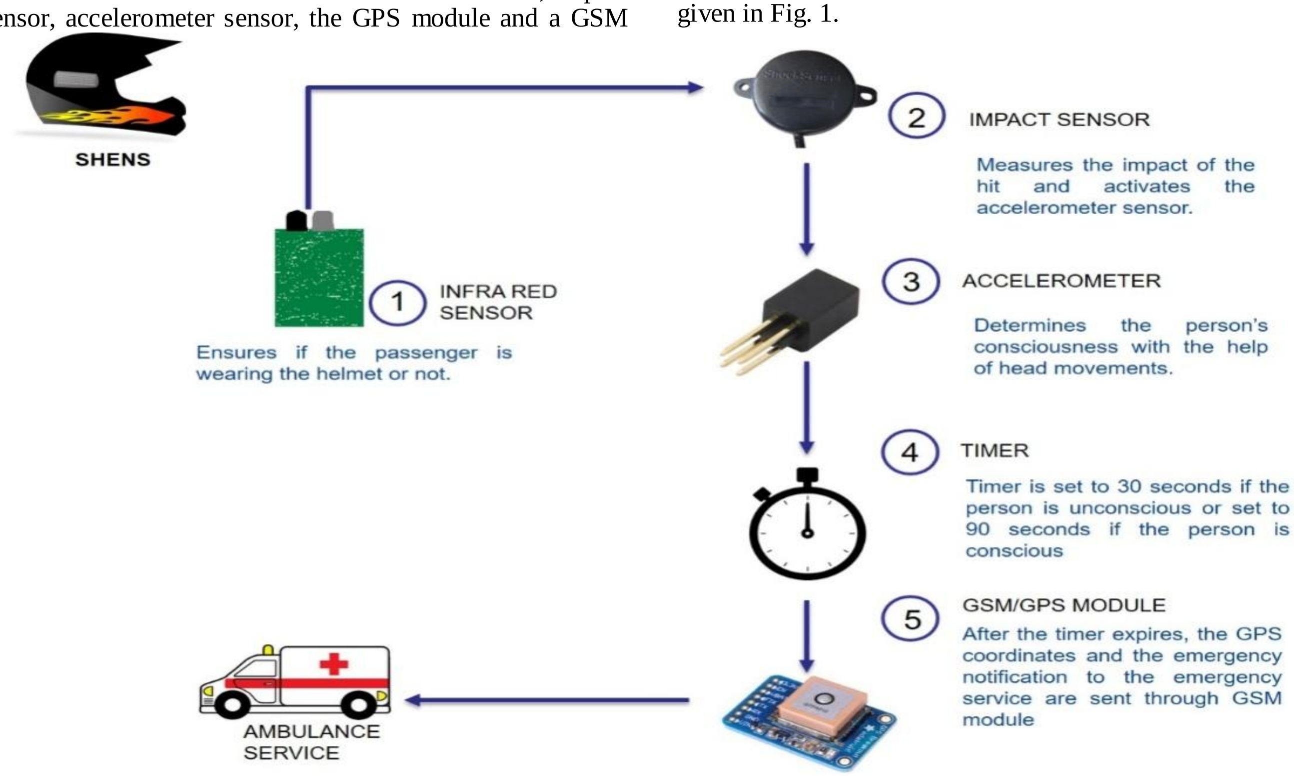


Figure 1. System model of SHENS

A. Helmet Activation using Infra-Red Sensor

The obstacle detection of the infra-red sensor [11] is the main principle involved in this module. The infra-red sensor consists of an infra-red transmitter and a receiver. In the case of any obstacle present in the path of the infra-red rays, they get reflected back to the receiver ensuring the presence of an obstacle. This same principle is applied for determining whether the helmet is worn by the rider or not. Hence, the infra-red sensor is mounted on the interior surface of the helmet. If the rider is wearing the helmet, then the infra-red sensor detects the constant obstacle which is the head of the rider within the helmet and keeps the entire system running. If the rider removes the helmet, infra-red sensor confirms that the person is not wearing the helmet and makes the smart helmet inactive. It comes in handy in various cases where the helmet falls accidentally causing fault notifications to the emergency service, which is a waste of time and resources. This system is very critical for the ideal functioning of SHENS.

B. Impact Determination using Impact Sensor

The impact sensor [12] is employed in SHENS to estimate the amount of impact on the surface of the helmet. It is very crucial for confirming that an accident has occurred. The impact sensor detects the sudden impact on the surface of the helmet. After the accident has occurred, producing an impact greater than the set threshold which is determined by using the equations given in the implementation section, while the accelerometer senses the tilt angles of the head [13].

C. Consciousness Detection using Accelerometer

The accelerometer sensor [14] senses a series of tilt angles after the person is met with an accident. The determination of tilt angles from the accelerometer sensor readings is described in Section IV. If the tilt angles are the same for a particular span of time, say 10 seconds, the accident victim is assumed to be not having any head movements. This lack of head movements is considered in this system as the victim is unconscious. If the tilt angles vary rapidly, the person is assumed to be conscious since head movements are present.

The timer module is one of the crucial components in SHENS responsible for setting the timer within the expiry of which the notification to the emergency service is sent. The timer module employed in SHENS is a software triggered inbuilt timer present on the Arduino Uno [15]. The timer can be visualized using a seven segment Light-Emitting Diode (LED) display which displays the countdown timer. The timer is set to two different intervals because there are two different scenarios of the person met with an accident being conscious or unconscious.

The two scenarios expected to be are as follows: If the accelerometer readings ensure that the person is conscious, the timer is set to 90 seconds. In this interval, the emergency notification can be aborted if no immediate medical assistance is needed. If the accelerometer readings show that the person is unconscious, the timer is set to 30 seconds. After the expiry of the timer, the determination of location phase is initiated.

D. Determination of Location of the Accident

The GPS module [16] comes into action immediately after the timer expires. The GPS module used in SHENS comes with a small form factor with an antenna capable of sending the GPS coordinates of the location in no time. The exact location of the person in the accident zone is determined in the form of latitude and longitude coordinates. These coordinates, upon decryption, provide the exact address of the accident zone for the emergency service to reach on time. The GPS module embedded in the SHENS is Skylab GPS module with a wired antenna for faster response of GPS coordinates from the satellite.

E. Notification to the Emergency Service

To send message or notification to the emergency service, a GSM module is embedded on the inner surface of the helmet. Upon successful discovery of the location of the accident, GSM module [17] comes into action. The GSM module takes a Subscriber Identification Module (SIM) to send the message to the emergency service. Very soon after GPS module identifies the location coordinates, the message in the format containing the GPS coordinates of the accident location is sent to the emergency service, thereby helping the medical service to reach the accident zone on time. Thus, providing accident notification on time along with the GPS coordinates of the location to emergency service can save millions of lives every day.

IV. IMPLEMENTATION

The implementation of the Smart Helmet with Emergency Notification System (SHENS) is carried out in a series of steps that are designed algorithmically to carry out all of its features. The detailed description of the techniques and tools used is discussed below to get the better insight about the entire development process of this smart helmet.

A. SHENS Working Algorithm

The working mechanism of SHENS can be better understood with the help of algorithmic description given below. All the components are interfaced and programmed to function based on Algorithm 1.

```
if POWER_BUTTON_STATUS_OFF
        o  SMART HELMET IS TURNED OFF
else if  POWER_BUTTON_STATUS_ON
        o  SMART HELMET IS TURNED ON
    if  INFRARED_SENSOR_READING = 0
        o  RIDER IS NOT WEARING HELMET
    else if  INFRARED_SENSOR_READING = 1023
        o  RIDER IS WEARING HELMET
        o  PASS CONTROL TO IMPACT SENSOR
        o  IMPACT SENSOR SENSES FOR HEAVY IMPACT CONTINUOUSLY
        while IMPACT_SENSOR_READING ≥ THRESHOLD
                o  ACCIDENT OCCURED
                o  PASS CONTROL TO ACCELEROMETER
                o  ACCELEROMETER MEASURES TILT ANGLES
            if  CHANGE_IN_TILT_ANGLES
                    o  HEAD MOVEMENTS SEEN
                    o  PERSON IS CONSCIOUS
                    o  set TIMER = 90 SECONDS
                while  RESET_SWITCH_STATUS-CHANGED
                    o  PERSON NOT INJURED
                    o  RESET THE TIMER
                    o  ABORT ALL PROCESSES
            else  CONSTANT_TILT_ANGLES_FOUND
                    o  HEAD MOVEMENTS NOT FOUND
                    o  PERSON IS UNCONSCIOUS
                    o  set TIMER = 30 SECONDS
        o  AFTER TIMER EXPIRES GPS MODULE TAKES OVER THE CONTROL
        o  DETERMINE GPS COORDINATES OF THE ACCIDENT LOCATION
        o  PASS CONTROL TO GSM MODULE
        o  NOTIFY EMERGENCY SERVICE WITH GPS COORDINATES THROUGH SMS/
```

Algorithm 1. SHENS working algorithm

The algorithm takes numerous assumptions to function efficiently during real time. The assumptions that are strictly considered during the development of this algorithm are as follows: i) POWER_BUTTON_STATUS variable denotes the state of the power button which activates or turns off the smart helmet, ii) The infra-red sensor outputs the value 1023 into the variable INFRARED_SENSOR_READING if the obstacle, in this case, the head of the rider, is detected, iii) The infra-red sensor outputs the value 0 into the variable INFRARED_SENSOR_READING if the obstacle, in this case, the head of the rider, is not detected, iv) The variable THRESHOLD and its determination are discussed in Section 4, v) The CHANGE_IN_TILT_ANGLES is the variation in the tilt angles that are calculated using (3), (4) and (5), which is mentioned in Section IV, vi) The CONSTANT_TILT_ANGLES is the constant and steady tilt angles without any deviation, that are calculated using (3), (4) and (5) of Section IV, vii) The RESET_SWITCH_STATUS-CHANGED refers to the change in the state of the reset switch which can be used to reset the timer in case of no immediate medical assistance is needed.

B. *Components used in the Implementation of the Proposed System*

The proposed model makes use of a wide range of hardware to function to its fullest capacity. The various components that are used in developing this smart helmet are tabulated as shown in Table I.

TABLE I COMPONENT USED IN SHENS.

HARDWARE	PURPOSE	SPECIFICATION
Arduino Uno	To integrate and control the sensor network, GPS and GSM modules.	Microcontroller
Infra-red sensor	To ensure the rider is wearing the helmet.	Uses Obstacle detection principle.
Impact sensor	To determine the impact of the hit during the accident.	MEAS-SPEC sensor
Accelerometer sensor	To detect the consciousness of the victim.	ADXL 335
7 segment LED display	To indicate the timer countdown.	Anode Display
GPS module	To determine the exact location of the accident.	Skylab 13BL
GSM module	To establish communication with the emergency service.	SIM900A
SIM Card	To send SMS to the emergency service.	Vodafone
Batteries	To power the helmet and enhance portability.	12 Volt 1 Amp Battery

C. Interfacing with Arduino UNO

The Smart Helmet with Emergency Notification System (SHENS) is implemented with the help of Arduino Uno, which is a programmable microcontroller capable of integrating various components like sensors, GSM and GPS modules. Arduino is an open-source prototyping platform for building embedded systems and electronic projects. Arduino also provides an Integrated Development Environment (IDE) that runs on a computer capable of uploading the compiled code into the physical Arduino board. The embedded C programming language is employed to program the sensors and other vital components. The prototypical connected system controlled by the Arduino is shown in Fig. 2.

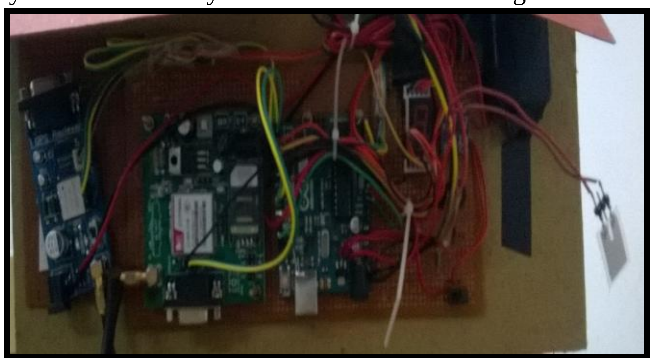


Figure 2. The connection between the Arduino Board and other components of SHENS

D. Impact Determination using Impact Sensor

The impact sensor detects the sudden impact on the surface of the helmet and outputs the analog value. The value should be converted into digital to derive the exact impact value of the hit. The actual impact a standard helmet can withstand is between the range 250g – 300g as mentioned in the reference [6]. Even with this level of protection, concussions, broken neck, and head damage can happen. However, the same impact of over 100g and above cannot be produced manually to simulate an accident scenario. Hence, in this work for the purpose of experimentation, the threshold impact is set to 2.5g for the convenience of testing, upon which the helmet reacts.

The impact of the hit on the surface of the helmet can be derived using the following key points. The first one, the analog default range of the impact sensor is 0 to 1023 and the digital default range of the impact sensor is between 0 volts and 5 volts.

In order to convert the analog values from the impact sensor into digital values the equation Eq. 1 given below is used.

$$\frac{\text{Raw Analog value from the sensor}}{\text{Maximum number of analog states of the sensor}} = \frac{\text{Voltage}}{\text{Reference Value}} \qquad (1)$$

The g-force or acceleration due to gravity acting on the object resting on the surface of the earth is 1g. The maximum number of analog states of the impact sensor is 1023 by default. The reference value used is 3.3V used in the Arduino board for the implementation purposes.

Therefore using Eq.2,

$$\text{Impact of the hit} = \text{Voltage} \qquad (2)$$

Hence it can be understood that the digital voltage is directly proportional to the acceleration due to gravity or the impact of the hit.

E. Consciousness Detection using Accelerometer

The consciousness of the accident victim can be analyzed using the accelerometer sensor. The accelerometer sensor has a default range of ±3g. The accelerometer sensor outputs a series of X, Y and Z values which are analog values. These values are converted to digital which in turn converted into angles. The readings are monitored for a few microseconds. The tilt angle of the helmet is calculated using the analog values from the accelerometer with the following formula.

X, Y and Z are the analog values from the accelerometer. The corresponding angles AX, AY and AZ are calculated using the arctan function which is presented in Eq. 3, Eq. 4 and Eq. 5 below.

$$AX = \arctan (X / \sqrt{} (Y \wedge 2 + Z \wedge 2) \qquad (3)$$

$$AY = \arctan (Y / \sqrt{} (X \wedge 2 + Z \wedge 2) \qquad (4)$$

$$AZ = \arctan (Z / \sqrt{} (X \wedge 2 + Y \wedge 2) \qquad (5)$$

The person can be said to be conscious or unconscious based on the following observations by the accelerometer sensor. If there are deviations in the angles sensed by the accelerometer, the victim is expected to have head movements ensuring that he or she is conscious. If the tilt angles are same for a certain amount of time, then it is understood that the person is unconscious. Thus, accelerometer sensor is employed in SHENS to determine the degree of consciousness of the person.

Finally, the program to carry out all the essential activities of the smart helmet is typed in the Arduino IDE and compiled. The successfully compiled program is uploaded into the board to initiate the effective functioning of the helmet.

V. RESULTS

The internal working of SHENS can be well understood by having a look at the Arduino console. The screenshots below explain the step by step outputs of the various integrated modules of SHENS. The impact values from the impact sensor can be presented in a graph in order to easily visualize the deviations over time. The graph indicating the determination of threshold calculated using (1) and (2) of the implementation section is presented below in Fig. 3.

After the threshold point of 2.5g which is set for the ease of testing, the control is transferred to the accelerometer sensor to determine the consciousness of the victim. Fig. 4 is the output of the internal working of the SHENS when the accident victim is conscious. The deviations in the angles obtained with the help of accelerometer sensor shows that the victim is found to have constant head movements indicating that the victim has not lost his/her consciousness. This deviation can be clearly seen in the graph shown in Fig. 5.

Fig. 6 shows the output from the serial monitor of the Arduino showing the operations carried out by the SHENS in the case when the person is unconscious. The absence of deviations in the angles obtained with the help of accelerometer sensor shows that the victim is not found to have head movements indicating that the victim has lost his/her consciousness. This deviation can be clearly seen in the graph depicted in Fig. 7.

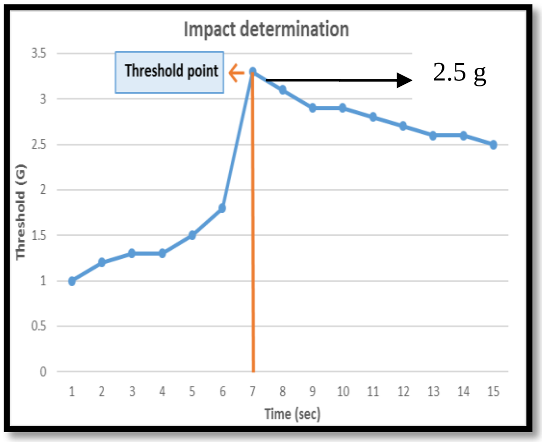
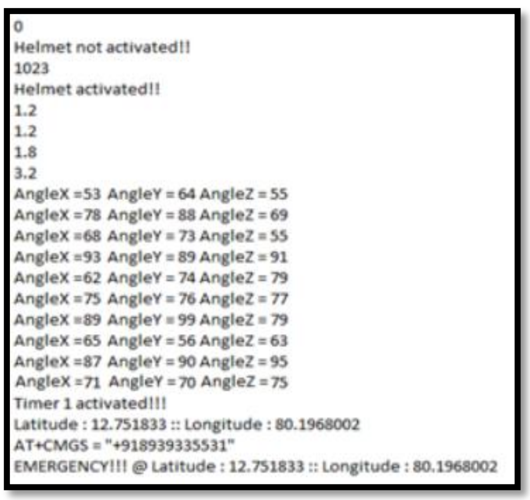


Figure 3. Visualization of impact determination



0
Helmet not activated!!
1023
Helmet activated!!
1.2
1.2
1.8
3.2
AngleX =53 AngleY = 64 AngleZ = 55
AngleX =78 AngleY = 88 AngleZ = 69
AngleX =68 AngleY = 73 AngleZ = 55
AngleX =93 AngleY = 89 AngleZ = 91
AngleX =62 AngleY = 74 AngleZ = 79
AngleX =75 AngleY = 76 AngleZ = 77
AngleX =89 AngleY = 99 AngleZ = 79
AngleX =65 AngleY = 56 AngleZ = 63
AngleX =87 AngleY = 90 AngleZ = 95
AngleX =71 AngleY = 70 AngleZ = 75
Timer 1 activated!!!
Latitude : 12.751833 :: Longitude : 80.1968002
AT+CMGS = "+918939335531"
EMERGENCY!!! @ Latitude : 12.751833 :: Longitude : 80.1968002

Figure 4. Serial monitor output when the victim is conscious

After the accelerometer sensor determines whether the victim is conscious or unconscious, the need to initiate emergency notification arises. The timer gets set for 90 seconds, if the victim is conscious and for 30 seconds if the person is unconscious. After the timer expires, the GPS module determines the location of the accident. The GPS coordinates are sent to the emergency contact as an SMS using the GSM module.

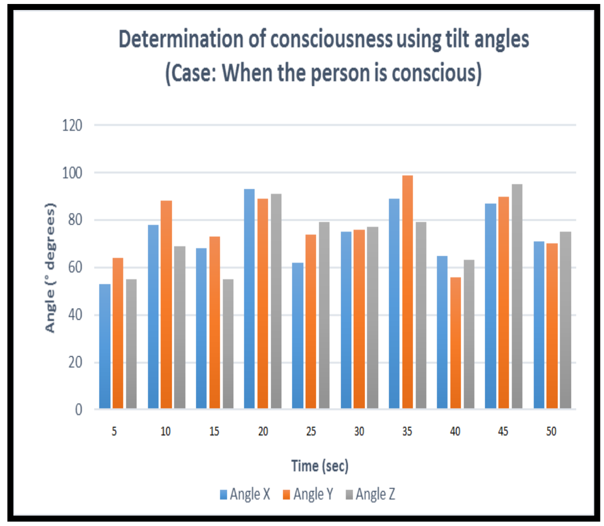
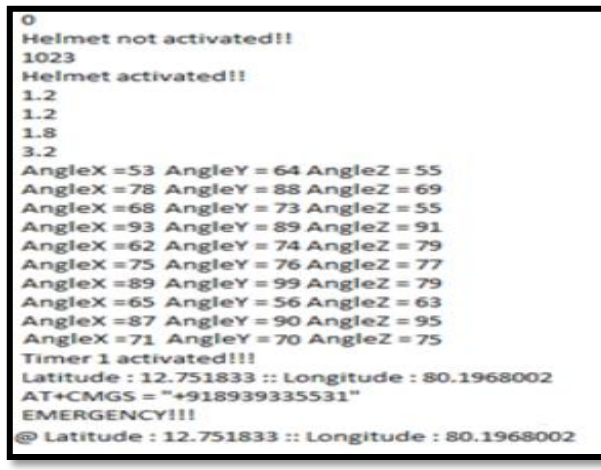


Figure 5. Graphical deviations in the tilt angles when the person is conscious



0
Helmet not activated!!
1023
Helmet activated!!
1.2
1.2
1.8
3.2
AngleX =53 AngleY = 64 AngleZ = 55
AngleX =78 AngleY = 88 AngleZ = 69
AngleX =68 AngleY = 73 AngleZ = 55
AngleX =93 AngleY = 89 AngleZ = 91
AngleX =62 AngleY = 74 AngleZ = 79
AngleX =75 AngleY = 76 AngleZ = 77
AngleX =89 AngleY = 99 AngleZ = 79
AngleX =65 AngleY = 56 AngleZ = 63
AngleX =87 AngleY = 90 AngleZ = 95
AngleX =71 AngleY = 70 AngleZ = 75
Timer 1 activated!!!
Latitude : 12.751833 :: Longitude : 80.1968002
AT+CMGS = "+918939335531"
EMERGENCY!!!
@ Latitude : 12.751833 :: Longitude : 80.1968002

Figure 6. Serial monitor output when the victim is unconscious

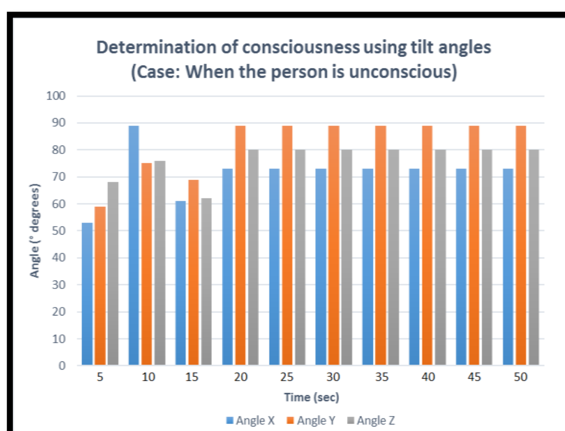


Figure 7. Graphical deviations in the tilt angles when the person is unconscious

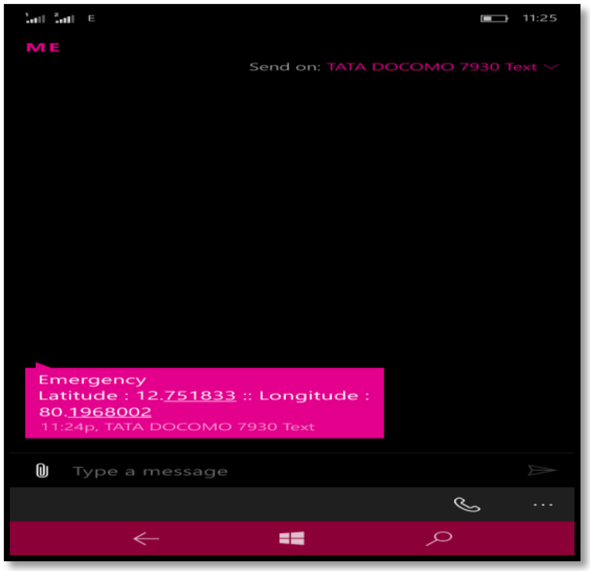


Figure 8. SMS from SHENS during the experimental accident

The SMS containing the GPS coordinates is sent to the intended emergency number which is already preprogrammed as soon as the timer gets expired. Fig. 8 indicates the SMS from SHENS during the experimental accident.

VI. CONCLUSION AND FUTURE WORK

The SHENS has the scope to become a daily gadget like a mobile phone since it has the potential to save people from the danger of losing their lives during road travel. A large number of people using two wheelers for their day to day chores can make use of SHENS ensure their safety during road travel. This helmet can be very much helpful when the accidents happen in the highways and scarcely crowded roads as the Smart Helmet with Emergency Notification System (SHENS) has the potential to help the accident victims to get timely medical assistance without any interventions from anyone around. There are some improvements and feature addition that can be done to SHENS in order to provide the humanity a better user experience. Some of the works that can be done in future are as follows. An emergency push button that can send the notification directly to the emergency service in case of the helmet not experiencing a threshold impact but accident victim is badly hurt. An alcohol detection sensor which can detect alcohol in the breath of the rider can be added to the system in order to send text alerts indicating drunken drive by the rider to the nearest police station by integrating with the GSM module.

ACKNOWLEDGMENT

This research was financially supported by the management of SSN College of Engineering, Chennai Tamilnadu, India.

REFERENCES

[1] Article from www.knowindia.net online available from http://www.knowindia.net/auto.html.

[2] Gubbi, J., Buyya, R., Marusic, S., and Palaniswami, M. Internet of things (IoT): A vision, architectural elements, and future directions. Future Gener. Comput. Syst. 29, 7, pp. 1645-1660, Sept. 2013.

[3] R. Sujatha, N. VijayaRagavan, K.S. Suganya, "IOT: To enhance automatic accident notification using M2M technologies", International Journal of Scientific & Engineering Research, Vol. 6, No. 3, pp. 1-4, March 2015.

[4] Fogue M, Garrido P, Martinez FJ, Cano JC, Calafate CT, Manzoni P, "A System for Automatic Notification and Severity Estimation of Automotive Accidents", IEEE Transactions on Mobile Computing, Vol. 13, No. 5, pp. 948 – 963, May 2001.

[5] "Traffic Accident Automatic Detection And Remote Alarm Device" – Wang Wei and Fan Hanbo

[6] Article from the Wikipedia online dated 2015 hosted online available from https://en.wikipedia.org/wiki/Transport_in_India#Two_Wheeler.

[7] Article on Helmets.org online available on March 7, 2015 from http://www.helmets.org/ideal.htm.

[8] "Fatality Analysis Reporting System General Estimate System – 2011 Data summry" - United States Department of Transportation.

[9] K. Sudarsan, P. Kumaraguru Diderot, "Helmet for Road Hazard Warning with Wireless Bike Authentication and Traffic Adaptive Mp3 Playback", International Journal of Science and Research (IJSR), Vol. 3, No. 3, March 2014.

[10] L Huan-liang, Q Hong-mei, F Ke, L Dong-lin, "Design of Human – computer interaction helmet for wearable computer", IEEE International Conference on E -Business and E -Government (ICEE), pp. 1-4, May 2011.

[11] IR Sensor - http://education.rec.ri.cmu.edu/content/electronics/boe/ir_sensor/1.html.

[12] Impact Sensor - http://electronicdesign.com/analog/low-cost-impact-sensor-uses-piezoelectric-device.

[13] MEMS - http://shockwatch.com/products/impact-and-tilt.

[14] Accelerometer Sensor - https://www.bosch-sensortec.com/bst/products/motion/accelerometers/overview_accelerometers.

[15] Arduino - https://www.arduino.cc/.

[16] GPS with arduino - http://www.instructables.com/id/Connecting-GPS-module-to-Arduino/.

[17] GSM with arduino- https://www.arduino.cc/en/Guide/ArduinoGSMShield.

Helmet Detection and Number Plate Recognition using Machine Learning

Gauri Marathe[1], Pradnya Gurav[2], Rushikesh Narwade[3], Vallabh Ghodke[4], Prof. S. M. Patil[5]
[1,2,3,4] *Department of Computer Engineering, Sinhgad College of Engineering, Pune, Maharashtra, India*
[5] *Sinhgad College of Engineering, Pune*

Abstract— **Motorcycles have always been the primary mode of transportation in developing countries. Motorcycle accidents have increased in recent years. One of the main reasons for fatalities in accidents is that a motorcyclist does not wear a protective helmet. The most common way to ensure that motorcyclists wear a helmet is by traffic police to manually monitor motorcyclists at road junctions or through CCTV footage and to penalize those without a helmet. But it requires human intervention and effort. This system proposes an automated system for detecting motorcyclists who do not wear a helmet and a system for retrieving motorcycle number plates from CCTV video footage. First, the system classifies moving objects as motorcycling or non-motorcycling. In the case of a classified motorcyclist, the head portion is located and classified as a helmet or non-helmet. Finally, the motorcyclist without a helmet is identified. Further we have developed a system which identifies the number plates and extracts the characters of the number plate using OCR algorithm.**

I.INTRODUCTION

Motorcycle Accidents have been rapidly growing throughout the years in many countries. The helmet is the main safety equipment of motorcyclists. However, many drivers do not use it. The main goal of helmet is to protect the drivers head in case of an accident. In such a case, if the motorcyclist does not use a helmet, it can be fatal. It is not possible for traffic police force to watch every motorcycle and detect the person who is not wearing a helmet. There was need to propose an automated system that monitors motorcycles and detects the persons wearing helmet or not and a system to detect number plates.

In India, road accidents are increasing very rapidly and lots of deaths occur due to head injuries as number of people do not wear helmets. To avoid these actions, there is need for a system that automatically detects the people who are not wearing a helmet and a system that detects number plates of the motorcycles and extracts the vehicle number which would help find the motorcyclist to be penalize. By doing this we propose that rate of accidents will reduce and many lives will be saved.

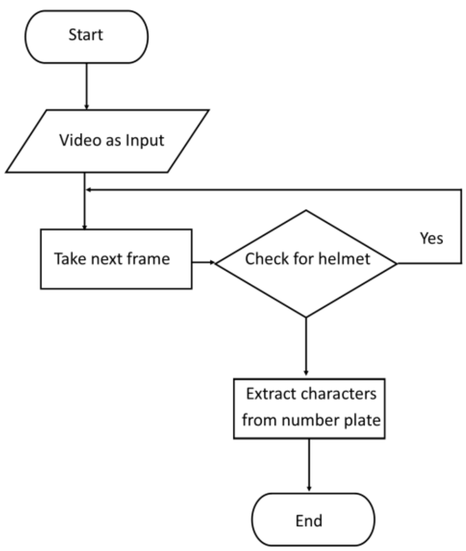
II.RELATED WORK

Sr.No.	Page Title	Authors	Methodology
1	Automated Helmet Detection for Multiple Motorcycle Riders using CNN	Madhuchhanda Dasgupta, Oishila Bandyopadhyay, Sanjay Chatterji, Computer Science Engineering IIIT Kalyani West Bengal, India	First detects riders using Y.OLOv3 and then detects if the rider is wearing helmet or not
2	Helmet and Number Plate detection of Motorcyclists using Deep Learning and Advanced Machine Vision Techniques	Fahad A Khan, Nitin Nagori, Dr. Ameya Naik, Department of Electronics and Telecommunication K. J. Somaiya college of Engineering Mumbai, India	The system uses YOLO to detect if the rider is wearing helmet or not.
3	Helmet Detection Using ML IoT	Dikshant Manocha, Ankita Purkayastha, Yatin Chachra, Namit Rastogi, Varun Goel Department of Electronics and Communication Engineering Jaypee Institute of Information Technology Noida, India	This system first identifies motorcyclists and then checks whether rider and pillion rider are wearing helmet or not using OpenCV and extracts number plate using OCR.
4	Convolutional Neural Network-based	Y Mohana Roopa, Sri Harshini Popuri, Gottam Gowtam sai Sankar, Tejesh	In this system rider with no helmet is detected then respective frame is

	Automatic Extraction and Fine Generation	Chandra Kuppili, Computer Science and Engineering Institute of Aeronautical Engineering, Hyderabad, India	taken and number from number plate is extracted. Then the challan is sent to vehicle owner's number.
5	Improved OCR based Automatic Vehicle Number Plate Recognitio n using Features Trained Neural Network	Bhavin V Kakani, Divyang Gandhi, Sagar Jani, EC Engineering Department Institute of Technology Nirma University	Thissystemisdedicatedon animprovedtechniqueofOCRbasedlicenseplaterecognitionusingneuralnetwork

III.METHODOLOGY

A.Figures



B. Phases of Development

1 Designing a module for functions to detect the helmet in the frame.
2 Designing a module to detect the number plate and extract the vehicle number from frame.
3 Connecting all the modules together and testing the integrity and accuracy of the system.

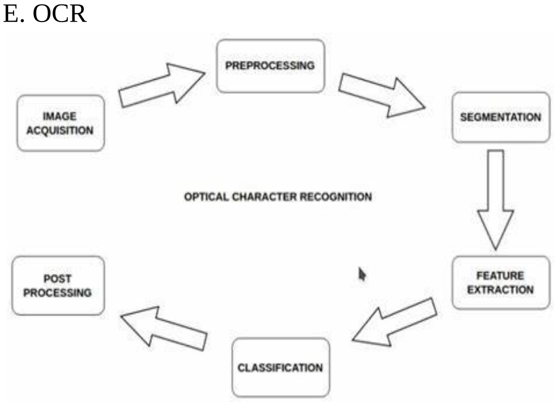
C. Implementation

1 Taking video or camera as input.
2 Taking single frame from that input.
3 Checking if that frame contains a helmet.
4 If the helmet is present then going back to 2nd stage
5 If helmet is not present then giving this frame to the function which detects number plate and extracts characters from it.
6 Repeating this procedure till the input is not empty/null.

D. Impletation Using YOLOv3

The YOLOv3 algorithm first separates a fame into a grid. Each grid cell predicts some number of boundary boxes (sometimes referred to as anchor boxes) around objects that score highly with the aforementioned predefined classes.Each boundary box has a respective confidence score of how accurate it assumes that prediction should be and detects only one object per bounding box. The boundary boxes are generated by clustering the dimensions of the ground truth boxes from the original dataset to find the most common shapes and sizes. The object detection problem is treated as a regression problem in the YOLO algorithm and the image is divided into an S × S grid. If the centre of a target falls into a grid, the grid is responsible for detecting the target.Each grid will output a bounding box, confidence, and class probability map. Among them. The bounding box contains four values: x, y, w, h, (x, y) represents the centre of the box. (W, h) defines the width and height of the box. Confidence indicates the probability of containing objects in this prediction box, which is the IoU value between the prediction box and the actual box. The class probability indicates the class probability of the object, and the YOLOv3 uses a two-class method.

E. OCR



Optical character recognition or optical character reader is that the electronic or mechanical conversion of pictures of written, handwritten, or printed text into machine-encoded text, whether or not from a scanned document, a photograph of a document, a scene photograph, or subtitle text superimposed on a picture.

1: Acquisition

Obtaining non-editable text content from scanned documents of all types, from flatbed scans of corporate archival material through to live surveillance footage and mobile imaging data.

2: Pre-processing

Cleaning up the source imagery at an aggregate level so that the text is easier to discern, and noise is reduced or eliminated. OCR software often "pre-process" images to boost the chances of recognition.

3: Segmentation and feature extraction

Scanning of the image content for groups of pixels that are likely to constitute single characters, and assignment of each of them to their own class. The machine learning framework will then attempt to derive features for the recurring pixel groups that it finds, based on generalized OCR templates or prior models. However, human verification will be needed later.

There are two main methods for extracting features in OCR:

In the first method, the algorithm for feature detection defines a character by evaluating its lines and strokes.

In the second method, pattern recognition works by identifying the entire character.

We can recognize a line of text by searching for white pixel rows that have black pixels in between. Similarly, we can recognize where a character starts and finishes.

4: Training

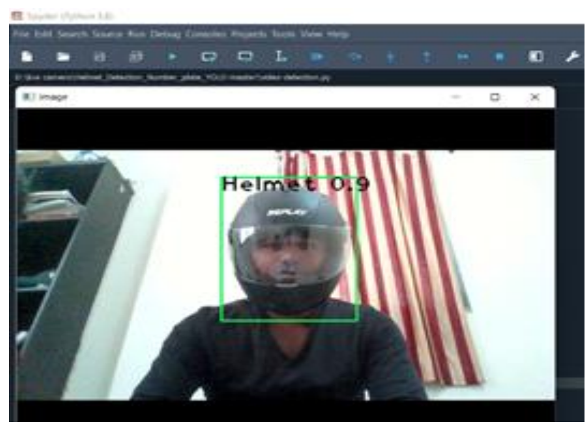
Once all features are defined, the data can be processed in a neural network training session, where a model will attempt to develop a generalized image>text mapping for the data.

5: Verification and re-training

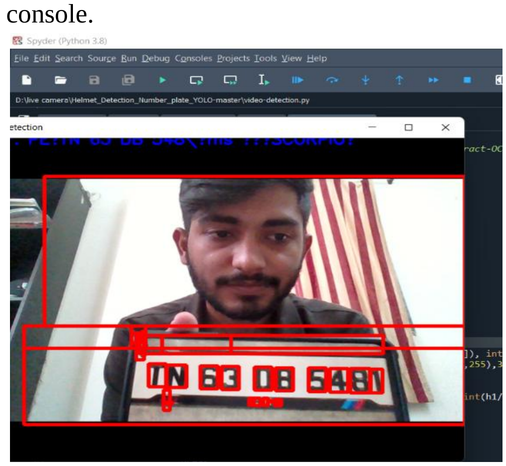
After processing, humans evaluate the results, with corrections fed back into subsequent training sessions. At this point, data quality may need to be reviewed. Data cleaning is time-consuming and expensive, and while initial training runs will perform de-skewing, high contrast processing, and other helpful methods to obtain a good algorithm with minimal pre-processing, further arduous refinement of the data may be necessary. OCR accuracy can be improved if the output is limited by a lexicon (a list of words permitted in a document). For instance, this could be all the words in English, or a more technical lexicon for a particular field. This method can be less efficient if the document contains words that are not in the lexicon, like proper nouns. Fortunately, to improve accuracy, there are OCR libraries available online for free. The Tesseract library is using its dictionary to control the segmentation of characters.

IV.RESULT

When we give the input video wearing helmet, it successfully detects the helmet and shows the confidence score and also it prints "Helmet Detected!" on the console



When the person is not wearing helmet the system searches for the number plate in the frame. Once detected it extracts characters and prints on the console.



REFERENCES

[1] R. R. V. e. Silva, K. R. T. Aires and R. d. M. S. Veras, ”Helmet Detection onMotorcyclists Using Image Descriptors and Classifiers,” 2014 27th SIBGRAPIConference on Graphics, Patterns and Images, Rio de Janeiro, 2014, pp. 141-148.

[2] P. Doungmala and K. Klubsuwan, ”Helmet Wearing Detection in Thailand Using Haar LikeFeatureandCircleHoughTransformonImageP rocessing,”2016 IEEE International Conference on Computer and Information Technology (CIT),Nadi,2016,pp.611-614.

[3] Li, J., Liu, H., Wang, T., Jiang, M., Wang, S., Li, K.,Zhao, X. (2017, February). Safety helmet wearingdetectionbasedonimageprocessingandma chinelearning.InAdvancedComputationalIntellig ence(ICACI),2017NinthInter- nationalConferenceon(pp.201-205).IEEE.

[4] K. Dahiya, D. Singh and C. K. Mohan, ”Automatic detection of bike-riderswithout helmet using surveillance videos in real-time,” 2016 International JointConference on Neural Networks (IJCNN), Vancouver, BC, 2016, pp.3046-3051.

[5] C. Vishnu, D. Singh, C. K. Mohan, and S. Babu, ”Detection of motorcyclists without helmet in videos using convolutional neural network,” 2017InternationalJointConferenceonNeuralNetw orks(IJCNN),Anchorage,AK,2017,pp.3036- 3041.

Helmet Detection and Number Plate Recognition using Machine Learning

Ranveer Roy[1], Shivam Kumar[2], Paritosh Dumbhare[3], Mahesh Barde[4]

[5]Professor-K.G.Shinde, Dept. of Computer Engineering, Sinhgad College of Engineering, Maharashtra, India

---***---

Abstract - *There are very few automobiles in developing countries because motorcycles have always been the predominant mode of transport. Motorcycle crashes have been on the rise in the last few years. A number of people who are involved in traffic collisions include motorcyclists who do not wear reflective helmets, since they do not believe they provide sufficient protection. Once the traffic police spot those driving motorcycls on a whole-or mMotorcycles in junctions-without helmets, they also use video from CCTV to take control of the drivers of those vehicles and penalise those who are riding without one. However, it can only be achieved through human action and commitment. Secondly, the classifies moving vehicles as motorcycle or nonmotorcycle. for example, when referring to the head component, in the case of a motorcyclists, it is graded as either full face or non-full face. An excellent image analysis of the motorcycle number is then used to extract the characters that were missed by the identification software and/ Finally, the character count of the motorcycle is found, and from the motorcycle is examined using OCR software. It is an Object Detection Algorithm used to identify faces in an image or a real time video. The algorithm uses edge or line detection features proposed by Viola and Jones in their research paper "Rapid Object Detection using a Boosted Cascade of Simple Features.* A Convolutional Neural Network is a Deep Learning algorithm which can take in an input image, assign importance to various aspects/objects in the image and be able to differentiate one from the other. CNNs are used for image classification and recognition because of its high accuracy. The CNN follows a hierarchical model which works on building a network, like a funnel, and finally gives out a fully-connected layer where all the neurons are connected to each other and the output is processed.

1.1 INTRODUCTION

The bulk of the people in countries like India, Brazil, Thailand, and Thailand use motorcycles for regular commutes. Wearing a helmet laws vary from country to country to country, but, in India, it is usually required by law for vehicle riders. Although even the wellbeing of those who use bikes is of prime importance, donning a helmet is mandatory. There are also laws in place to protect riders from motorcycle accidents; presently, traffic police have the duty of preventing motorcycle injuries. However, this approach is less effective because there is simply not enough police personnel to be able to properly conduct the surveillance, and the search because of the motorcyclists' Additionally, CCTV has been used in all major cities for monitoring purposes. Although they need human intervention and cannot be done on their own. because of the numbers of motorcycles and the further they are on the streets, the more it has been discovered that many die from transport incidents, making it a high priority to implement more precautions The role of tracking motorcycle drivers is proposed in this paper to be automated in the scheme. By using machine learning, the device identifies motorists not wearing helmets and automatically provides their motorcyclist's licence plate number on demand, without the need for operators to look it up on driver licence photos at camera posts.

1.2 MOTIVATION

While the growing popularity of motorcycles over the decades has led to increased crash numbers, this only occurred during the 1980s, when the Honda 750 grew to 8-horsepower. a lot of motorcyclists do wear helmets, but many would prefer to conceal their head-This is a plausible for a multitude of reasons, like those who want to avoid attracting attention from authorities, or those who want to not be seen when driving an illegal bikes. Drivers in North America are generally agree that wearing a helmet or face-protected helmets reduces the risk of suffering a head injury in a collision. It is possible that the driver could die as a result of the collision, as a result of the lack of a helmet; also, serious head trauma may be an issue for the driver. there are two challenge factors that cause the traffic police to lose their ability to verify whether a motorcyclist is wearing a helmet: The standard of examination is difficult for the traffic police to achieve, and the subjectivity of the decision making process This scheme prevents cars from using a car with a licence plates such that non frequent drivers can be identified and those who do are using them are penalised. Permanent number and permanent VIN monitoring are implemented in order to prevent those who drive without a licence from doing so.

1.3 PROBLEM STATEMENT

As the bikers in our country are increasing ,the road mishapes are also increasing day by day, due to which many deaths occur, most of them are caused due to most common negligence of not wearing helmets, also many deaths occur due to lack prompt medical attention needed by the injured person.

2. LITERATURE SURVEY

Madhuchhanda Dasgupta, Oishila Bandyopadhyay, Sanjay Chatterji, Computer Science & Engineering IIIT Kalyani West Bengal, India," Automated Helmet Detection for Multiple Motorcycle Riders using CNN"[1]. The ability to continuously monitor vehicle compliance with traffic rules is an important component of any effective traffic management system. In India, motorcycles may be one of the most prominent modes of transportation due to the fact that there are many citizens in urban areas. It has been stated that most motorcyclists have abstained from use of head protection in city traffic or even in the roadway driving. Many studies have shown that using a helmet on motorcycles reduces the likelihood of head and brain injuries when one is involved in a collision. Most traffic and safety rules are now monitored by a traffic video surveillance camera system, which allows the rules to be observed by means of breach of today. This paper offers a practical solution for confirming single or multiple motorcycle passengers, or "dual," as the designers call it, with or verifying their movement. When someone (say, a motorcycle rider) enters the scene at the beginning of the experiment, YOL will be applied to see if an object is present. YOL3, the state-of-of-the-the-the-art, will be used to investigate the starting point. The second neural network architecture, Convolutional Net, has been developed for detection of motorcyclists while using a technique called pattern matching and edge detection. Thus, the results suggest the proposed by the use of a CNN model on the same traffic videos are more promising than those from other models.

Fahad A Khan, Nitin Nagori, Dr. Ameya Naik, Department of Electronics & Telecommunication K.J.Somaiya college of Engineering Mumbai, India," Helmet and Number Plate detection of Motorcyclists using Deep Learning and Advanced Machine Vision Techniques"[2]. presented to me Since the recent increase in use of motorcycles has made it more difficult to keep the roads clear, crashes and injuries are on the rise. one of the main causes of this is the helmet that wasn't being used by the motorcyclist Currently, a person must conduct a physical search or have CCTV footage of a different from the junction from that provided by the Department by those motorcyclists inspected by law, in order to locate any who are not wearing helmets. a proposal involves a computer structure to examine photographs of a motorcycle riders to identify those who wear helmets from those who don't wear helmets, allowing more precise identification of the users of motorised cycles. In general, the machine gets objects based on features and then removes them. YOL-Dark architecture which utilises convolutionaletal neural networks trained on Common Objects in a la Cena offers both convolutional net deep learning models that allow for object recognition and computer vision. YOL's classifier's wavelet layers are altered to distinguish between three known classes, and the mechanism is implemented as a sliding window. the test results, providing a much more accurate picture of the (to a greater extent) the map's extent, achieved an average precision of 81%

Dikshant Manocha, Ankita Purkayastha, Yatin Chachra, Namit Rastogi, Varun Goel Department of Electronics and Communication Engineering Jaypee Institute of Information Technology Noida, India," Helmet Detection Using ML & IoT"[3]. presented to me this paper is focused on predicting unhelmet needs from the data of two-circling cyclists without a centralised authentication. It also helps provide a user experience for imposition fees. Vehicle recognitions start and vehicle instances are initially established on the captured traffic using first-in-one-first-out (FIFO) or best-in-first order, and two-out-first (FIR) methods, and the distinctions are subsequently made using two-in-two-out (TIR) or least-recent-in-first-out (LFO) method. After checking whether the riders and passengers are present in the vehicle, it computes if the pillion riders or the bike is without a helmet with OpenCV. When a motorcycle doesn't have a helmet on, it is scanned and tracked by digital imaging, so that a potential driver, pillion passenger, or motorcycle rider may be flagged as unlicensed (OCR). After getting the vehicle's registration number, a fine will be generated and all information will be mailed to the individual who was cited, along with an E-mail and a text message sent to the vehicle's owner. An account (an app and a website) may be presented with which allows the user to pay their court fees.

Y Mohana Roopa, Sri Harshini Popuri, Gottam Gowtam sai Sankar, Tejesh Chandra Kuppili, Computer Science and Engineering Institute of Aeronautical Engineering, Hyderabad, India," Convolutional Neural Network-based Automatic Extraction and Fine Generatio"[4]. it had helped me to come up with a great idea Humanity, particularly as a human beings, possesses a characteristic tendencies such as these: seeing correlations between causes and effects, ignoring what is related, and neglecting what has little bearing on the occurrence, and also perceiving faults in things that are not present. For those who know the reasons of the most fatalities in motor vehicle crashes, and want to stay home, their helmets and other protective gear are also present an important safety precaution. susability could attribute that it is inconsequential because few to no individuals are often using it, or perhaps that no one has bothered to make sure it operational in the past prevention has to remain within limits and increase potential; monitoring must be done to ensure potential does not increases but still maintaining or checking the current capabilities. There is an obvious relationship between traffic flow and human activity, and we thus, for practical purposes, are considered to be the main actors in it. it is physically impractical for a police officer to be part of the flow when he is enforcing the rules of the road Successful undertaking of a large projects will be made possible by a limited group of individuals, and many would be needed to help them. In this situation, the number on the helmet has to be factored in: two people from the pile of plates are likely to emerge. This is to ensure better identification of vehicles, as opposed to the other extreme, which is based on expediency, where multiple numbers from multiple sources are registered on the same vehicle would be discarded. watchful wait-and-out situation Using Exant's method to find cars that donning of helmet camera footage as well as having a vehicle number plate reader readers, we can then expand the search to the collection of unlicensed vehicles to find certain vehicles not with the latter.

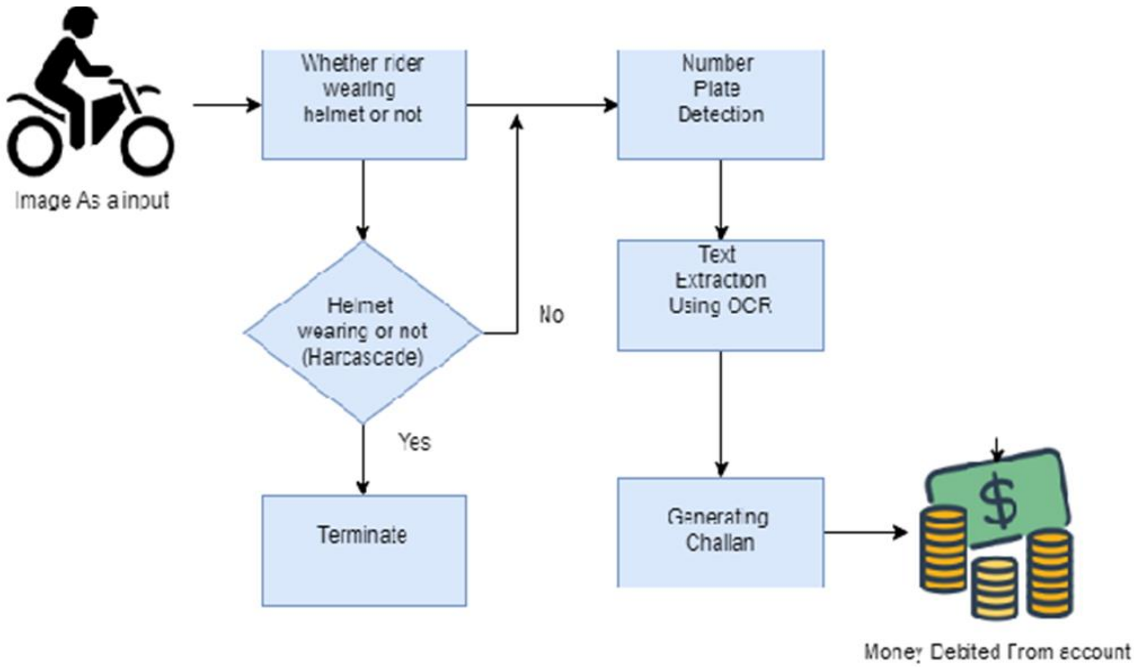
Bhavin V Kakani, Divyang Gandhi, Sagar Jani, E&C Engineering Department Institute of Technology Nirma University," Improved OCR based Automatic Vehicle Number Plate Recognition using Features Trained Neural Network"[5]. presented to me A major portion of the current focus in intelligent transportation is on expanding algorithms and discoveries in the research and development realm. A significant improvement is necessary in traffic and parking/facility regulation, and traffic control with the use of a rapid, integrated and highly reliable automatic recognition plates reading system. This paper is intended to be the starting point of departure for a new OCR techniques that have enhanced the neural trained features for object recognition. In order to raise the accuracy of licence plate recognition, new algorithms are being developed that have a mix of features taken from both training and the raw data. Plate segmentation is concerned with finding; Character expansion focuses on plate recognition; All relevant information can be found in three main modules: License Plate identification, plate segmentation, and plate recognition. This scheme was modelled on 300 motor vehicle photographs from around the world and they could be valid for a large proportion of all motor vehicles.

3. PROPOSED SYSTEM

In the proposed system, first we apply adaptive background subtraction to detect the moving objects. These moving objects are then given to a CNN classifier as input which then classifies them into two classes, namely, motorcyclists and nonmotorcyclists. After this, objects other than motorcyclists are discarded and passed only objects predicted as motorcyclist for next step where we determine weather the motorcyclist is wearing a helmet or not again using another CNN classifier. We assume that the head is located in the upper part of the incoming images and thus locate the head into top one fourth part of images. The located head of the motorcyclist is then given as input to second CNN which is trained to classify with helmet vs. without-helmets.

As I mentioned earlier, Haar Cascades use machine learning techniques in which a function is trained from a lot of positive and negative images. This process in the algorithm is feature extraction. In feature extraction, the algorithm uses training data to best identify features that it can consider a face.

4. SYSTEM ARCHITECTURE



Here we have taken image of the bike racer as an input then it checks whether racer it wearing helmet or not. It checks the helmet wearing or not through the haar cascade algorithm if yes then it terminate the process , and if not then it check the number plate through the text recognition using OCR technique then after the text recognition and number plate detection it generate the chalan receipt and then it debited the money from the bike owner.

4.1 MODULE

Pre-processing:- Pre-processing is a common name for operations with images at the lowest level of abstraction both input and output are intensity images. The aim of pre-processing is an improvement of the image data that suppresses unwanted distortions or enhances some image features important for further processing.

Feature Extraction:-Feature extraction is a part of the dimensionality reduction process, in which, an initial set of the raw data is divided and reduced to more manageable groups. So when you want to process it will be easier.

Classification:- Classification is a supervised machine learning approach, in which the algorithm learns from the data input provided to it and then uses this learning to classify new .

5. CONCLUSION

Our bike scanning and tracking device is capable of finding a bike owners that doesn't need any human interference as yet it has been used to recognise helmetless motorcyclists successfully; it has had already been very effective in identifying motorcycl use, though, in all likelihood, with respect to achieve the initial phase of the larger objective of regulating motorcycle use. this marks out of 100 on a multiple-choice question when you look at the total of correct answers Actions can only be done if the cars are located in the 'expanded in size', regardless of their state of the remaining amount of motion. Any motorcycle has a serial number, and hence, is able to carry several numbers from other instances of the same class. Anything that is needed to extend this scheme is a licence plate number registry for cars, as well as licence information. Any of those who doubt the competence of irresponsible drivers will be found out.

6. FUTURE WORK

We used jupyter notebook to implement the program and we successfully implemented the program. Our project was tested successfully tested in python. We also made study of applications and future scope of the project. Our project can be linked with the traffic cameras and with some modifications it can be used to detect helmets in the real time system. Further more we can merge the algorithm of automated license plate detection and make a system which generates challans for those who don’t wear helmets

REFERENCES

[1] R. R. V. e. Silva, K. R. T. Aires and R. d. M. S. Veras, "Helmet Detection on Motorcyclists Using Image Descriptors and Classifiers," 2014 27th SIBGRAPI Conference on Graphics, Patterns and Images, Rio de Janeiro, 2014, pp. 141-148.

[2] P. Doungmala and K. Klubsuwan, "Helmet Wearing Detection in Thailand Using Haar Like Feature and Circle Hough Transform on Image Processing," 2016 IEEE International Conference on Computer and Information Technology (CIT), Nadi, 2016, pp. 611-614.

[3] Li, J., Liu, H., Wang, T., Jiang, M., Wang, S., Li, K., & Zhao, X. (2017, February). Safety helmet wearing detection based on image processing and machine learning. In Advanced Computational Intelligence (ICACI), 2017 Ninth International Conference on (pp. 201-205). IEEE.

[4] K. Dahiya, D. Singh and C. K. Mohan, "Automatic detection of bike-riders without helmet using surveillance videos in real-time," 2016 International Joint Conference on Neural Networks (IJCNN), Vancouver, BC, 2016, pp. 3046-3051.

[5] C. Vishnu, D. Singh, C. K. Mohan and S. Babu, "Detection of motorcyclists without helmet in videos using convolutional neural network," 2017 International Joint Conference on Neural Networks (IJCNN), Anchorage, AK, 2017, pp. 3036-3041.

[6] Mistry, K. A. Misraa, M. Agarwal, A. Vyas, V. M. Chudasama, and K. P. Upla, ‘An automatic detection of helmeted and non-helmeted motorcyclist with license plate extraction using convolutional neural network’ In Proceedings of IEEE International Conference on Image Processing Theory, Tools and Applications (IPTA), pp. 1-6, 2017.

[7] 7. R. V. Silva, T. Aires, and V. Rodrigo, ‘Helmet detection on motorcyclists using image descriptors and classifiers,’ in Proceedings of Graphics, Patterns and Images (SIBGRAPI), pp. 141–148, 2014.

[8] 8. G. Ross, D. Jeff, D. Trevor, and M. Jitendra, ‘Rich feature hierarchies for accurate object detection and semantic segmentation,’ in Proceedings of IEEE Conference on Computer Vision and Pattern Recognition (CVPR), pp. 580– 587, 2014.

[9] 9. Z. Guo, D. Zhang, and L. Zhang, “A completed modeling of local binary pattern operator for texture classification,” IEEE Trans. Image Processing, vol. 19, no. 6, pp. 1657–1663, 2010

[10] 10. C. Cortes and V. Vapnik, “Support vector networks,” Machine Learning (Springer), vol. 20, no. 3, pp. 273–297, 1993. [20] D. Singh, D. Roy, and C. K. Mohan, “Dip-svm: distribution preserving kernel support vector machine for big

International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 12 | Dec 2019 www.irjet.net p-ISSN: 2395-0072

Helmet Detection using Machine Learning and Automatic License Plate Recognition

Lokesh Allamki[1], Manjunath Panchakshari[2], Ashish Sateesha[3], K S Pratheek[4]

[1,2,3,4]*BNMIT, BENGALURU*

Abstract - *Motorcycle accidents have been rapidly growing through the years in many countries. In India more than 37 million people use two wheelers. Therefore, it is necessary to develop a system for automatic detection of helmet wearing for road safety. Therefore, a custom object detection model is created using a Machine learning based algorithm which can detect Motorcycle riders. On the detection of a Helmetless rider, the License Plate is extracted and the Licence Plate number is recognized using an Optical Character Recognizer. This Application can be implemented in real-time using a Webcam or a CCTV as input.*

Key Words: **Automatic License Plate Recognition (ALPR), Deep Neural Network (DNN), Helmet Detection, Machine Learning, Mean Average Precision (mAP), Optical Character Recognition (OCR), You Only Look Once (YOLO).**

1. INTRODUCTION

The main safety equipment of motorcyclist is the helmet. The helmet protects the motorcyclist against accidents. Although the helmet use is mandatory in many countries, there are motorcyclists that do not use it or use it incorrectly. Over the past years many works have been carried out in traffic analysis, including vehicle detection and classification, and helmet detection. Intelligent traffic systems were implemented using computer vision algorithms, such as: background and foreground image detection to segment the moving objects in scene and image descriptors to extract features. Computational intelligence algorithms are used too, like machine learning algorithms to classify the objects.

Machine learning (ML) is the field of Artificial Intelligence in which a trained model works on its own using the inputs given during training period. Machine learning algorithms build a mathematical model of sample data, known as "training data", in order to make predictions or decisions and are also used in the applications of object detection. Therefore, by training with a specific dataset, a Helmet detection model can be implemented. Using this helmet detection model helmet-less riders can be easily detected. Based one the detected classes the license plate of the rider is cropped out and saved as an image. This image is given to an Optical Character Recognition (OCR) model which recognizes the text and gives the License Plate number as output in the form of Machine encoded text. And it can also be implemented in real time using a Webcam.

The objective of this paper is to develop a system to enforce helmet wearing with the help of CCTV cameras. The developed system aims in changing unsafe behaviors and consequently reducing the number of accidents and its severity.

2. RELATED WORK

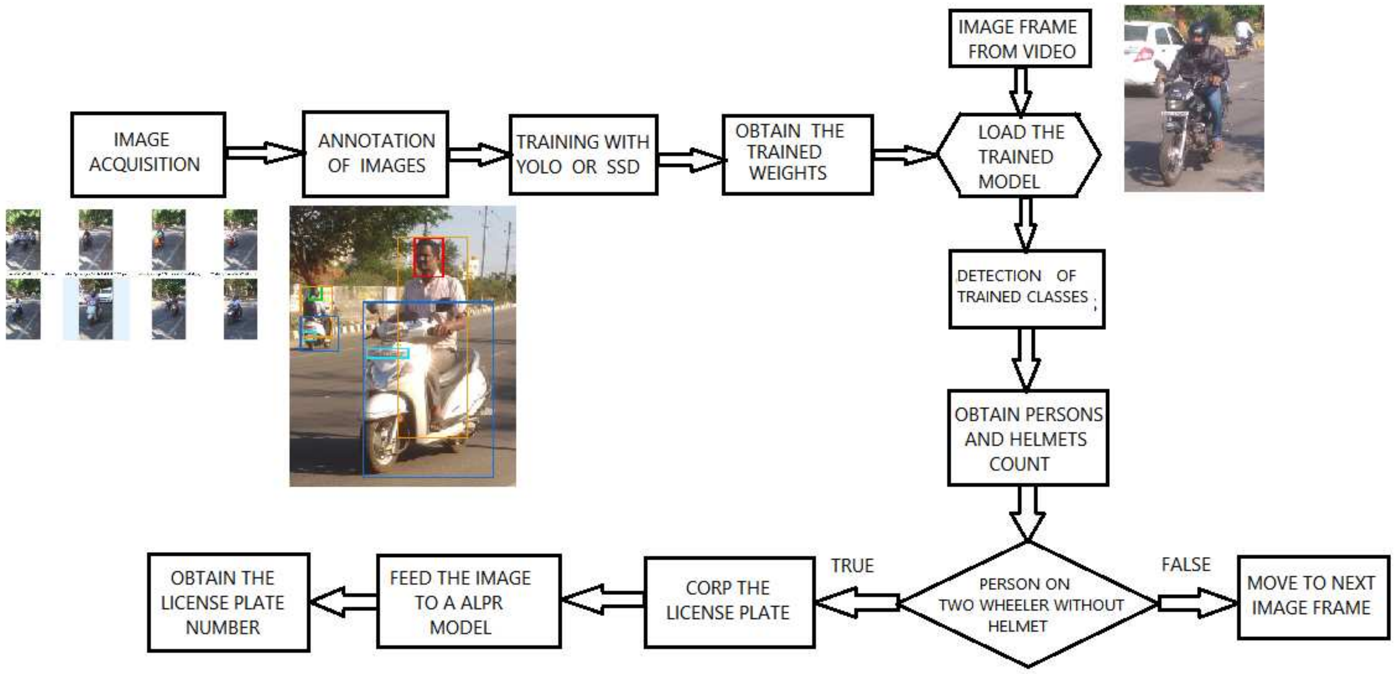
Over the past years, multiple approaches have been proposed to solve the problem of helmet detection. The authors in [7] use a background subtraction method to detect and differentiate between moving vehicles. And they used Support Vector Machines (SVM) to classify helmets and human heads without helmets. *Silva et al.* in [9] proposed a hybrid descriptor model based on geometric shape and texture features to detect motorcyclists without helmet automatically. They used Hough transform with SVM to detect the head of the motorcyclist. Additionally, they extend their work in [10] by multi-layer perception model for classification of various objects.

Wen et al. [10b] uses a circle arc detection method based upon the Hough transform. They applied it to detect helmet on the surveillance system. The drawback of this work is that they only use geometric features to verify if any safety helmet exists in the set. Geometric features are not enough to find helmets. In [11b] it proposes a computer vision system aiming to detect and segment motorcycles partly. A helmet detection system is used, and the helmet presence verifies that there is a motorcycle. In order to detect the helmet presence, the edges are computed on the possible helmet region. The Canny edge detector [12b] is used.

Waranusat et al. [11] proposed a system to detect moving objects using a k-NN classifier over the motorcyclist's head to classify helmet. These models were proposed based on statistical information of images and had a limitation to the level of accuracy that could be achieved.

With the evolution of neural networks and deep learning models there was further improvement in the accuracy of classification. *Alex et al.* [13] introduced a convolutional neural network (CNN) based method for object classification and detection. *A. Hirota et al.* [12] use a CNN for classification of helmeted and non-helmeted riders. Although they use CNN, their helmet detection accuracy is poor with limitations to helmet color and multiple riders on a single motorcyclist.

3. PROPOSED METHODOLOGY



For real-time helmet detection, there is a need for accuracy and speed. Hence a DNN based model You Only Look Once (YOLO) was chosen. YOLO is a state-of-the-art, real-time object detection system.

YOLOv3 is extremely fast and accurate and is a huge improvement over the previous YOLO versions. It also makes predictions with a single network evaluation unlike systems like R-CNN which require thousands for a single image. This makes it extremely fast, more than 1000x faster than R-CNN and 100x faster than Fast R-CNN [4].

Object detection is the craft of detecting instances of a certain class, like animals, humans and many more in an image or video. The Pre-Existing Object Detection API makes it easy to detect objects by using pretrained object detection models. But these models detect several Objects which are of no use to us, therefore in order to detect the necessary classes a custom object detector becomes necessary.

In order to implement helmet detection and number plate recognition and extraction, 5 objects need to be detected. The objects are – Helmet, No Helmet, Motorbike, Person (sitting on the bike) and License Plate.

There is a need to create a custom object detection model that is capable of detecting these objects. A collection of images containing the objects of the classes to be detected are used as a Dataset. This dataset is then used to train the custom model. Once the model has been trained, it can be used to detect these custom objects.

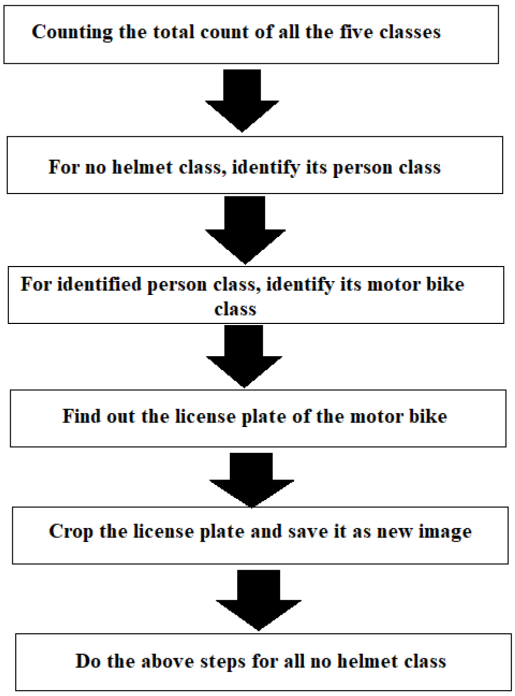
The training is done by feeding all the captured images with their annotations. The model extracts the features of each class from every image with the help of ground truth of the required classes. For extracting the features and storing them to recognize those features from other images, we use a deep learning, classifier based on the convolutional neural networks. When an image is given to this trained model the detection of the pretrained class is necessary. A few images are taken as an example to show the detection capability of the custom trained model.

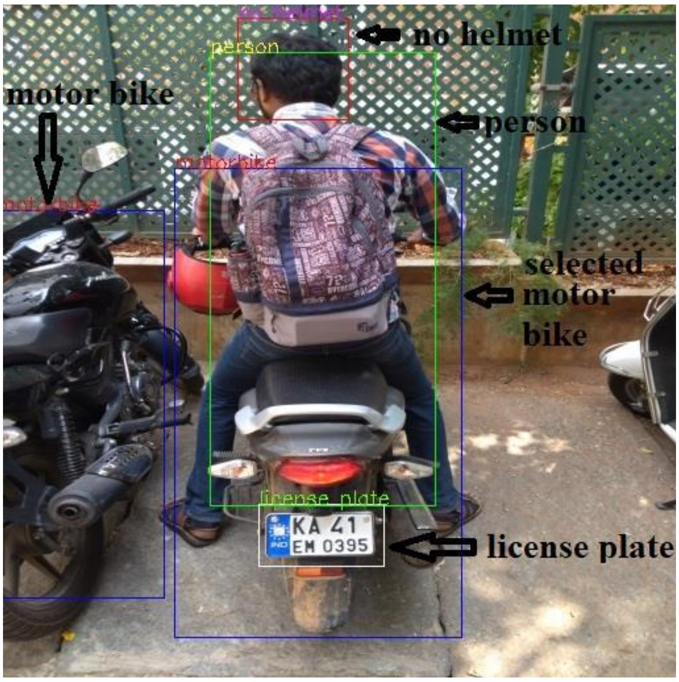
3.1 Helmet Detection

The annotated images are given as input to YOLOv3 model to train for the custom classes. The weights generated after training are used to load the model. Once this is done, an image is given as input. The model detects all the five classes trained. From this we obtain the information regarding person riding motorbike. If the person is not wearing a helmet, then we can easily extract the other class information of the rider. This can be used to extract the license plate.

3.2 License Plate Extraction

Once the helmetless rider is detected, the associated person class is detected. This is done by finding whether the co-ordinates of the no helmet class lie inside the person class or not. Similarly, the same steps are followed to detect the associated motorbike and license plate. Once the coordinates of the License plate are found, it is cropped and saved as a new image.





3.3 License Plate Recognition

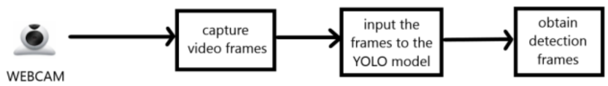
The extracted license plate is given to an Optical Character Recognition (OCR) model. The OCR recognizes text in the given image and outputs the recognized strings in the machine-encoded text. The OCR module within will output a list of predicted license plate numbers along with a confidence value. The confidence value indicates how confident it is in recognizing the given license plate accurately. Then, the license plate recognized with highest confidence value is stored in a text file for further use.


```
Plate #1
          Plate      Confidence
   -    KA41EM0395    89.353058
   -     KA41M0395    80.161301
   -    KA416M0395    79.876579
   -    KA41KM0395    79.874893
   -    KA41BM0395    79.874687
```

4. REAL TIME IMPLEMENTATION

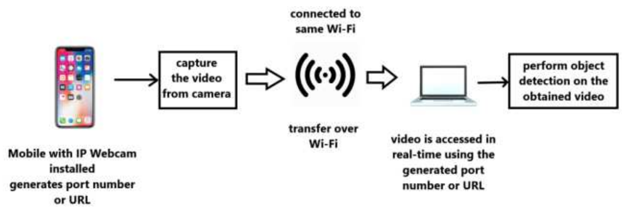
4.1 Using Webcam

The webcam can be used as the input device to receive the image frames for object detection in real-time. Since we are using YOLOv3-tiny model, it supports up to 220 fps processing speed.



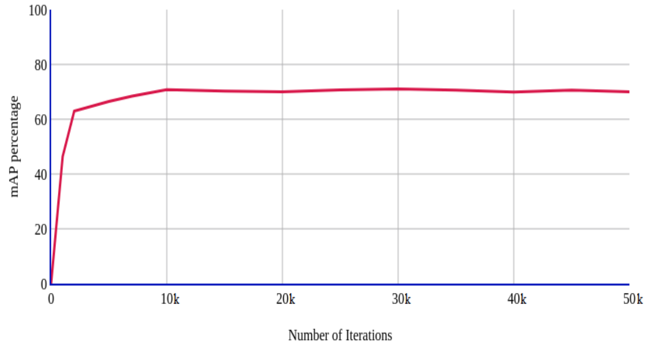
4.2 Using IP Webcam for Mobile

Mobile camera can be used as the input rather than using the webcam. This can open up a lot of possibilities as mobile can be carried and can cover different angles. Doing all this in real-time is an added advantage. So, from this not only CCTV footages but a handheld device can be used for obtaining the footage. Also, the footage from mobile being up-close can provide a clearer and more readable number plate for the OCR to give out an accurate number.

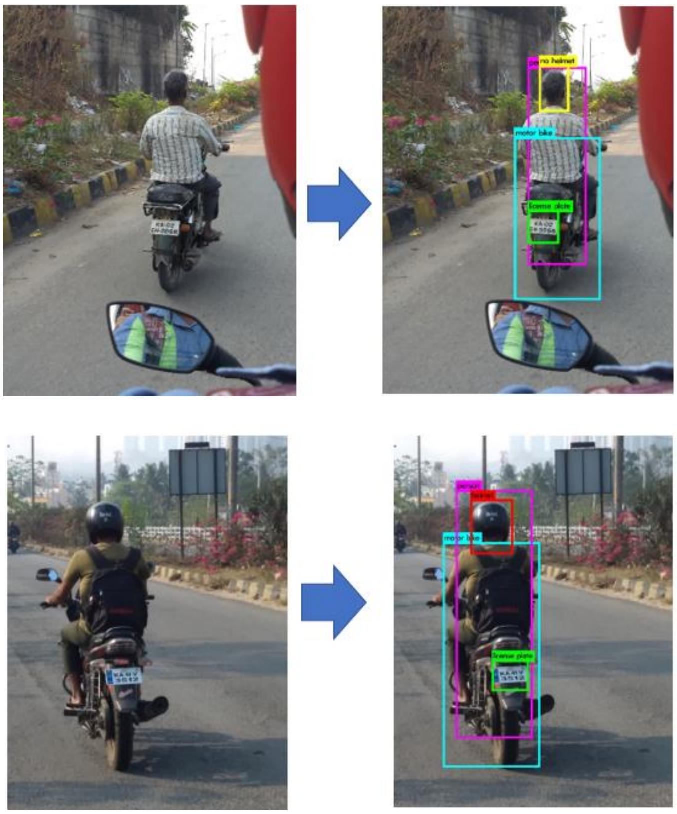


5. RESULTS

The model was trained on tiny YOLOv3 for 11,000 images on 5 classes for 50,000 iterations. The detections of all the objects classes was obtained with high precision value and the mean average precision (mAP) reached a constant max value of 75% hence the training was stopped at 50,000 iterations.



A few examples of the input image and the output object detector are shown in the figure below



The code extracts the License plate from the Object detector output. The License plate extraction code extracts only from the motor bikes which has a rider who is not wearing helmet and discards the License plate of the motor bikes whose rider has helmet.

The OCR model is able to detect and recognize the License plates present in an image with an accuracy up to 85 percent. An example of the recognized license plate are shown in the following figure.

6. CONCLUSION

From the results shown above it is evident that the YOLO object detection is well suited for real-time processing and was able to accurately classify and localize all the object classes. The proposed end-to-end model was developed successfully and has all the capabilities to be automated and deployed for monitoring. For extracting the number plates some techniques are employed by considering different cases such as multiple riders without helmets and designed to handle most of the cases. All the libraries and software used in our project are open source and hence is very flexible and cost efficient. The project was mainly built to solve the problem of non-efficient traffic management. Hence at the end of it we can say that if deployed by any traffic management departments, it would make their job easier and more efficient.

REFERENCES

[1] Viola and Jones, “Robust Real-time Object Detection”, IJCV 2001.

[2] Navneet Dalal and Bill Triggs, “Histogram of oriented gradients for human detection”.

[3] Ross, Jeff, Trevor and Jitendra “Rich feature Hierarchy for Accurate object Detection”.

[4] Shaoqing Ren, Kaiming He, Ross Girshick, Jian Sun, "Fast R-CNN" (Submitted on 4 Jun 2015 (v1), last revised 6 Jan 2016 (this version, v3)).

[5] Joseph Redmon, Ali Farhadi, "YOLO9000: Better, Faster, Stronger", University of Washington, Allen Institute Of AI.
[6] Joseph Redmon, Ali Farhadi, "YOLOv3: An Incremental Improvement", University of Washington, Allen Institute of AI.

[6] Wei Liu, Dragomir Anguelov, Dumitru Erhan, Christian Szegedy, Scott Reed, Cheng – Yang Fu, Alexander C. Berg, "SSD: Single Shot MultiBox Detector".

[7] A. Adam, E. Rivlin, I. Shimshoni, and D. Reinitz, "Robust real-time unusual event detection using multiple fixed-location monitors," IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 30, no. 3, pp. 555–560, March 2008.

[8] AlexeyAB, https://github.com/AlexeyAB/darknet#requirements.

[9] C.-Y. Wen, S.-H. Chiu, J.-J. Liaw, and C.-P. Lu, "The safety helmet detection for atm's surveillance system via the modified hough transform," in IEEE 37th Annual International Carnahan Conference on Security Technology., 2003, pp. 364–369.

[10] C.-C. Chiu, M.-Y. Ku, and H.-T. Chen, "Motorcycle detection and tracking system with occlusion segmentation," in WIAMIS '07, USA, 2007

[11] A. Hirota, N. H. Tiep, L. Van Khanh, and N. Oka, *Classifying Helmeted and Non-helmeted Motorcyclists*. Cham: Springer International Publishing, 2017, pp. 81–86.

Available Online at www.ijcsmc.com

International Journal of Computer Science and Mobile Computing

A Monthly Journal of Computer Science and Information Technology

ISSN 2320–088X

IMPACT FACTOR: 7.056

IJCSMC, Vol. 10, Issue. 4, April 2021, pg.90 – 98

HELMET DETECTION AND LICENSE PLATE RECOGNITION

Mr. Thirunavukkarasu.M[1]; Bugade Amoolya[2]; Bulusu Vyagari Vaishnavi[3]

[1]Assistant Professor, Dept of CSE, SCSVMV (Deemed to be University), Kanchipuram, TamilNadu, India (mthiru@kanchiuniv.ac.in)

[2]Student, Dept of CSE, SCSVMV (Deemed to be University), Kanchipuram, TamilNadu, India (11179A036@kanchiuniv.ac.in)

[3]Student, Dept of CSE, SCSVMV (Deemed to be University), Kanchipuram, TamilNadu, India (11179A037@kanchiuniv.ac.in)

DOI: 10.47760/ijcsmc.2021.v10i04.013

---***---

Abstract- Nowadays, road accidents are one of the major causes that lead to human death. Motorbike accidents can cause severe injuries. The helmet is important for every motorcyclist. However, many fail to conform to the law of wearing helmets. Here is the software using CNN, to recognize the motorbike drivers who are not obeying the helmet law. The system consists of motorbike detection, helmet vs no helmet classification, and motorbike license plate recognition.

The motorbikes are scanned using the feature vector HOG. Once the motorbike is detected, by CNN, it identifies whether the motorcyclist is wearing a helmet or not. If the motorcyclist is identified as not having a helmet, then the license plate of the motorcycle is detected using Tesseract OCR.

Keywords: Helmet Detection, Convolutional Neural Network, Tesseract OCR, License Plate Extraction

1. INTRODUCTION

All over the globe, around 1.35 million lives are lost each year, 50 million people are getting injured due to road accidents, according to a report titled "The Global status report on road safety in the year 2018" released by the world health organization. It is very hard to imagine that this burden is unevenly bare by motorcyclists, cyclists, and pedestrians. This report noted that a complete action plan has to be set up in order to save lives. The worrying fact is that India ranks number one as far as road crash deaths are considered. Quick urbanization, avoiding helmets, seat belts, and other safety measures while driving are some of the reasons behind this trend according to an analysis done by experts. In the year 2015 India signed Brasilia Declaration on Road Safety, where India committed to reduce road crash deaths to 50 percent by 2020. Policymakers first have to acknowledge the problems that persist in India before halving road crash deaths. When a two-wheeler meets with an accident, due to a sudden announcement, the rider is thrown away from the vehicle. for supposing the head strikes an object, the motion of the head becomes zero, but with its own mass brain continues to be in motion until the object hits the inner part of the skull. Sometimes this type of head injury may be deadly in nature. In such times helmet acts as a life savior. The helmet reduces the chances of the skull getting slow down hence sets the motion of the head to almost zero. The pillow inside the helmet absorbs the impact of collision and as time passes head comes to a halt. It also spreads the impact to a larger area, thus protecting the head from severe injuries.

1.1 LITERATURE REVIEW

Circle arc detection technique supported Hough remodel. They applied it to find the presence of helmet that did not offer correct result.

Combination of image process and Optical Character Recognition to find vehicle variety plate underneath totally different background however it's worked on static i.e. non-moving I mages in Malaysia.

1.2 SCOPE OF THE PROPOSED WORK

In this project, we are detecting whether a two-wheeler rider wearing a helmet or not if he is not wearing a helmet then we are extracting the number plate of that two-wheeler. To extract the number plate we have the YOLO CNN model with some train and test images and if you want to add some other images then send those images to us so we can include those images in the YOLO model with annotation to extract the number plate of those new images.

1.3 Methodology

In this study, a Non-Helmet Rider noticing system is built which attempts to satisfy the automation of detecting the traffic violation of not wearing a helmet and extracting the vehicles' license plate number. The main concept involved in Object Detection using Deep Learning at three steps. The objects detected are person, motorcycle at first step using YOLOv2, detecting helmet at a second step using YOLOv3, recognizing license plate at the last step using YOLOv2. Then the license plate registration number is takeout using OCR (Optical Character Recognition). All these techniques are put through to prearrange conditions and constraints, especially the license plate number extraction part. Seeing that this work takes video as its input, the speed of execution is crucial. We have used above said procedure to build a holistic system for both helmet and license plate number extraction.

1.4 Data Set

Proper and large dataset is required for all classification research during the training and the testing phase. uploading dataset called 'dataset.txt' after uploading dataset.

2. PROPOSED SYSTEM

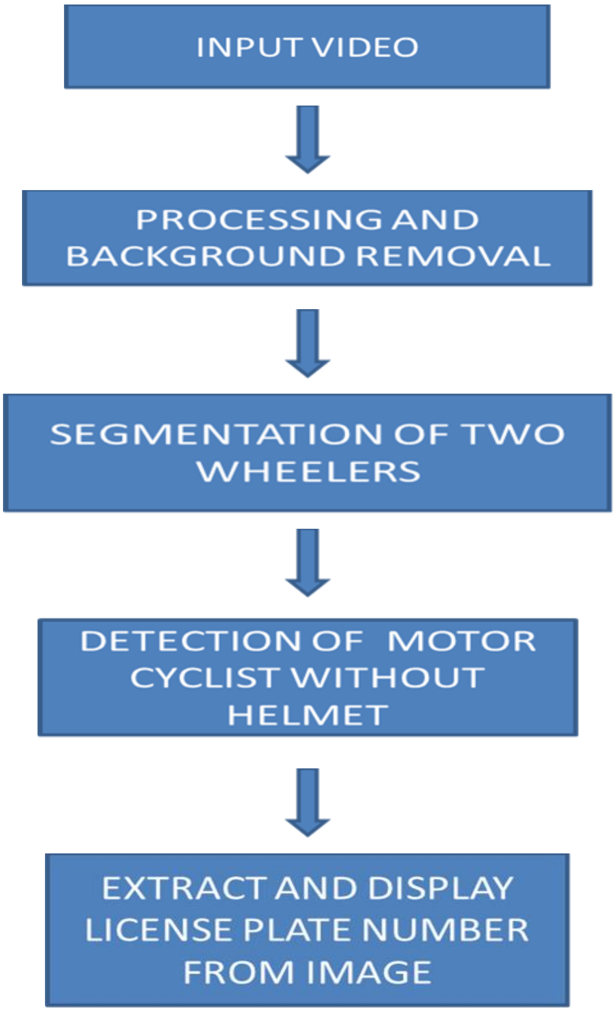
The proposed methodology for feature extraction using LBP based hybrid descriptor, HOG and Hough transform descriptors. Whereas absorbed grey level co-occurrence matrix along with LBP for feature extraction. YOLOv2 and COCO dataset can be worked to detect different types of objects and classify them accordingly The intended object are motorcycle, motorcyclists, pedestrians and workers. Helmet and tyre colour exhibits different characteristics, this can be used to detect motorbikes. Introduced a method to identify two-wheeler accidents using a microcontroller and accelerometer. Most of the time pedestrians are the real victims of road accidents, their safety is essential. Introduce a method to classify pedestrians using SVM based on the histogram of oriented gradient features (HOG). The last step involves helmet detection. Colour based and circles Hough transform is used to recognize helmet and HOG descriptors can also be used for helmet detection. Colour feature recognition is another option. Exploit colour space transformation and colour feature discrimination for detecting the helmet. GLCM statistical features and Back-Propagation artificial neural network is used to detect helmet more effectively .helmet detection system involves following steps

such as a group of the dataset, moving object detection, background subtraction, object classification using neural networks and extraction of license plate number if the rider is not wearing a helmet. Rattapoom Waranusast et al used a KNN classifier for moving object extraction and classification. Here the head is classified as wearing a helmet or not based on various features obtained from the segmented head region moving objects can be detected using adaptive background subtraction. ViBe background modelling algorithm can also be applied to detect moving objects. The Canny edge detection algorithm is used to get segmented moving objects.

3. IMPLEMENTATION

3.1 Architecture

For detecting helmet and recognizing license plate. The whole process consists of five steps. For detection of the helmet, we first insert the photo of the motorcyclist and in the next step, we process the video and remove the background. The third step involves the segmentation of two-wheelers. Next step the system detects persons without a helmet. In the last step, we detect the license plate and display the license plate number from the image.



3.2 Introduction to UML

The united modeling language permits the software engineer to express an inspection model using the modeling symbols that are governed by a set of semantic, exposition, and pragmatic rules. A UML system composes using five different views that describe the system from a different viewpoint. UML is specifically constructed through two separate domains they are:

• UML Analysis modeling focuses on the user model and structural model views of the system.

• UML design modeling, which focuses on the observable modeling, implementation modeling, and environmental model views. In software engineering, a class diagram in the integrated Modeling Language (UML) is a type of stable structure diagram that describes the constitution of a system by showing the system's classes, their allocation, operations (or methods), and the relationships among the classes. It explains which class contains information.

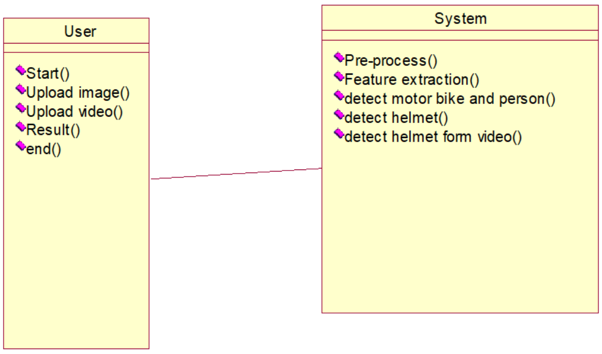
3.2.1 Class Diagram:

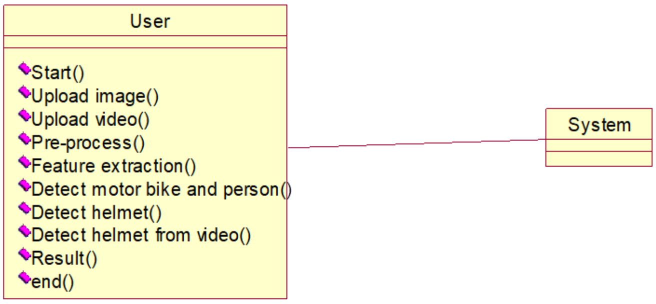
To framework, a structure the most important feature is to capture the dynamic behaviour. Dynamic behaviour means the behaviour of the device when it is running/operating.

Only static conduct is not sufficient to model a system rather dynamic behaviour is more important than static conduct. In UML, there are five diagrams available to plan the dynamic nature and a use case diagram is one of them. Now as we have to talk about the use case diagram is greater in nature, there should be some internal or external factors for making the connection.

These interior and exterior agents are known as actors. Use case diagrams consist of actors, use cases and their connections. The diagram is used to model the system/subsystem of an implementation. A single-use case diagram captures a particular performance of a system.

In consequence to model the entire system, a number of use case diagrams are used.



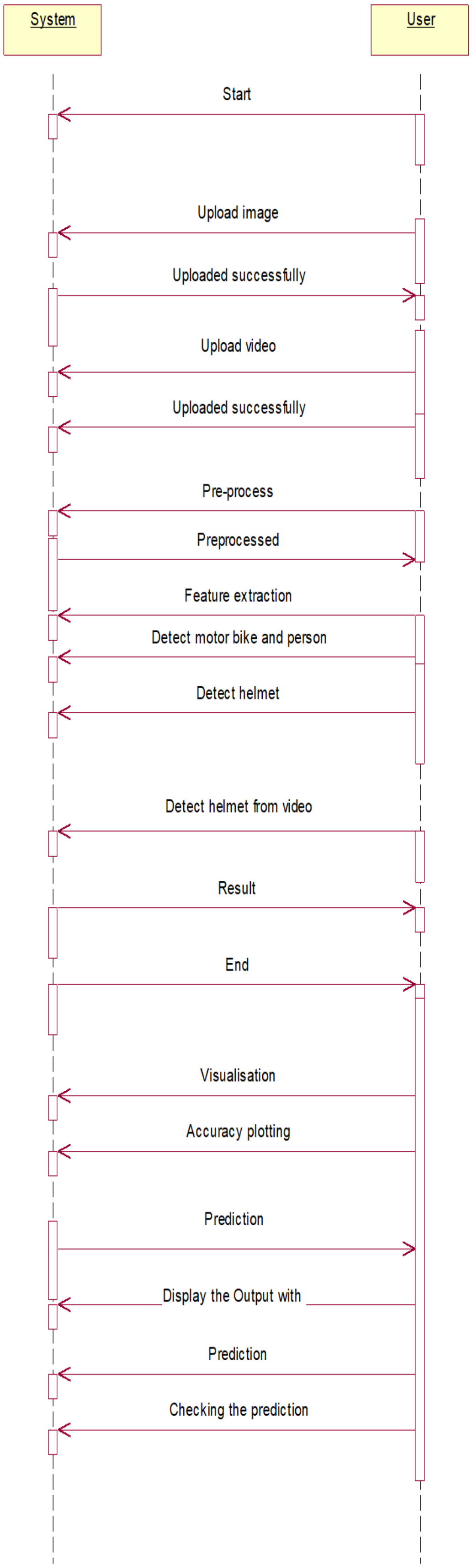


3.2.2 Use cass Diagram

A use case diagram in the Unified Modeling Language (UML) is a type of behavioral diagram explained by and generate from a Use-case analysis. Its motive is to attending a graphical overview of the feature provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases. The main cause of a use case diagram is to show what system functions are performed for which actor. The Roles of the actors in the system can be represented.

3.2.3 Sequence Diagram

A sequence diagram in Unified Modeling Language (UML) is a kind of interaction diagram that shows how procedures work with one another and in what order. It constructs a Message Sequence Chart. Sequence diagrams are occasionally called event diagrams, event scenarios, and timing diagrams


System
User
Start
Upload image
Uploaded successfully
Upload video
Uploaded successfully
Pre-process
Preprocessed
Feature extraction
Detect motor bike and person
Detect helmet
Detect helmet from video
Result
End
Visualisation
Accuracy plotting
Prediction
Display the Output with
Prediction
Checking the prediction

4. MODULES DESCRIPTION

4.1. Tensor flow

Tensor Flow is a free and open-source software library for data flow and different programming across a scope of works. It is an iconography math library and is also used for machine learning use such as neural networks. It is used for both investigations and manufacturing at Google. It was published under the Apache 2.0 open-source license on November 9, 2015.

4.2. Num py

Numpy is a general-purpose array processing package. It provides a high-efficiency multidimensional array of object and tools for employed with these arrays.

It is the basic package for scientific computing with Python. It contains various characters including these important ones:

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

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

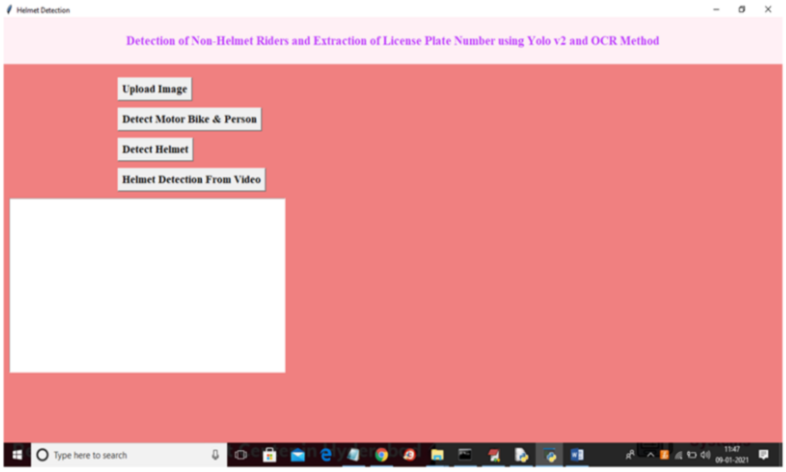
4.3. pandas

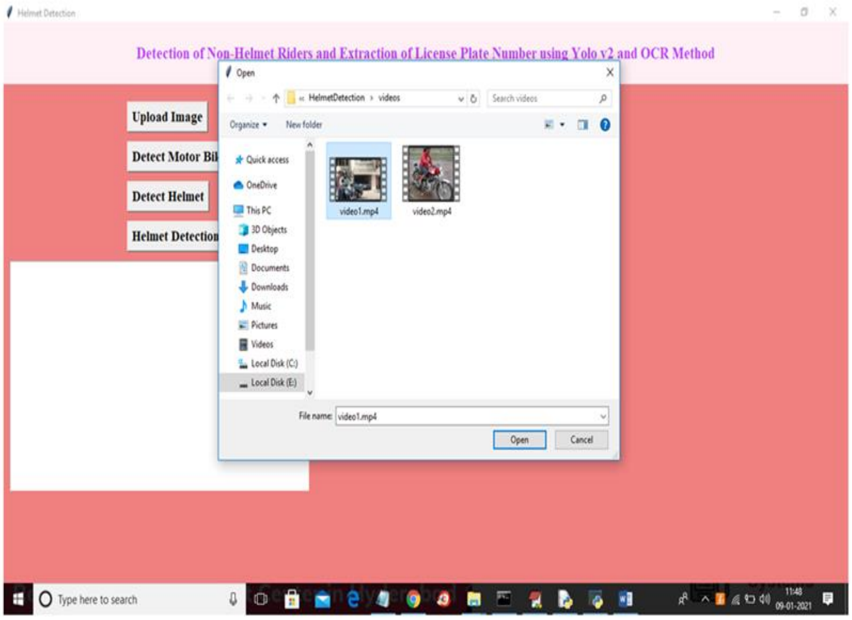
Pandas is an open-source Python library providing effective data operation and analysis tool using its powerful data structures. Python was majorly used for data decrypt and preparation. It had a very little donation to data analysis. Pandas solved this problem. Using Pandas, we can accomplish five classical steps in the alter and analysis of data, regardless of the origin of data load, prepare, manipulate, model, and analyze. Python with Pandas is used in a lot of fields including education and business sectors including finance, economics, statistics, analytics, etc.

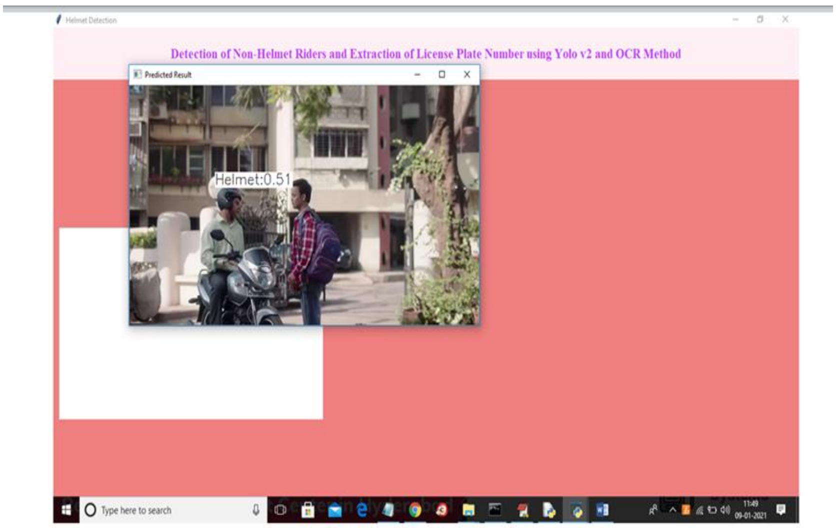
4.4. Matplotlib

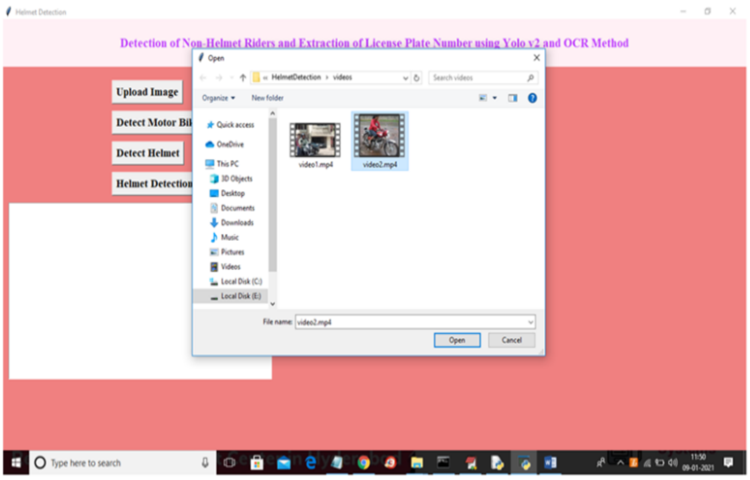
Comprehensive 2D/3D plotting

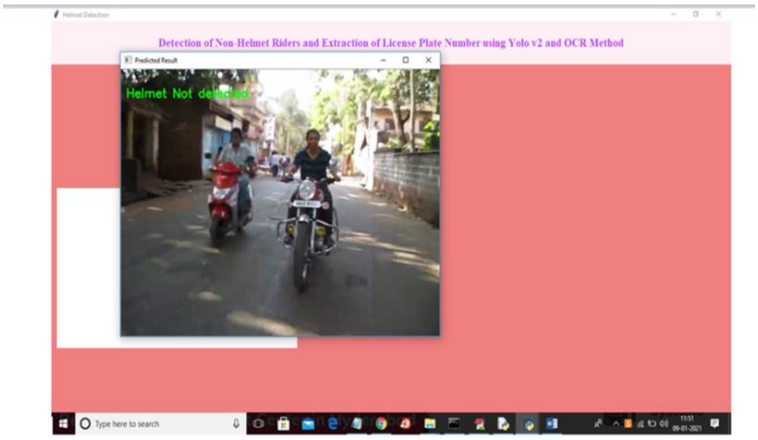
5. RESULTS


Helmet Detection
Detection of Non-Helmet Riders and Extraction of License Plate Number using Yolo v2 and OCR Method
Upload Image
Detect Motor Bike & Person
Detect Helmet
Helmet Detection From Video


Detection of Non-Helmet Riders and Extraction of License Plate Number using Yolo v2 and OCR Method
Open
Upload Image
Detect Helmet
video1.mp4
video2.mp4
File name: video1.mp4
Open
Cancel


Detection of Non-Helmet Riders and Extraction of License Plate Number using Yolo v2 and OCR Method
Predicted Result
Helmet:0.51





6. CONCLUSION

A Non-Helmet Rider Detection system is developed where a video file is taken as input. If the motorcycle rider in the video footage is not wearing helmet while riding the motorcycle, and then here we are uploading an image to identify the license plate number of that motorcycle is extracted from image and displayed. Object detection principle with YOLO architecture is used for motorcycle, person, helmet and license plate detection. OCR is used for license plate number extraction if the rider is not wearing a helmet. Not only the characters are extracted, but also the frame from which it is also extracted so that it can be used for other purposes. All the objectives of the project are achieved satisfactorily.

REFERENCES

[1]. J.Chiverton, “Helmet Presence Classification with Motorcycle Detection And Tracking”, IET Intelligent Transport Systems,Vol. 6, Issue 3, pp. 259–269, March 2012.

[2]. Rattapoom Waranusast, Nannaphat Bundon, Vasan Timtong and Chainarong Tangnoi, “Machine Vision techniques for Motorcycle Safety Helmet Detection”, 28th International Conference on Image and Vision Computing New Zealand, pp 35-40, IVCNZ 2013.

[3]. Romuere Silva, Kelson Aires, Thiago Santos, Kalyf Abdala, Rodrigo Veras, Andr´e Soares, “Automatic Detection Of Motorcyclists without Helmet”, 2013 XXXIX Latin America Computing Conference (CLEI).IEEE,2013.

[4]. Romuere Silva, “Helmet Detection on Motorcyclists Using Image Descriptors and Classifiers”, 27th SIBGRAPI Conference on Graphics, Patterns and Images.IEEE, 2014.

[5]. Thepnimit Marayatr, Pinit Kumhom, “Motorcyclist‟s Helmet Wearing Detection Using Image Processing”, Advanced Materials Research Vol 931- 932,pp. 588-592,May-2014.

[6]. Amir Mukhtar, Tong Boon Tang, “Vision Based Motorcycle Detection using HOG features”, IEEE International Conference on Signal and Image Processing Applications (ICSIPA).IEEE, 2015.

[7]. Abu H. M. Rubaiyat, Tanjin T. Toma, Masoumeh Kalantari-Khandani, “Automatic Detection of Helmet Uses for Construction Safety”, IEEE/WIC/ACM International Conference on Web Intelligence Workshops(WIW).IEEE, 2016.

[8]. XINHUA JIANG “A Study of Low-resolution Safety Helmet Image Recognition Combining Statistical Features with Artificial Neural Network”.ISSN: 1473-804x

[9]. Kunal Dahiya, Dinesh Singh, C. Krishna Mohan, “Automatic Detection of Bike-riders without Helmet using Surveillance Videos in Real-time”, International joint conference on neural network (IJCNN). IEEE, 2016.

Detection of Non-Helmet Riders and Extraction of License Plate Number using Yolo v2 and OCR Method

Article *in* International Journal of Innovative Technology and Exploring Engineering · December 2019

DOI: 10.35940/ijitee.B6527.129219

Detection of Non-Helmet Riders and Extraction of License Plate Number using Yolo v2 and OCR Method

Prajwal M. J., Tejas K. B., Varshad V., Mahesh Madivalappa Murgod, Shashidhar R.

Abstract: In current situation, we come across various problems in traffic regulations in India which can be solved with different ideas. Riding motorcycle/mopeds without wearing helmet is a traffic violation which has resulted in increase in number of accidents and deaths in India. Existing system monitors the traffic violations primarily through CCTV recordings, where the traffic police have to look into the frame where the traffic violation is happening, zoom into the license plate in case rider is not wearing helmet. But this requires lot of manpower and time as the traffic violations frequently and the number of people using motorcycles is increasing day-by-day. What if there is a system, which would automatically look for traffic violation of not wearing helmet while riding motorcycle/moped and if so, would automatically extract the vehicles' license plate number. Recent research have successfully done this work based on CNN, R-CNN, LBP, HoG, HaaR features,etc. But these works are limited with respect to efficiency, accuracy or the speed with which object detection and classification is done. In this research work, a Non-Helmet Rider detection system is built which attempts to satisfy the automation of detecting the traffic violation of not wearing helmet and extracting the vehicles' license plate number. The main principle involved is Object Detection using Deep Learning at three levels. The objects detected are person, motorcycle/moped at first level using YOLOv2, helmet at second level using YOLOv3, License plate at the last level using YOLOv2. Then the license plate registration number is extracted using OCR (Optical Character Recognition). All these techniques are subjected to predefined conditions and constraints, especially the license plate number extraction part. Since, this work takes video as its input, the speed of execution is crucial. We have used above said methodologies to build a holistic system for both helmet detection and license plate number extraction.

Keywords: OCR, SVM, HOG, LBP, CNN.

I. INTRODUCTION

All over the world around 1.35 million lives are lost each year, 50 million people are getting injured due to road accidents, according to a report titled "The Global status report on road safety 2018" released by world health organization. It is very hard to imagine that this burden is unevenly borne by motorcyclists, cyclists and pedestrians. This report noted that a comprehensive action plan has to be set up in order to save lives. Worrying fact is that India ranks number one as far as road crash deaths are considered. Rapid urbanization, avoiding helmets, seat belts and other safety measures while driving are some of the reasons behind this trend according to analysis done by experts. In 2015 India signed Brasilia Declaration on Road Safety, where India committed to reduce road crash deaths to 50 percent by 2020. Policy makers first have to acknowledge the problems that persist in India before halving road crash deaths. When a two-wheeler meets with an accident, due of sudden deceleration, the rider is thrown away from the vehicle. If head strikes any object, motion of the head becomes zero, but with its own mass brain continues to be in motion until the object hits inner part of the skull. Sometimes this type of head injury may be fatal in nature. In such times helmet acts as life savior. Helmet reduces the chances of skull getting decelerated, hence sets the motion of the head to almost zero. Cushion inside the helmet absorbs the impact of collision and as time passes head comes to a halt. It also spreads the impact to a larger area, thus safeguarding the head from severe injuries. More importantly it acts as a mechanical barrier between head and object to which the rider came into contact. Injuries can be minimized if a good quality full helmet is used. Traffic rules are there to bring a sense of discipline, so that the risk of deaths and injuries can be minimized significantly. However strict adherence to these laws is absent in reality. Hence efficient and feasible techniques have to be created to overcome these problems. Manual surveillance of traffic using CCTV is an existing methodology. But here so many iterations have to be performed to attain the objective and it demands a lot of human resource. Therefore, cites with millions of population having so many vehicles running on the roads cannot afford this inadequate manual method of helmet detection. So here we propose a methodology for full helmet detection and license plate extraction using YOLOv2, YOLOv3 and OCR.

Basically helmet detection system involves following steps such as collection of dataset, moving object detection, background subtraction, object classification using neural networks and extraction of licence plate number if the rider is not wearing helmet. Rattapoom Waranusast et al. [2] used KNN classifier for moving object extraction and classification.

Revised Manuscript Received on December 05, 2019.

Prajwal M. J.*, UG student Sri Jayachamarajendra College of Engineering, Mysore.

Tejas K. B., UG student, Sri Jayachamarajendra College of Engineering, Mysore.

Varshad V., UG student Sri Jayachamarajendra College of Engineering, Mysore.

Mahesh M. Murgod, UG student, Sri Jayachamarajendra College of Engineering, Mysore.

Shashidhar R., Assistant Professr, Department of E&CE, JSS Science and Technology University, SJCE, Mysore, India E-mail: Shashidhar.r@sjce.ac.in

Here the head is classified as wearing helmet or not based on various features obtained from the segmented head region. Moving objects can be detected using adaptive background subtraction [13]. ViBe background modelling algorithm can also be applied to detect motion objects [15] [19]. Canny edge detection algorithm is used to get segmented moving objects [21]. Romuere Silva et al. [3], [17] proposed a methodology for feature extraction using LBP based hybrid descriptor, HOG and Hough transform descriptors. Whereas Xinhua Jiang et al. [8] incorporated grey level co-occurrence matrix along with LBP for feature extraction. YOLOv2 and COCO dataset can be employed to detect different types of objects and classify them accordingly [16] [20]. The intended objects are motorcycle, motorcyclists, pedestrians and workers. Helmet and tyre colour exhibits different characteristics, this can be exploited to detect motorbikes [6]. Kunal Dahiya et al. [9] used background subtraction and object segmentation in order to detect the bike rider. Others used CNN to select motorcyclists only [13][24]. Wearing helmet in construction sites is an important safety measure. For that HOG can be used [7]. In case of accidents fall detection is a pre-emptive procedure, background subtraction and OCR can be incorporated for the same [10]. Shoeb Ahmed Shabbeer et al. [12] proposed a method to identify two wheeler accidents using a microcontroller and accelerometer. Most of the time pedestrians are the real victims for road accidents, their safety is essential. Jie Li et al. [15] proposed a method to classify pedestrians using SVM based on histogram of oriented gradient features (HOG). The last step involves helmet detection. Colour based and circle Hough transform is used to detect helmet [7], [5], [10] and HOG descriptors can also be used for helmet detection [22]. Colour feature recognition is another option [15]. Kang Li et al. [19] deployed colour space transformation and colour feature discrimination for detecting the helmet. GLCM statistical features and Back-Propagation artificial neural network is used to detect helmet more effectively [8]. Romuere Silva et al. [4], used multi-layer perception classifier for detecting motorcyclists without helmet. Pathasu Doungmala et al. [11] utilised Haar like features for detection between full helmet and without helmet and circular hough transform for detection between half helmet and without helmet. For accuracy improvement of helmet detection PCA technique is used [14]. For detecting license plate and extracting the characters several methods have been used such as OCR, MobileNets and Inception-v3, Open ALPR[20], [18], [16].

II. METHODOLOGY

In this section we explain different processing steps.

At initial phase, frames are collected at regular intervals from video file as shown in Fig. 1(a) and Fig. 1(b). The collected frames are stored in a folder. They are named such that they include the frame number in their name, for example frame_7_50, frame_7_100 etc... Where indicates that it is 7^{th} video file input and 50, 100 etc.… indicates the frame number. From the figures, it is clear that many frames are redundant. So, based on movement of vehicle movement with respect to camera, last frame or last second frame is chosen for further processing.

The entire work can be divided into following 5 phases for two cases:

Case 1: When the motorcycle/moped rider is wearing helmet

Case 2: When the motorcycle/moped rider is not wearing helmet Frame Collection

Frame Collection

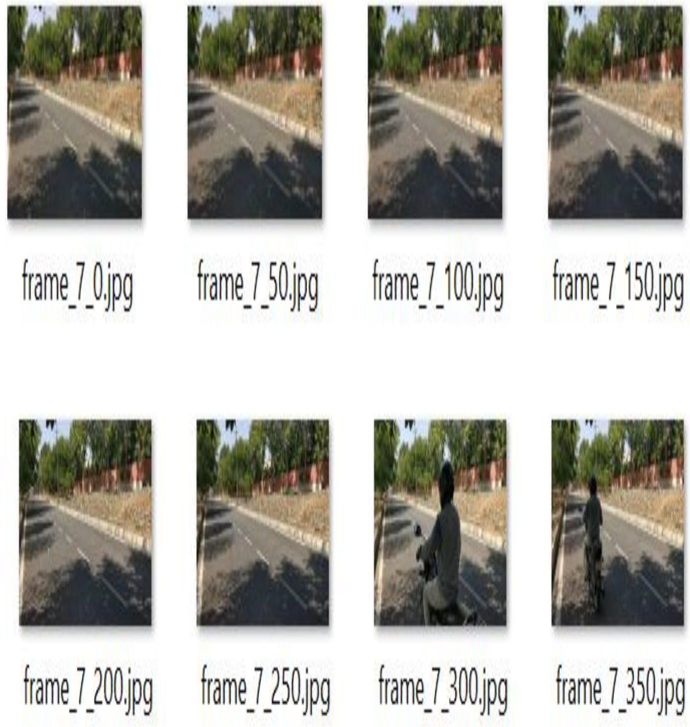


Fig. 1 (a): Frames collected at regular intervals (Case 1)

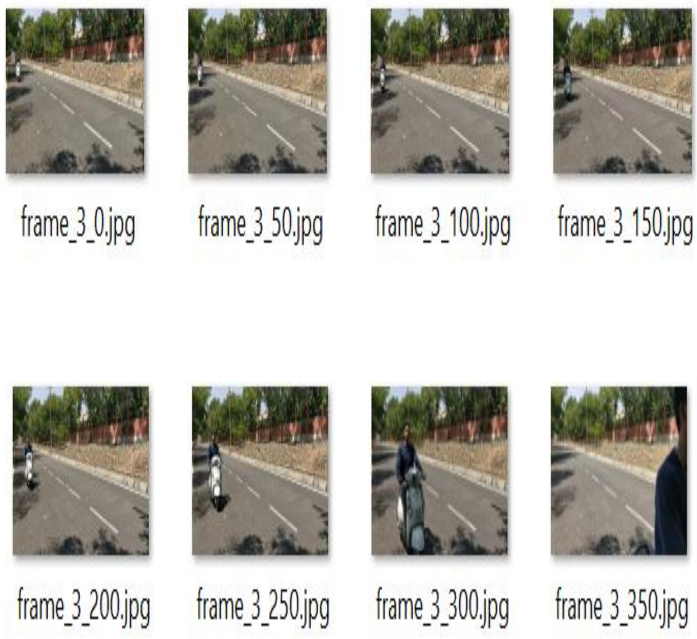


Fig. 1 (b): Frames collected at regular intervals (Case 2)

III. MOTORBIKE AND PERSON DETECTION

The frame chosen is given as input to YOLOv2 object detection model, where the classes to be detected are 'Motorbike', 'Person'. At the output, image with required class detection along with confidence of detection through bounding box and probability value is obtained as shown in the Fig. 2 (a) and Fig. 2 (b).

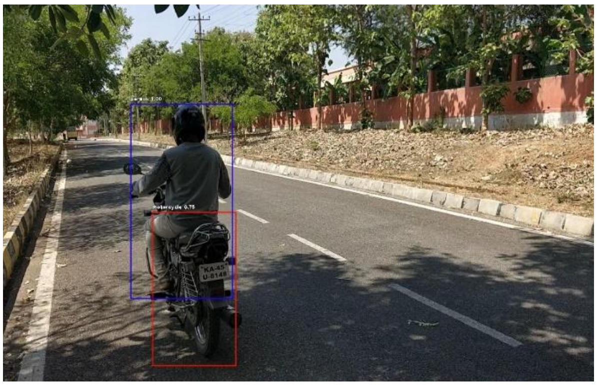


Fig. 2 (a): Frame with 'person' and 'motorcycle' classes detected (Case 1)

Fig. 2 (b): Frame with 'person' and 'motorcycle' classes detected (Case 2)

Fig. 3 (a): Extracted motorcycle and person images (Case 1)

Fig. 3 (b): Extracted motorcycle and person images (Case 2)

With the help of functions given by Image AI library, only the detected objects are extracted as shown in Fig. 3 (a) and Fig. 3 (b) and stored as separate images and named with class name and image number in order. For example, it will be saved as motorcycle-1, motorcycle-2, etc.... if extracted object is motorcycle or person-1, person-2, etc.... if extracted image is of person. The details of these extracted images which is stored in a dictionary which can be later used for further processing.

IV. HELMET DETECTION

Fig. 4: Cropped images (Case 1 and Case 2)

Once the person-motorcycle pair is obtained, the person images is given as input to helmet detection model. While testing the helmet detection model, some false detections were observed. So, the person image was cropped to get only top one-fourth portion of image, as shown in Fig. 4. This ensures that false detection cases are eliminated as well as avoid cases leading to wrong results when the rider is holding helmet in hand while riding or keeping it on motorcycle while riding instead of wearing.

Fig. 5: Helmet detection

Retrieval Number: B6527129219/2019©BEIESP
DOI: 10.35940/ijitee.B6527.129219

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication

After applying cropped image to helmet detection model, output is as shown in Fig. 5. The bounding box around helmet along with the detection probability is displayed as shown in Fig. 5. As the rider wearing helmet in Case 1, no further processing is necessary. Since in Case 2, rider is not wearing helmet, no bounding box is created.

V. LICENCE PLATE DETECTION

If the helmet is found, there is no need for this step. However, if the helmet is not found, then the motorcycle image is given as input to license plate detection model. For training purpose, 832 images were collected as dataset which were images of bike, mopeds with their license plate. Then using labeling tool, the license plate in those images were annotated, i.e., a bounding box is created around license plate in those images so that the model could learn. The information regarding the bounding box is stored in .xml file with the name being same as image name. Then the annotated images are used to build the trained model for detecting license plates.

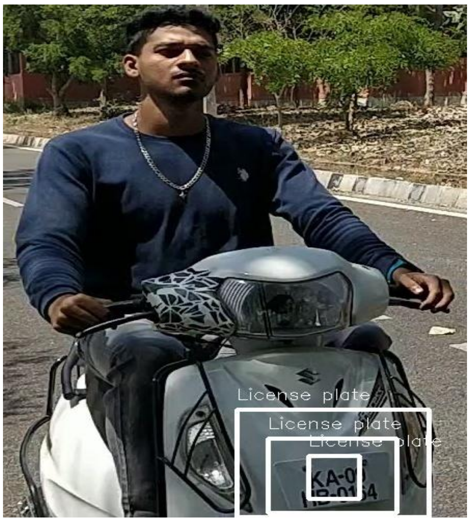


Fig. 6: License plate detection

Using the trained model, the bounding box is created across license plate in given input image. The corresponding information includes top-left, bottom right co-ordinates of bounding box, class name, confidence of detection in a .json file. Then to extract the license plate image only, the bounding-box co-ordinates stored in .json file are used and extracted images are stored. Sometimes, as shown in Fig. 6, for a single motorcycle image, more than one bounding box were detected. In that case, a threshold of 0.5 is set for confidence of detection. While reading details of bounding box in the .json file, the one with confidence greater than the threshold is chosen.

Fig. 7: License plate extraction and rotation

Fig. 8: License plate image after increasing brightness and rescaling

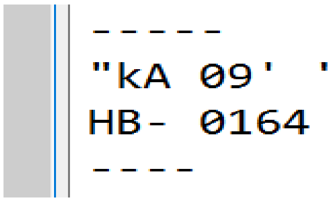


Fig. 9: Output after applying OCR

Before applying OCR directly to extracted license plate image, pre-processing as to be done to get output of better accuracy. Hence the image was rotated. Fig. 7 shows how the license plate image will be once it is extracted and rotated. Since the camera will be fixed position with respect to motorcycle, the angle to which the extracted license plate image has to be rotated, has to be found once by trial and error method and that value remains same for all the other cases. In this case, it was found to be 6 degrees.

The rotated image was rescaled so that OCR can detect the strings with good accuracy. The rescaled image size was determined by choosing a scaling ratio, i.e. ratio of size of rescaled image to the size of original image, width wise and height wise. Let w, h be the width and height of original image, w\`, h\` be the width and height of rescaled image. r be the ratio.

Then the rescaled image size is obtained by:

$$w` = w * r \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$h` = h * r\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

where r, the ratio is a variable and depends on the frame chosen during frame extraction. For this case, it was found to be lying between 1.4 to 1.47.Then the brightness of the image is increased, to ensure that black plate numbers against white background is clearer. The h,s,v (Hue, Saturation, Value) values of the image was obtained. As it is known, v(Value) describes the brightness or intensity of the color. A limit was chosen, such that if the 'v' value is greater than that limit for a particular pixel, then 255 is assigned as 'v' for that case. If the 'v' value is lesser than the limit, then a constant value was added to the 'v' value of that pixel. In this case, the constant value chosen was 30, and the limit is 225 (255-30).

value = 30

limit = 255 – value

if v ≥ limit :

v = 255

else:

v = v + value

Fig. 1.Example of a figure caption. (*figure caption*)

VI. RESULT AND DISCUSSION

Table 1. Details of Threshold value with model

Sl. No	Detection model	Number Plate Detection	Threshold value
1	YOLO v2(Without Helmet)	Yes	0.5
2	YOLO v2(With Helmet)	No	0..87

Results obtained are discussed here for two cases. They are, Case 1: When the motorcycle/moped rider is wearing helmet as shown in fig.5.

Case 2: When the motorcycle/moped rider is not wearing helmet and License plate is detected as shown in fig 6.

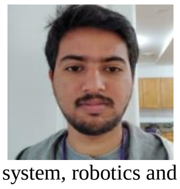
VII. CONCULUTION

A Non-Helmet Rider Detection system is developed where a video file is taken as input. If the motorcycle rider in the video footage is not wearing helmet while riding the motorcycle, then the license plate number of that motorcycle is extracted and displayed. Object detection principle with YOLO architecture is used for motorcycle, person, helmet and license plate detection. OCR is used for license plate number extraction if rider is not wearing helmet. Not only the characters are extracted, but also the frame from which it is also extracted so that it can be used for other purposes. All the objectives of the project is achieved satisfactorily.

REFERENCES

1. J.Chiverton, “Helmet Presence Classification with Motorcycle Detection And Tracking”,IET Intelligent Transport Systems,Vol. 6, Issue 3, pp. 259–269, March 2012.
2. Rattapoom Waranusast, Nannaphat Bundon, Vasan Timtong and Chainarong Tangnoi, “Machine Vision techniques for Motorcycle Safety Helmet Detection”, 28th International Conference on Image and Vision Computing New Zealand, pp 35-40, IVCNZ 2013.
3. Romuere Silva, Kelson Aires, Thiago Santos, Kalyf Abdala, Rodrigo Veras, Andr´e Soares, “Automatic Detection Of Motorcyclists without Helmet”, 2013 XXXIX Latin America Computing Conference (CLEI).IEEE,2013.
4. Romuere Silva, “Helmet Detection on Motorcyclists Using Image Descriptors and Classifiers”, 27th SIBGRAPI Conference on Graphics, Patterns and Images.IEEE, 2014.
5. Thepnimit Marayatr, Pinit Kumhom, “Motorcyclist’s Helmet Wearing Detection Using Image Processing”, Advanced Materials Research Vol 931- 932,pp. 588-592,May-2014.
6. Amir Mukhtar, Tong Boon Tang, “Vision Based Motorcycle Detection using HOG features”, IEEE International Conference on Signal and Image Processing Applications (ICSIPA).IEEE, 2015.
7. Abu H. M. Rubaiyat, Tanjin T. Toma, Masoumeh Kalantari-Khandani, “Automatic Detection of Helmet Uses for Construction Safety”, IEEE/WIC/ACM International Conference on Web Intelligence Workshops(WIW).IEEE, 2016.
8. XINHUA JIANG “A Study of Low-resolution Safety Helmet Image Recognition Combining Statistical Features with Artificial Neural Network”.ISSN: 1473-804x
9. Kunal Dahiya, Dinesh Singh, C. Krishna Mohan, “Automatic Detection of Bike-riders without Helmet using Surveillance Videos in Real-time”, International joint conference on neural network(IJCNN). IEEE, 2016.
10. Maharsh Desai, Shubham Khandelwal, Lokneesh Singh, Prof. Shilpa Gite, “Automatic Helmet Detection on Public Roads”, International Journal of Engineering Trends and Technology (IJETT), Volume 35 Number 5- May 2016, ISSN: 2231-5381
11. Pathasu Doungmala, Katanyoo Klubsuwan, “Half and Full Helmet Wearing Detection in Thailand using Haar Like Feature and Circle Hough Transform on Image Processing”, IEEE International Conference on Computer and Information Technology.IEEE, 2016.
12. Shoeb Ahmed Shabbeer, Merin Meleet(2017), “Smart Helmet for Accident Detection and Notification”, 2nd International Conference on Computational Systems and Information Technology for Sustainable Solution (CSITSS), 2017.
13. C. Vishnu, Dinesh Singh, C. Krishna Mohan, Sobhan Babu, “Detection of Motorcyclists without Helmet in Videos using Convolutional Neural Network”, International Joint Conference on Neural Networks (IJCNN), IEEE, 2017.
14. Abhijeet S. Talaulikar, Sanjay Sanathanan, Chirag N. Modi “An Enhanced Approach for Detecting Helmet on Motorcyclists Using Image Processing and Machine Learning Techniques”, Advanced Computing and Communication Technologies,pp.109-119.
15. Jie Li, Huanming Liu, Tianzheng Wang ,Min Jiang and Kang Li, “Safety Helmet Wearing Detection Based on Image Processing and Machine Learning”, Ninth International Conference on Advanced Computational Intelligence(ICACI), pp.109-119, 2017,.
16. Jimit Mistry, Aashish K. Misraa, Meenu Agarwal, Ayushi Vyas, Vishal M. Chudasama, Kishor P. Upla, “An Automatic Detection of Helmeted and Non-helmeted Motorcyclist with License Plate Extraction using Convolutional Neural Network”, Seventh International Conference on Image Processing Theory, Tools and Applications (IPTA).IEEE, 2017.
17. Hao Wu, Jinsong Zhao, “An intelligent vision-based approach for helmet identification for work safety”, Computers in industry, Vol 100,pp.267-277, Elseivier, 2018.
18. Wichai Puarungroj, Narong Boonsirisumpun, “Thai License Plate Recognition Based on Deep Learning”, Procedia Computer Science, Vol.135, pp.214-221,Elseivier 2018.
19. Kang Li, Xiaoguang Zhao, Jiang Bian, Min Tan, “Automatic Safety Helmet Wearing Detection”, 2017 IEEE 7th Annual International Conference on CYBER Technology in Automation, Control, and Intelligent Systems (CYBER).IEEE, 2017.
20. Kavyashree Devadiga, Pratik Khanapurkar, Shreya Joshi, Shubhankar Deshpande, Yash Gujarathi, “Real Time Automatic Helmet Detection of Bike Riders”, IJIRST –International Journal for Innovative Research in Science and Technology,Volume 4, Issue 11, ISSN: 2349-6010, April 2018.
21. Yogiraj Kulkarni, Shubhangi Bodkhe, Amit Kamthe, Archana Patil, “Automatic Number Plate Recognition for Motorcyclists Riding Without Helmet”, IEEE International Conference on Current Trends toward Converging Technologies(ICCTCT),IEEE, 2018.
22. Dharma Raj KC, Aphinya Chairat, VasanT imtong, Matthew N. Dailey, Mongkol Ekpanyapong, “Helmet Violation Processing Using Deep Learning”, 2018 International Workshop on Advanced Image Technology (IWAIT), IEEE, 2018.
23. Prajwal M J., Tejas K B., Varshad V., Mahesh Madivalappa Murgod and Shashidhar R “A Review on Helmet Detection by using Image Processing and Convolutional Neural Networks” International Journal of Computer Applications 182(50):52-55, April 2019

AUTHORS PROFILE



Prajwal M. J., received his Bachelor degree from Sri Jayachamarajendra College of Engineering, currently pursuing master of science in Electrical Engineering program at NYU Tandom school of Engineering. His interest and research is control system, robotics and Artificial Intelligence.

Tejas K. B. received his Bachelor degree from Sri Jayachamarajendra College of Engineering, currently pursuing Master of Technology in Network and Internet Engineering at JSS Science and Technology University.

Varshad V. received his Bachelor degree from Sri Jayachamarajendra College of Engineering, Currently Working in VLSI Domain.

Mahesh Madivalappa Murgod received his Bachelor degree from Sri Jayachamarajendra College of Engineering,

Shashidhar R., Received His Bachelor And Master Degree From Visvesvaraya Technological University. Pursuing Ph.D. In Signal Processing Domain At Jss S&Tu, Mysuru, He Currently Working As Assistant Professor At Department Of Electronics And Communication Engineering, Jss Science And Technology University, Sri Jayachamarajendra College Of Engineering, Mysuru. His Area Of Interest And Research Is Signal Processing, Image Processing, Speech Signal Processing, Embedded Systems, Machine Learning And Artificial Intelligence.

e-ISSN: 2582-5208
International Research Journal of Modernization in Engineering Technology and Science
Volume:03/Issue:02/February-2021 Impact Factor- 5.354 www.irjmets.com

A SURVEY ON HELMET DETECTION AND NUMBER PLATE RECOGNITION FOR SAFETY AND SURVEILLANCE SYSTEM

Ajith R[*1], Sharan S[*2], Prajwal B H[*3], L Shreyas[*4], Navya Shree[*5]

[*1,2,3,4] Student, Department of Computer Science and Engineering, Dayananda Sagar College of Engineering, Bangalore, Karnataka, India.

[*5] Professor, Department of Computer Science and Engineering, Dayananda Sagar College of Engineering, Bangalore, Karnataka, India.

ABSTRACT

Now-a-days two wheelers is the most preferred mode of transport. It is highly desirable for bike riders and the pillions to use helmet. This paper uses image processing technique by which motorcyclists without helmet will be detected. In this project moving vehicles can be detected using the input as image or a video and then classified into motorcyclists and non-motorcyclists by background removal and based on size of the image being detected. If in case motorcyclist is detected without a helmet, the vehicle details with the person(s) on vehicle and the number plate is captured in the form of an image. An algorithm is designed to recognize number plates of motor cyclists using images or videos taken by camera. The recognition of number plate algorithm has different steps like Vehicle Classification, Pre-processing, choosing the ROI(Region of Interest), Recognition of number plates characters using image processing algorithms, storing in the database with the image as the proof with date and time recorded . A database will be designed with the proof stored with the offence to identify every offender accurately and arrest the suspect's vehicle and hence imposing violation fines, the system uses pure machine learning in order to identify different types of helmet that it comes across with minimum cost.

Keywords: motorcyclists without helmet, number plate recognition, image processing.

I. INTRODUCTION

This system aims in bringing the major safety measures while riding a two wheeler both for the rider and the pillion. This has become a major cause of deaths in road accidents in many places where the vehicle density in very high and the people are least bothered to take care of themselves by taking proper precautionary measures while riding motorcycles. Though measures are taken by the government to avoid such problems by mandating the use of helmets for both the rider and the pillion, people are careless which is causing a serious trouble not only for the people without helmets but also for others who drive on the roads. So, keeping public safety as an important measure this mechanism of automated helmet detection plays a vital role where traffic police cannot be assigned for each and every street for implementing stricter rules.

This project of automated helmet detection uses methods of machine learning to categorize vehicles as two wheelers or not and if it's a two wheeler then recognize the head part as the person wearing the helmet or not. If the rider or the pillion is not wearing the helmet then the image of the person with the vehicle is captured. Using different mechanisms, the number plate of the vehicle is recognized as the string od characters and numbers and stored in a database the details of the vehicle number plate and the captured images as the proof. Using this data fines can be imposed on the riders who repeated commit the mistake of not wearing the helmet.

II. LITERATURE SURVEY

- **Romuere R.V.e Silva, Kelson R.T. Aires, Rodrigo de M. S. Veras** "Detection of Helmet on MotorCyclists"[1]

In this paper, the process of classification and descriptors are used to detect the vehicles and then detect the persons with 2 wheelers and detect if they are wearing the helmet or not.
The processes used in this projects are:

Vehicle segmentation and classification:

Detection of the background-

A reference of the road as background is considered so that the motion of the vehicle can be detected with respect to the stable object (road).

Segmentation of moving objects-

Using background subtraction, the moving objects(vehicles) are differentiated with the background which gives only an image of the vehicles and the background will be eliminated.

Vehicle classification-

The vehicles are classified as motorcycles or non-motorcycles and a feature vector is obtained for each generated image and passed on to random forest classifier to categorize vehicle as motorcycle or a non-motorcycle.

Detection of helmet:

Determining RoI-

This step is performed so that only the region of interest is chosen which reduces the processing time and increases processing time.

Extracting the features-

A sub-window is formed in the above generated RoI and the main part of the image(head in this case) is extracted and passed as input for the classifier to check if the biker has put on his helmet or not.

This project/paper does mainly deal with helmet detection. For it to be used in surveillance system, it should be able to detect the number plate of the vehicle to impose fines on the rider which lacks in this project.

- **Lokesh Allamki, Manjunath Panchakshari, Ashish Sateesha, K S Pratheek** “Helmet detection using machine learning and Automatic Number Plate recognition”[2]

This paper does the process of extracting the objects from the image using YOLO object detection and has 3 3segments in the entire process

1. **Helmet detection -** Annotated images are given to YOLOv3 model for training and the actual input for detection is given after training the model.
2. **License plate Extraction** – once the person without helmet is detected then the class with respect to person and corresponding vehicle and its number plate is detected and the number plate is cropped and saved.
3. **License plate recognition** – The extracted number plate detected previously is passed on to OCR(Optical Character Recognition), the module outputs the string of numbers and alphabets with the accuracy percentage of the string recognized.

This paper does not deal with the ability to detect the difference between motorcycle and a non-motorcycle and this project cannot be implemented for input as videos since the input given through OCR is images only.

- **Felix Wilhelm Sieberta, Hanhe Linb** “Detecting motorcycle helmet use with deep learning”[3]

There are 3 divisions in this project in which the data is collected in the form of videos, preprocessed and used in detecting the riders of motorcycle with and without helmets.

1.Dataset creation and annotation - Random data in the form of videos is collected from Myanmar and is preprocessed to each video of 100 frames each and object detection is done through YOLO9000 algorithm with pre trained weights and the recognized vehicle with person is bounded using boxes.

2.Helmet use detection algorithm - For object detection, the single stage approach of RetinaNet is used to detect the helmets. ResNet50 as backbone initialized with pre-trained weights from ImageNet. The models were implemented using python keras library with tensor flow as backend
3.Results - The helmet use detection results of the algorithm on the test set, using the optimal model developed on the validation set (where it obtained 72.8% weighted mAP)

The limitation for this project is that in many instances there will be 2 persons travelling in the motor-cycle and this model does not recognize is the pillion is wearing the helmet or not. This can detect only one person with a helmet or not and the accuracy is low for a CNN network.

- **M. Swapna**, **Tahniyath Wajeeh**, **Shaziya Jabeen** "A Hybrid Approach for Helmet Detection for Riders Safety"[4]

In this model various previous methods related to automatic helmet detection has been taken into consideration and the new model has been given. This is a technique of automatic helmet detection , where the input is of either the video which has been recorded or it might be a video through a web camera. This method includes 4 different steps in it.

1.Image procurement - This is the very first step of any vision system , where cameras are used to capture images of riders on road.
2.Preliminary processing technique - This step is mainly focused on elimination of background noise , enhancement of contrast and image binarization.
3.Vehicle classification - This step is mainly focused on vehicle classification based on two main parameters i.e aspect ratio and size of the particular vehicle and then the vehicle are classified.
4.Helmet detection - This step includes extraction of head part from the classified image and providing it to ROI where the matching of ROI and trained features happen to determine whether helmet is there or no.

This model gives a idea of the number of people who violate the traffic rules. It is also cost effective as we use open source technology like OpenCV , etc. for development purpose. Further this model can be used to detect people talking on phone while driving and to identify people driving at a high speed.

- **C. Vishnu**, **Dinesh Singh**, **C. Krishna Mohan and Sobhan Babu** "Detection of Motorcyclists without Helmet in Videos using Convolutional Neural Network"[5]

This model tells us that since the motorcycles are affordable, people use it for daily transportation. Due to this increased use the occurance of accidents are high . Major of the accidents include head injury, which is due to helmet violation by the motorcycle users. As many cities have surveillance system for safety purpose , we can use it for detecting non helmet riders which would be a cost effective approach. This approach uses a machine learning technique , CNN(Convolution Neural Network) for getting good images inspite of various problems like illumination, climate changes , etc. There are four different steps included in the process of this model:

1. Background modeling and object detection: This step is basically used for applying adaptive background subtraction to get the images properly and of same quality no matter what ever the conditions might be whether its day time, night or rainy , etc. To separate various factors not needed we use Gaussian mixture model.

2. Object detection using Convolution neural network: This technique is basically a type of feed forward neural network using back propagation network. The idea of using this technique was due to the ability to extract interdependent data from the images. This technique involves various levels for detecting the object , where in each level we get the data and in final level the entire image is finally formed.

3. Recognizing motorcycle from moving objects: We use bounding boxes technique for the identification of the motorcycle from other objects. These boxes are evaluated by providing them as an input to the CNN model , which in reference to the various data in test model gets to know motorcycle and other .

4. Recognizing motorcyclists with helmet: To identify motorcyclists we apply cropping for the top one fourth of the image, cause that's the position where the head of the motorcyclists would always be. Then we find the doing subtraction of the binary image of the same. Then CNN is applied to get the output.

This model gives a well defined way of dealing with helmet detection and various way of getting rid from the problem. Thus this is a new approach using machine learning apart from the previous approach which used image processing and other old technologies.

III. COMPARITIVE ANALYSIS

Project	Pillion Without Helmet Detection	Storing Output In Database	Differentiation Between Motorcycle And Non-Motorcycle	Input Type	Number Plate Detection
1	No	No	Yes	Only Image	No
2	No	No	No	Only Image	Yes
3	Yes	No	No	Image Or Video	No
4	No	Yes	No	Only Image	Yes
5	No	No	Yes	Image Or Video	No
Our Project	Yes	Yes	Yes	Image Or Video	Yes

IV. CONCLUSION

Health is the vital need of any person and so injuries during riding vehicles can lead to serious accidents and sometimes it can be fatal resulting in the death of the people. This project mainly uses deep neural networks for image recognition of the person in the input given in the form of a video or an image and the system recognizes the rider and the pillion for wearing the helmet or not and using optical character recognition (OCR), the number plate details are read and stored in the database which saves the lives of many by forcing riders to wear helmets during travelling on two wheelers.

V. REFERENCES

[1] Detection of helmets on motorcyclists. By Remuera R.V.e Silva, Kelson R.T. Aires, Rodrigo de M. S. Veras

[2] Helmet Detection using Machine Learning and Automatic License Plate Recognition. By Lokesh Allamki, Manjunath Panchakshari, Ashish Sateesha, K S Pratheek(BNMIT, Bangalore)

[3] Detecting motorcycle helmet use with deep learning. By Felix Wilhelm Sieberta, Hanhe Lin (Department of Psychology and Ergonomics, Technische Universit¨at Berlin, Marchstraße 12, 10587 Berlin Germany).

[4] A Hybrid Approach for Helmet Detection for Riders Safety using Image Processing, Machine Learning, Artificial Intelligence. By M.Swapna, Tahniyath Wajeeh, Shaziya Jabeen.

[5] C. Vishnu, Dinesh Singh, C. Krishna Mohan and Sobhan Babu Visual Intelligence and Learning Group (VIGIL), Department of Computer Science and Engineering Indian Institute of Technology Hyderabad, Kandi, Sangareddy-502285, India