Pedestrian Detection using Linear SVM Classifier with HOG Features

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Abstract: Detecting pedestrians in an image is a useful technique in the development of the Intelligent Transportation System (ITS). Histogram of Oriented Gradient (HOG) is widely used as a feature algorithm and treated the entire body of the human as a single feature. In this paper, we compared the well-known feature based approaches: Haar features and HOG features in PSU pedestrian dataset under complex backgrounds, wide illuminations, large variation on pose and clothing. In practice, there are many complex movements and backgrounds in the real world environments. The experiment results show that a rich feature set supports the better detection performance. The performance of the detection results show that the accuracy of the HOG training model is 45.93% which is much better than Haar training model. Our proposed method can also apply to detect human in the real-world environment.

Keywords: feature extraction, learning model, gradient, feature vector, appearance based model, detection

1. Introduction

Pedestrian detection is a primary issue among object detection in computer vision such as video surveillance and image processing. Detecting human especially human bodies in images is still challenging problems under complex background, illumination changes, wide variations in pose and clothing [1].

There are many models for pedestrian detection system to detect the human by recognizing the human structure or its models appearing in images. Human modeling can be essential to increase the performance and effective for the pedestrian's detectors. Generally, the detector mainly has two components: a feature extraction algorithm that encodes an input image as a feature vector, and a recognition model that classifies the target human bodies according to the feature sets. Many feature extraction techniques are used to extract the features for human modeling and Histogram of Object Oriented (HOG) was efficient feature for human detection. For recognition model, the classification techniques are used to recognize the pedestrians or non-pedestrians and classify from the complex background movements. SVM is one of the useful techniques and many researchers are used for the pedestrian detection system.

In this paper, we used the traditional pedestrian detection methods which trained the pedestrian detector based on global features. We evaluated the original HOG features before training and compared HOG training model and Haar-Cascade training model. We studied from the experiment that a rich feature set supports the outstanding detection performance under difficult illumination.

2. Literature Review

Pedestrian detection is a special kind of intelligent frameworks that provides the fundamental information from images to recognize human. There are many detection models to increase the performance and accuracy of the detectors. Among them, the appearance based pedestrian detection model is trained with labelled (positive and negative) samples to extract feature vectors.

N. Dalal and B. Triggs [1] proposed Histogram of Oriented Gradient (HOG) descriptors for robust visual object recognition which significantly outperformed existing feature sets. The detector used a single detection window with fine-scale gradients. The proposed approach gave near-perfect separation on the original MIT pedestrian database. H. Ramzan [2] proposed an automated pedestrian detection system by combining pedestrian's motion patterns and HOG features in dynamic background to recognize pedestrians for reducing accidents between the vehicles and the pedestrians. This features approaches significantly improved the performance of the pedestrian detection with the use of the motion vectors. Viola et al [3] proposed a rapid object detection algorithm using a basic and over-complete set of Haar-like features and a cascade classifier. The integral image scales were used to achieve true scale and the classifiers radically reduced computation time while improving detection accuracy.

From this review, Pedestrian detection based on HOG is currently the most basic algorithm for detecting pedestrians to calculate the occurrences of gradient orientation in localized position of an image.

3. Proposed Methodology

The system flow of the detection system is shown in Fig 1. There are two phases: training phase and detection phase in the proposed system. For the training phase, we used positive and negative training samples with the same size before extracting the feature. HOG is used to extract features and the orientation of gradient is describing as the angle between the gradient and horizontal or vertical direction. After that, the feature vectors are calculated and 4608 features per detection window are obtained from the detection window of size 64 x 128 pixels and for a block of 16 x 16 cells, shifted by 8 pixels. A linear SVM is used to generate the classification model to predict the pedestrian or not. For the detecting phase, we used the testing images which are

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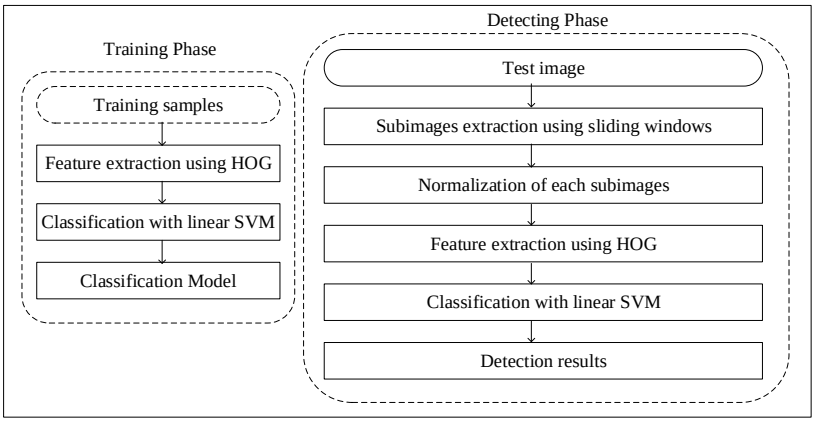

Fig 1. Detection model of the pedestrian detection system

different from the training images. Before computing the gradients, the original image is converted into 64x128 detection window to calculate the HOG descriptor for each image. Each scaled images are searched on each position by using sliding window. A linear kernel of SVM is used with soft margin C=0.1 to construct the hyperplane where positive and negative images are separated. Finally, the detection results are generated.

4. Experiment Results

Experiment setup is based on Intel® Core™ i7-4510U CPU @ 2.00GHz, 8 GHz RAM and window 10 environment. We tested the detection system into two training model: HOG training model and Haar Model. We trained both model with same training data from PSU Pedestrian Datasets. For the training images, we used 1184 positive images and 517 negative images with 256x256 image resolution. Fig 2 shows the comparison performance results on both model. The accuracy is better in HOG training model than in Haar training model. False negative rates are much higher in Haar training model and missed values are also increasingly higher as compared with the HOG training model.

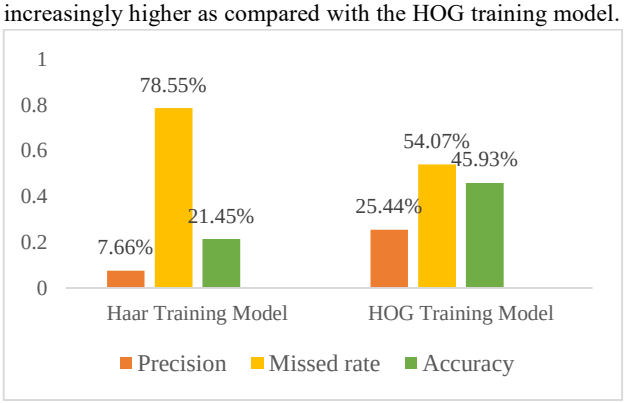

Fig 2. Comparison of the detection performance

Fig 3 shows the comparison detection result on both training model. In Haar training model, the detector falsely detects on the trees as the negative and when pedestrians are nearly in front of the camera view, the detector incorrectly assumes as the negative. The detection results of HOG training model show that when the pedestrians are in the crowded conditions, the performance rates decrease. The detector is inaccurately detecting when pedestrians are partially occluded and nearly scale.

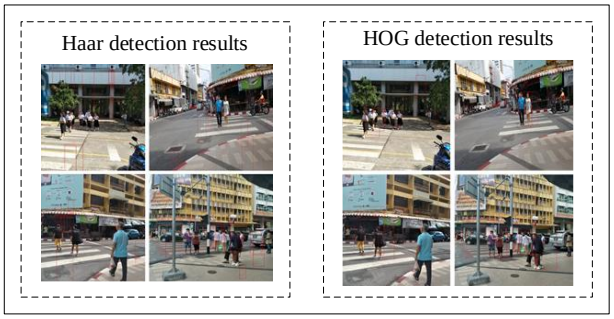

Fig 3. Comparison Detection results of the training models.

5. Conclusion and Discussion

In this paper, we compared two training models with the same training and testing images from PSU pedestrian dataset for the detection results. The detection results are not good enough and the detectors inaccurately detect the pole and tress as the positive in both training model. HOG is widely used for the rich single features but it causes false detection when the whole body of pedestrians do not appear. Haar feature is also widely used in face detection but it does not give better results on pedestrian detection. The performance accuracy of the HOG training model is 45.93% and the accuracy of the Haar training model is 21.45 %. The proposed training model is much better detection results under complex backgrounds in the real world environment.

References

[1] N. Dalal and B. Triggs, “Histograms of oriented gradients for human detection,” in *Proceedings - 2005 IEEE Computer Society Conference on Computer Vision and Pattern Recognition, CVPR 2005*, 2005.

[2] H. Ramzan, B. Fatima, A. R. Shahid, S. Ziauddin, and A. A. Safi, “Intelligent Pedestrian Detection using Optical Flow and HOG”, (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 7, No. 9, 2016

[3] P. Viola and M. Jones, “Rapid object detection using a boosted cascade of simple features,” in *Proceedings of the 2001 IEEE Computer Society Conference on Computer Vision and Pattern Recognition. CVPR 2001*.

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