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# Helmet Detection and Number Plate Recognition Using Machine Learning

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## Article History

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*KNN classifier*

## Abstract

*The continuous mobilization of vehicles has led to a surge in the number of road accidents across the world. To get better at this, the government is trying to focus on the safest and most preventive measures in traffic. The practice of direct observation is found to be time taking and a lot of human effort is needed. So, our main idea is to introduce a helmet and license plate detection mechanism. This project attempts to implement a detection process through a few machine-learning algorithms by using predefined libraries. This system notices a person with/without a helmet thereby imposing fines on the detected candidate's license plate. Further, this research work concludes that the automatic identification of helmets can overcome the challenges faced by the manual data collection process. Moreover, this project work assumed that, through data collection, the algorithm can help to track helmet use and promote its active use by people to ensure road safety.*

## 1. 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 Revised Manuscript Received on December 05, 2019 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 must be set up in order to save lives (Silva and Romuere) . Two-wheeler is a very popular mode of transportation in almost every country. However, there is a high risk involved because of less protection. When a two-wheeler meets with an accident, (Doungmala and Klubsuwan) 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 (Li et al.) . 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 (Vishnu et al.) . 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. Hence efficient and feasible techniques must be created to overcome these problems. To reduce the involved risk, it is highly desirable for bike-riders to use helmet (Yadav and Singh) . Worrying fact is that India ranks in top as far as road crash deaths are considered. (Mahesh and Baskar) 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. (Suresh et al.) Observing the usefulness of helmet, Governments have made it a punishable offense to ride a bike without helmet and have adopted manual strategies to catch the violators (Priya et al.) .However, the existing video surveillance-based methods are passive and require significant human assistance. In general, such systems are infeasible due to involvement of humans, whose efficiency decreases over long duration. (Chirag et al.) Automation of this process is highly desirable for reliable and robust monitoring of these violations as well as it also significantly reduces amount research has successfully done this work based on CNN,R-CNN,HoG,HaaR features,etc. (Vishnupriya et al.) But these works are limited with respect to efficiency, accuracy or the speed with which object detection and classification is done.

## 2. Literature Survey

Literature survey is mentioned in Table 1.

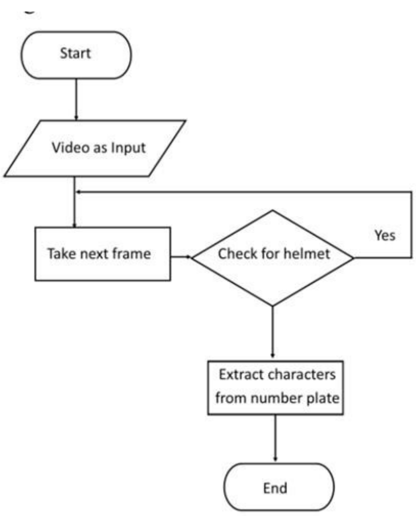


**FIGURE 1. Phases of Development**

## 3. Methodology

### 3.1. Phases of methodology

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.

### 3.2. Phases of Development

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.

### 3.3. Implementation

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 $\times$ 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.

**TABLE 1.** **Literature Survey**

| YEAR | TITLE NAME | **AUTHOR NAME** | SURVEY |
|---|---|---|---|
| 2021 | Real-time Helmet Detection and Tracking System for Motorcycle Riders | Y. Zhang and Y.Du | Faster R- CNN object detection algorithm , a multi- object tracking algorithm. |
| 2021 | A Survey on Helmet Detection Methods in Motorcycle Riders for Intelligent Transportati on System | N. G. Cuong, N. K. Quoc, and L. K. Son | Deep learning. |
| 2020 | Helmet Detection and Violation Analysis in Motorcycle Riders Using Deep Learning Techniques | N. H. Tran, T. Q. Nguyen, and K. T. Nguyen | YOLOv3 object detection algorithm, a classificatio n model |
| 2020 | Helmet Net: Efficient Helmet Detection for Riders Using Convolution Neural Networks | V. R. Suwardi, A. D. Wibowo, and E. F. Adi | CNN model, a classificatio n model |
| 2022 | Helmet detection using deep learning for motorcycle riders | K.Kumar et al | CNNs and the YOLOv4 object detection algorithm |
| 2022 | Helmet Detection and Tracking for Motorcycle Riders using Machine Learning | Zhang et al. | a helmet detection and tracking system for motorcycle riders using machine learning |

### *3.4. OCR*

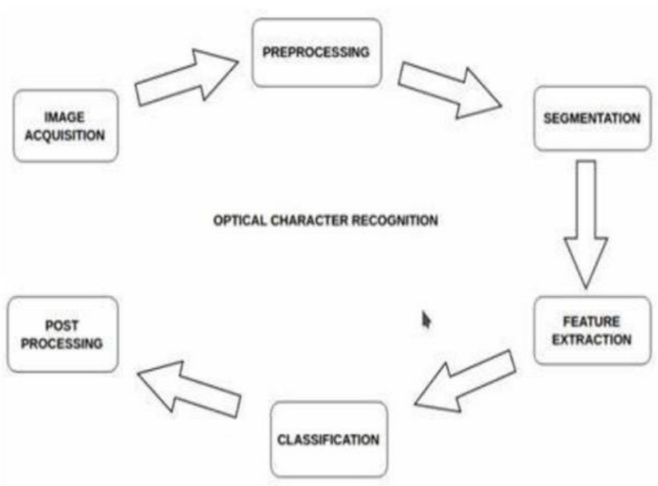


**FIGURE 2.** **Optical Character Recognition**

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.

#### *3.4.1. 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.

#### *3.4.2. 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 “preprocess” images to boost the chances of recognition.

#### *3.4.3. 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:

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

2. 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.

#### 3.4.4. 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.

#### 3.4.5. 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

## 4. Algorithms :

### 4.1. R-CNN:

Regions with CNN features (R-CNN) and its upgraded versions Faster R-CNN and Fast R-CNN are examples of algorithms. R-CNN uses a DL model to remove image attributes and create region proposals with a sliding window at start, but it has a lot of recurring calculations. Fast R-CNN uses the SPP module to provide fixed-size output while integrating the regression and classification of bounding boxes into a network to diminish frequent calculations. R-CNN inputs picture features into Region Proposal Networks (RPN) at a faster rate. The RPN be able to accept feature maps of several size, object candidate box confidence and output coordinate information, and then categorize the object candidate boxes. In two-stage object detection model like Faster R-CNN, area classification and selection should be done step by step. With the advancement of deep learning, factors such as the number of candidate boxes, the difficulty of basic network, the difficulty of classification, and regression sub-networks affect two-stage detection algorithms and the quantity of calculation continues to rise.

### 4.2. YOLO:

In the algorithm, YOLO skips the candidate box extraction stage and instead uses an end-to- end deep convolution network to perform candidate box classification, feature extraction, and regression. Safety helmet wearing detection is an important practical application in object identification that is intimately tied to our production and daily lives. It has been the subject of extensive research by a number of academics. The authors in retrieved the features of helmet and worker from the image and used a cascade to determine if the worker was wearing a helmet. Based on pedestrian detection results. Used head positioning, color space transformation, and color feature recognition to recognize people wearing helmets. To improve feature resolution in helmet detection applied the upgraded YOLO-Dense backbone. To detect wearing helmets, authors in employed Single Shot multi-box Detector (SSD). However, current helmet detection systems have drawbacks, like limited generalization capacity for multi-scene detection and low detection accuracy for small items. The author in employed the enhanced Faster-RCNN technique to detect helmet wearing after using the K- means++ clustering algorithm to cluster the helmet's size in the image. However, the one- stage detector has a faster detection speed among the present helmet-wearing detection algorithms, but its detection accuracy for dense and small targets is low, and its generalization capacity of diverse scenes is pathetic. Due to the enormous computation amount and sluggish detection speed of

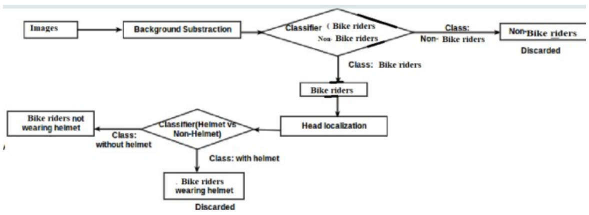


**FIGURE 3.** **Architecture diagram**

the two-stage detector, it is impossible to congregate the real time necessities of helmet detection.

## 5. Proposed System :

• Such as a group of the dataset, moving object detection, background subtraction, object classification using neural networks and extraction of number plate number if the rider is not wearing a helmet.

• 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 modeling algorithm can also be applied to detect moving objects. The Canny edge detection algorithm is used to get segmented moving objects.

## 6. System Requirements:

### *6.1. Hardware Requirements:*

Hard disk : 80GB

RAM : 8 GB (min), 16 GB or higher is recommended.

Processor : 64 bit, four core ,2.5GHz minimum per core

Monitor :15”Color Monitor

### *6.2. Software Requirements:*

Operating System : Windows 10 and 11 (Intel/AMD 64 bit) ,

Linux (Intel/AMD 64 bit kernel

## 7. Architecture Diagram:

Architecture diagram is shown in Figure 3.

## 8. 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. The result image is shown in Figure 4.

**FIGURE 4.** **Output**

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