Automatic Detection of Bike-Riders without Helmet

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ABSTRACT

The paper proposes an approach for automatic detection of bike-riders without helmet using surveillance videos in real time. The proposed approach first detects bike riders from surveillance video using cross correlation analysis. Then it determines whether bike-rider is using a helmet or not using kurtosis features and knn classifier. The system has given an average recognition accuracy of 71.43% that is satisfactory.

Keywords: Detecting Bike riders without helmet, cross correlation, knn classifier.

I.   INTRODUCTION

Two-wheeler is a very general mode of transportation in almost every country. However, there is risk involved because of less protection. To reduce the risk, it is required for bike rider to use helmet, government has made it a serious violation to ride bike without helmet & have manual strategies to catch the violators. However, the current video surveillance based methods are passive and require significant human assistance; such systems are infeasible due to participation of humans, whose efficiency decreases over period [1]. Automation of this process is highly required for reliable & robust monitoring of these violations along with it also reduces amount of human sources needed. Also, several countries are employing systems involving surveillance cameras at public places. So, detecting violators using the proposed infrastructure is also cost-effective.

A basic problem that often occurs image processing is to determine the position of a given pattern in an image, or part of an image, the so-called region of interest. This problem is closely related to determination of a received digital signal processing using e.g. a matched filter.

Two basic cases can be differentiated:
➢ The position of the pattern is unknown.
➢ An estimate for the position of the pattern is given.

Usually, both cases have to be treated to solve the problem of determining the position of a given pattern is an image. In the latter case, the information about the position of the pattern can be used to reduce the computational effort significantly. It is also known as feature tracking in sequence of image.

For both feature tracking and the initial estimation of the position of given pattern, a lot of different, well-known algorithm have been developed. One basic approach that can be used in both cases mentioned above is template matching. This means that the position of the given pattern is determined by a pixel-wise comparison of the image with a given template that contains the desired pattern. For this, the template is shifted u discrete steps in the x direction & v steps in the y direction of the image, then the comparison is calculated over the template area for each position (u, v). To calculate this comparison, normalized cross correlation is used.

In this model frames are extracted from the videos and converted to grayscale image, using template matching method(cross correlation analysis) bike riders are detected in the frame. After that, head portion is taken to identify the rider using helmet or not. For detecting helmet, feature is extracted using kurtosis and then knn classifier is used to classify the

helmet or no-helmet. We used 10 videos among them out of 28 bike-riders 20 bike-riders are detected correctly and 8 bike-riders are detected wrong. The average recognition accuracy obtained is about 71.43%

This paper has 5 sections. Section 2 gives related work, section 3 describes proposed methodology, section 4 lists results and conclusion is given in section 5.

II. RELATED WORK

Paper [1] has described an automatic analysis of a video stream so as to make alerts when an "unusual" incident happens. Such algorithms may use as an attention mechanism, which with appropriate detection and false alert rate, will allow a single operator to effectively "watch" number of cameras.

Paper [2] describes about a real time monocular vision based rear vehicle & motorcycle detection & tracking method is presented for Lane Change Assistant (LCA). To attain robustness & accurateness this work detects and tracks multiple vehicles and motorcycles by combining multiple signals.

Paper [3] describes about a vision based motorcycle observing system to identify and tracking motorcycles. The technique uses visual length, width & pixel ratio to identify the type of the motorcycle. Because the motor cycle riders necessity to wear their helmets, helmet detection or search process required whether helmet or motor cycles exits or not.

Paper [4] works on visual surveillance in dynamic scenes try to detect, identify & track object from image sequences. The aim of visual surveillance is to make whole surveillance automatically.
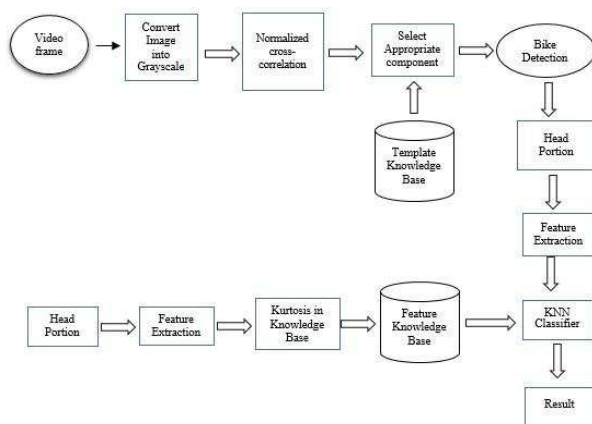
III. PROPOSED METHODOLOGY

Fig.3.1 System Design

This section present the technique for real time identification of bike rider with helmet or without helmet which work in two phase. In the first phase, we identify bike rider in the frame. In second phase, Find the head of bike rider and identify whether the rider is wearing helmet or not.

Phase-I: Detection Bike-riders

This phase include identification of bike rider in a frame. All the frames are read and converted into grayscale, so that the filters can be applied on it. Template matching methods compare area of images against another using normalized correlation method. Sample frame used to recognize same object in source frame. The matching procedure moves templates to all possible locations in source frame & the template matches the frame in that location.

The algorithm employed following formula to calculate the correlation coefficient c (u, v).

$$c(u,v) = \frac{\sum\limits_{x,y}\left[f(x,y) - \overline{f_{u,v}}\right]\left[g(x-u,y-v) - \overline{g}\right]}{\left\{\sum\limits_{x,y}\left[f(x,y) - \overline{f_{u,v}}\right]^2 \sum\left[g(x-u,y-v) - \overline{g}\right]^2\right\}^{1/2}}$$

Where
- $f(x, y)$ is coordinate of image.
- $g(x, y)$ is the coordinate of template image.
- g is the mean of the template.
- f is the mean of $f(x, y)$ in the region under the template.

The center of object which looks like the template image has the position where the calculated cross correlation coefficient is the largest. The question is what size of the image f is to reduce the computational time using template matching technique to the possible extent. The template image g has a defined size that is dependent on the size of the target which we want to recognize.

Phase-II: Detection of Bike-riders Without Helmet

After bike riders are identified in previous phase, the next step is to identify if bike ride is wearing helmet or not.

1. Feature Extraction: Identified around head portion of bike rider is used to identify if bike-rider is wearing helmet or not. To achieve this, kurtosis is used to identify the head of bike-rider, taking mean average of RGB to identify the bike-rider wearing helmet or not.

$$k = \frac{E(x-\mu)^4}{\sigma^4}$$

Where μ is the mean of x, σ is the standard deviation of x, and $E(t)$ represents the expected value of the quantity t. kurtosis computes a sample version of this population value.

2. Classification: The technique need to identify if bike rider is violating the law i.e. not using helmet. For this, we consider knn classifier is used to classify using extracted features from previous step. To analyse the classification results and identify the best solution, different combination of features.

We have dataset of helmet/no-helmet using kurtosis. knn classifier the predict value calculated after applying kurtosis, then predict value matched with stored dataset then classify predicted value corresponding to kurtosis value.

IV.   RESULTS

In the experiments, we used our own dataset by collecting videos. The frames are extracted from videos and set the database. The sample features are shown in table1.

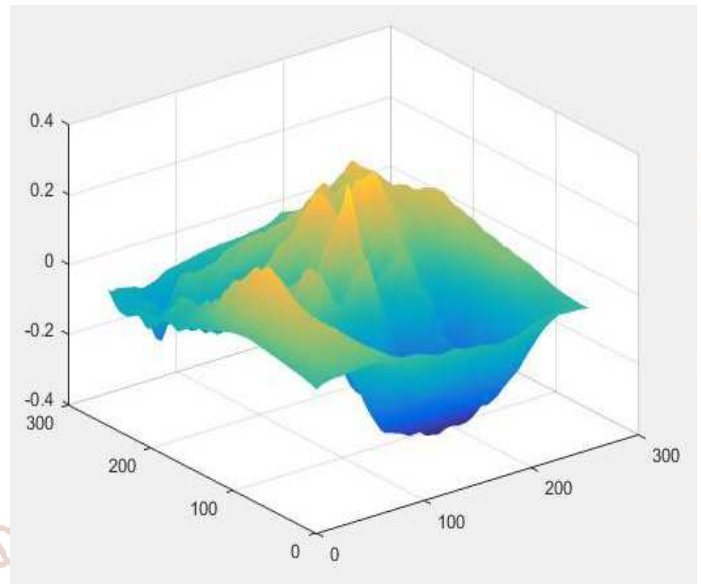Figure 4.1 Input frames

Figure 4.2 Output frame

Fig.4.3 Cross Correlation

Table.1 Feature set for some of Helmet/No Helmet

| Videos	Actual Images	Recognized Images	matches
1	No Helmet	Helmet	0
	No Helmet	No Helmet	1
2	No Helmet	No Helmet	1
	No Helmet	Helmet	0
	No Helmet	No Helmet	1
3	No Helmet	No Helmet	1
	No Helmet	No Helmet	1
4	No Helmet	Helmet	0
	No Helmet	No Helmet	1
5	No Helmet	No Helmet	1
	No Helmet	No Helmet	1
	No Helmet	No Helmet	1
6	Helmet	Helmet	1
	Helmet	Helmet	1
	Helmet	No Helmet	0
	Helmet	Helmet	1
	Helmet	Helmet	1
	Helmet	No Helmet	0
7	Helmet	Helmet	1
			1
8	Helmet	Helmet	1
	Helmet	Helmet	1
9	Helmet	Helmet	1
	Helmet	Helmet	1
	Helmet	No Helmet	0
10	Helmet	No Helmet	0
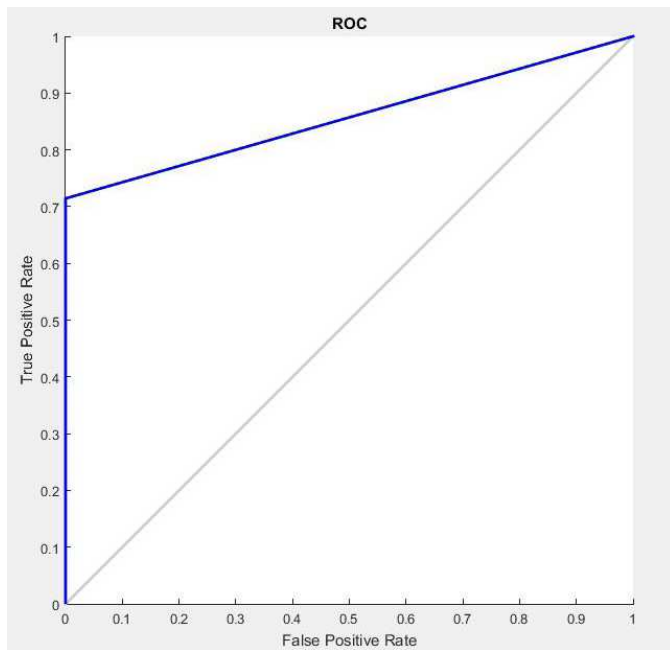
Fig.4.4 ROC graph

Finally recognition of Helmet/No Helmet using KNN classifier is carried out and is plotted as an ROC graph. We used 10 videos among them out of 28 bike-riders 20 bike-riders are detected correctly and 8 bike-riders are detected wrong. The average recognition accuracy obtained is about 71.43%

V. CONCLUSION
A framework for real-time detection of traffic rule violators who ride bike without using helmet. Proposed framework will also assist the traffic police for detecting such violators. This framework can be extended to detect and report number plates of violators in future work.

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