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Automatic Detection of Helmet and License Plate Recognition using CNN & GAN

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Abstract

Enforcing use of helmet on every bike-rider is mandatory nowadays due to high accident rate and poor conditioned roads. There are laws regarding safety measures which ensure use of helmet. But currently, they involve manual intervention which is not proven to be so effective because sometimes, bike-riders tend to escape without any penalty after breaking the safety rules like wearing a helmet while riding. Automation is efficient & also a better way to deal with this problem but it comes with its own challenges. To name a few, Low quality image frames (low image resolution, pixel density etc.), rain, dew & fog and partly hidden faces. Hence, the robustness of detection methodology strongly depends on the strength of extracted features and also the ability to deal with the lower quality of extracted data. The first goal of this project is to boost the potency of helmet detection and then recognizing the license number plate recognition. This model consists of many essential steps developed using today's most advanced & optimized Convolutional Neural Network (CNN), Generative Adverbial Network (GAN) models & libraries. This model is a classification based model that uses supervised learning approach to train CNN and GAN. The proposed helmet detection model can be used to detect helmet and recognizes license plate even in adverse conditions.

Keywords: *CNN, GAN, Machine learning, Artificial Intelligence, HOG.*

1. Introduction

According to India Today survey, more than 48,746 bike-riders died in road accidents in 2017. Incidentally, 73.8% of them did not wear a helmet. Statistics are according to India Environment Portal [25]. Road accidents lead to a huge number of deaths every year. The reasons behind this are bad road conditions, malfunctioning of vehicles, careless driving or bike riding, not following traffic rules and so on. Of these, some are avoidable. Like, proper safety measures taken ensure reduction in accidents and thereby reduction in death rate. Though there's been helmet compulsion for bike riders, many of those don't use it. This project intends to automate the fine application process by detection of helmet on biker's head. Currently, the traffic police officers manually apply fine for breaking the traffic rules. But, sometimes due to ignorance or due to other factors they manage to escape without fine even after the traffic rule violation. The automation in this process will reduce such cases and hence increase strict acts against them. The accuracy for detection of helmet is around 90-93% and of license plate recognition lies around 50-60%. This accuracy needs to be increased for efficient implementation of enforcement acts.

In recent years, the use of cameras for the security purposes, law enforcement purposes has increased a lot. There are ways to detect helmet using image processing and machine learning. There are the methods like OpenCV method giving 74% accuracy, The Image Descriptors method giving accuracy of 91.37%, and The Local Binary Patterns (LBP) method giving accuracy of 94%. However these images were not captured in real time. The proposed system will be able to detect motorcyclists wearing the helmet using CNN. The license plate recognition is done using the GAN algorithm.

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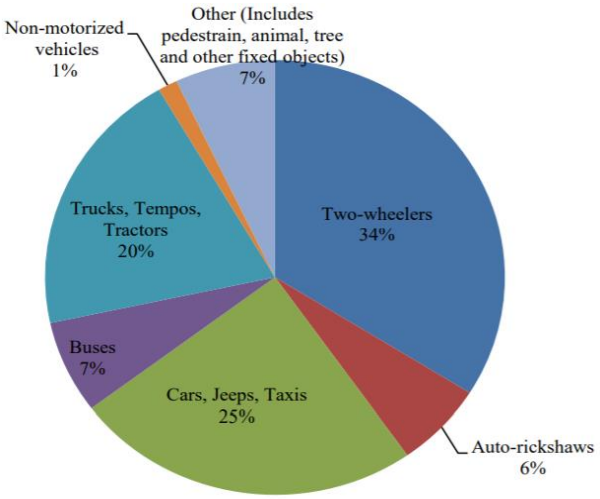

Figure 1.1 share of different vehicle types in road accidents (2017)

2. Literature Survey

Table 2.1 Overview of Literature Survey

Year	Author	Title	Approach	Limitations
2019	Emy Barnabas Et Al.	Helmet Detection and License Plate Recognition Using CNN.	A CNN to detect helmet and license plate recognition using OCR.	The accuracy of license plate recognition is very less.
2018	C. Vishnu Et Al.	Detection of Motorcyclists without Helmet in Videos using CNN	A CNN approach to detect helmet.	low accuracy and was limited only to helmet detection.
2018	Kavyashree D Et Al.	Real Time Automatic Helmet Detection of Bike Riders.	Helmet detection using background subtraction and license plate recognition using OCR.	It was not able to detect helmet when image was not clear.
2017	Kunal Dahiya Et Al.	Automatic Detection of Bike-riders without Helmet using Surveillance Videos in Real-time.	Helmet detection using feature extraction and SVM classifier.	Can't detect helmets when there was a change in atmospheric conditions.
2016	Kang Li Et Al	Automatic Safety Helmet Wearing Detection.	Uses the technique of K nearest neighbor to detect helmet.	The results were not good when images were not clear.

3. Proposed System

This system proposes to implement a neural network based helmet detection model which makes use of OpenCV and CNN. First, this system identifies the motorcycles using the HOG. Then the system applies helmet feature extraction and tries to detect the helmet. If the person is not wearing a helmet, the license plate of the vehicle is captured using the use of CNN. Later, the recognition of the characters in license plate is done with the help of GAN algorithm.

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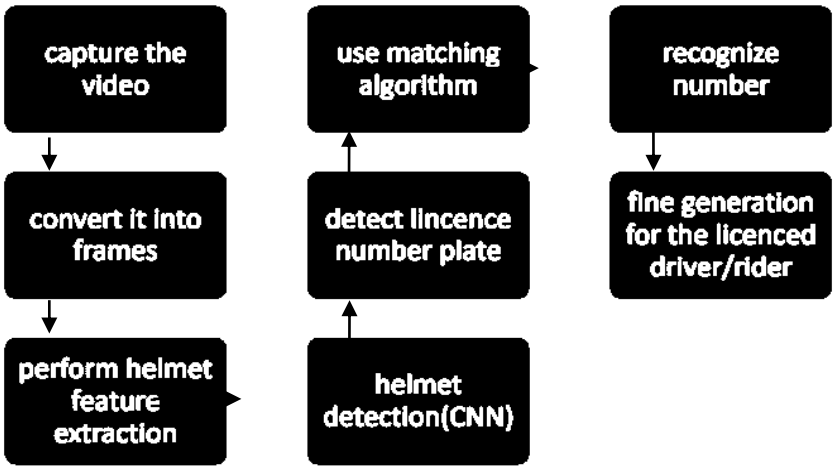

Figure 3.1 Model Workflow

The various units involved are as follows:

I. *HOG for Detection of Motorcycle.*

II. *CNN for classification of Helmet.*

III. *License plate detection using CNN.*

IV. *Recognition of characters in license plate using GAN.*

Once the camera captures the image, the first step is detection of motorcycle in the captured image. For that purpose the histogram of gradients technique is used[8]. HOG is a feature descriptor that is normally used for detection object which describes the shape and appearance of the image. Once the image with motorcycle is detected, whether the helmet is present on not, is detected. For that purpose one has to determine the region of interest of the person[9]. Region of interest is selected because it reduces the area and only a particular region is concentrated, which reduces the time of processing. The head portion of the motorcyclist is selected completely inside the region of interest. The grey scale image of the head portion is determined and calculated. After that obtained images of head and helmet is fed to CNN thereby classifying helmet vs. non-helmet motorcyclist. CNN learns the common hidden features in the set of trained data and differentiate among the helmet and head. If the motorcyclist is not wearing a helmet then the next step is recognizing the license plate of the motorcyclist. This is done by using GAN where a training data set is created from the images, it is converted into frames and further used for vehicle number identification.

To determine whether the image that has been captured has a motorcycle or not, histogram of image gradient is calculated. It divides source image into blocks and calculates direction and magnitude. It is done by using a 1 dimensional centered mask that passes horizontally as well as vertically. The direction and magnitude are added to a 8 x 8 pixel representing it in 9 bin histogram. The image that has been divided into the blocks is concatenated with the histograms for formation of an element vectors. These vectors are then concatenated to form a giant vector that is 3780 feature vectors. Once these feature vectors are obtained, these vectors are then fed to a SVM classifier which classifies it as “motorcycle” or “non-motorcycle”. Once the bike riders are detected the next step is to determine

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whether the rider is wearing a helmet or not. For that purpose the upper one fifth part of image is cropped which is the region where the motorcyclists' head is mostly located. Using this technique will reduce the area where the search is performed.

Then a CNN model is built for separation of helmet and non-helmet images. The features that are obtained from the model illustrate that the CNN learns the common hidden features in the training set and is able to distinguish between a helmet and a head. The cropped image is then fed to a set of convolutional layers. The input image is then convolved with a filter to obtain feature map. With the convolution the stride is set to 1 and the padding is set to 0. To remove the non-linearity of the feature map, a ReLU operation is performed. Max pooling reduces the dimension of the feature map. Finally, the softmax is performed on the fully connected layers to predict that the person is wearing any helmet or not.

Once the helmet classifier predicts as no helmet detected, the image of the motorcyclist is passed for number plate detection. GAN is a machine learning algorithm used for detection of the number plate. Here, character segmentation is done in order to recognize them from the license plate. Segmentation-based methods first segment the license plate into the individual characters, and then recognize the segmented characters respectively using a classifier. Segmentation algorithm consists of a projection-based and connected component-based. After the segmentation, template matching based and learning based algorithms can be used to tackle this character level classification task. This will then recognize the characters of the license number plate.

4. Algorithms Used

HOG for detection of motorcycle

1. Input image to the HOG algorithm.
2. Uses SVM classifier to classify bike-rider between motorcyclist and non-motorcyclist.

CNN for helmet detection

1. Selection of region of interest. Here head is selected.
For that the upper one fifth part of the image is cropped which is the region where the motorcyclists' head is mostly located.
2. Image is converted into grey scale.
3. Obtained images of head and helmet sent to CNN for training the model.
4. Softmax function applied on fully connected layer to predict that it is helmet or not.

GAN for license plate recognition

1.Input image of motorcycle taken from CNN model of person without helmet.
2.CNN algorithm used to detect license plate.
3. Segmentation of characters of license plate performed.
4. Template matching based and learning based algorithms used.
5. Output with recognized license plate characters.

5. Results

The Results from the Table-4.1 represents the algorithms having different accuracies for helmet detection. OpenCV and C++ together show a accuracy of 74% with is not good for helmet detection purpose. Local Binary Patterns shows accuracy of 94% which is not efficient for detection purpose.

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Scale-invariant feature transform method gives accuracy of 93%.But this cannot be used for datasets having unclear images. Image Descriptors is famous algorithm and gives a accuracy of 91.37%. For license plate recognition OpenCV has been used earlier but the accuracy is 84%. However these images were not captured in realtime. The proposed system will be able to recognize the helmet and license plate with an accuracy of approximately 97% to 98% with the help of improved data set quality and more number of images.

The system is desired to show correct results in low light conditions, in cases where target face is at a certain angle to the mounted camera and also in video frames with low pixel density. Even when the images are slightly blur it will show good accuracy.

Table 5.1 Summary

Algorithms	True Positive	False Positive	Accuracy
C++, OpenCV[23]	74	26	74%
Image Descriptors [9]	91	9	91.37%
SIFT/HOG[1]	93	7	93.8%
LBP/HOG [7]	94	6	94.3%

6. Conclusion

The system proposed here can provide comprehensive and more accurate helmet detection and recognition of license plate against the dataset for a stream of real time CCTV footage.

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8. References

8.1. Books

[1] J. Chiverton, “Helmet presence classification with motorcycle detection and tracking,” IET Intelligent Transport Systems (ITS), vol. 6, no. 3, pp. 259–269, 2012.

[2] R. E. Kalman, “A new approach to linear filtering and prediction problems,” Journal of Basic Engineering, vol. 82, no. 1, pp. 35–45, 1960.

8.2. Conference Proceedings

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[1] K. Dahiya, D. Singh, and C. K. Mohan, "Automatic detection of bikeriders without helmet using surveillance videos in real-time," in Proc. Int. Joint Conf. Neural Networks (IJCNN), Vancouver, Canada, 24–29 July 2016, pp. 3046–3051.
[2] D. Singh, C. Vishnu, and C. K. Mohan, "Visual big data analytics for traffic monitoring in smart city," in Proc. IEEE Conf. Machine Learning and Application (ICMLA), Anaheim, California, 18–20 December 2016.
[3] C. Behera, R. Ravi, L. Sanjeev, and D. T, "A comprehensive study of motorcycle fatalities in south delhi," Journal of Indian Academy of Forensic Medicine, vol. 31, no. 1, pp. 6–10, 2009.
[4] W. Hu, T. Tan, L. Wang, and S. Maybank, "A survey on visual surveillance of object motion and behaviors," IEEE Trans. Systems, Man, and Cybernetics, Part C: Applications and Reviews, vol. 34, no. 3, pp. 334–352, 2004.
[5] C.-C. Chiu, M.-Y. Ku, and H.-T. Chen, "Motorcycle detection and tracking system with occlusion segmentation," in Proc. Int. Workshop on Image Analysis for Multimedia Interactive Services, Santorini, Greece, 6–8 June 2007, pp. 32–32.
[6] R. Silva, K. Aires, T. Santos, K. Abdala, R. Veras, and A. Soares, "Automatic detection of motorcyclists without helmet," in Proc. Latin American Computing Conf. (CLEI), Puerto Azul, Venezuela, 4–6 October 2013, pp. 1–7.
[7] D. Jeff, J. Yangqing, V. Oriol, H. Judy, Z. Ning, T. Eric, and D. Trevor, "DeCAF: A Deep Convolutional Activation Feature for Generic Visual Recognition," Int. Conf. on Machine Learning (ICML), vol. 32, no. 1, pp. 647–655, 2014.
[8] Z. Kaihua, L. Qingshan, Wu, and Y. Ming-Hsuan, "Robust Visual Tracking via Convolutional Networks without Training," IEEE Trans. Image Processing, vol. 25, no. 4, pp. 1779–1792, 2016.
[9] G. Ross, D. Jeff, D. Trevor, and M. Jitendra, "Rich feature hierarchies for accurate object detection and semantic segmentation," in Proc. IEEE Conf. Computer Vision and Pattern Recognition (CVPR), Colombus, Ohio, 24–27 June 2014, pp. 580–587.

8.3. report

[1]Online:http://www.indiaenvironmentportal.org.in/files/file/road%20accidents%20in%20India%202017.pdf accessed on December 2019.

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