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HOG Based Contriving Individual detection

Sowmya K S
[1] Associate Professor, Department of Electronics and communication, DBIT
Bangalore-74, Karnataka, India
sowmyaks@yahoo.com

***Abstract*—The workplace of building construction is a cluttered enviornment which makes the automated detection of workers challenging. Challenges include placement of cameras, variation of lighting conditions, occlusion etc. In this paper HOG is used as the feature detector and Linear SVM is used to classify the person from the background.The algorithm is tested using INRIA database and also on real time videos captured from construction sites.The detection rate is 99% for the INRIA database and 90% for the real time vieos captured.**

***Index Terms*— HOG, Occlusion, Linear SVM ,cluttered enviornment, INRIA and Gradient..**

I. INTRODUCTION

Building construction workspace comprises of contriving individuals and equipments distributed according to activities going in the site. The distribution of equipments and activities forms a cluttered and hazardous working environment. Therefore safety of workers is of primary concern. The health issues also has to be addressed as the workers carry lot of construction material and exposed to dust .Also unsafe actions of the workers results in injuries. Behavior measurement can be used to evaluate safety performance and prevent serious accidents. The site engineer requires lot of time to manually monitor the workers behavior. The workers behavior is directly related to rate of construction progress. Instead cameras can be installed at critical points in the worksite and analyze the behavior very efficiently. Also planning and supply of resources can be done properly on time in our busy schedule of our lives.

An automated surveillance system at the site workplace has to continuously observe the activities of the workers, resources has to be monitored and has to give an alarm if the safety procedures are violated by the workers. It also has to determine the safe actions of the workers and unsafe actions of the workers. The system should also identify the individuals and the vehicles on the worksite and monitor their track so that accidents can be avoided.

The challenges in this regard include placement of cameras at the required places in construction sites so as to cover maximum field of view, variation in lighting conditions, Occlusion, complete scene understanding, variation of camera position according to tracking accuracy, Action recognition of multiple equipment and workers, lack of quantifying techniques to deal whether the extracted information is sufficient to address the safety and behavior issues.

In this paper contriving individual detection is done on the sequence of videos obtained at the construction worksite. HOG algorithm is used in this regard.[13]. Preceding work done in this area is summarized in

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section II. The HOG algorithm for detection of contriving individual is done in section III. Section IV discusses the results of applying the algorithm to the detection of individuals in construction worksites. Section V concludes by discussing the results and future work

II.RELATED WORK

SHAKERI Moein, et al. [1] presents an outline to capture and measure construction progress automatically from video images taken on site. An algorithm for object detection and structures detection in outdoor site with unconstrained imagery is done. The developed algorithm is experimented with real images from two different building sites.

Saurabh Dumbre et al. [2] present a new, less obtrusive method for open site tracking of personnel. Video feeds are collected from on site video cameras and presented to the user. The user can then select the person that is to be tracked. Epipolar geometry is used in each frame to calculate the 3D position of the person. The method is implemented using C++.

A 3D object recognition technique is proposed by Nuri Choi et al. [5]. Content-based image retrieval and image improvement techniques are applied to generate images that extract the exact features of the object that has to be identified. After extracting the feature through image processing techniques, the 3D spatial data corresponding to the object is acquired.

Jinhai Xiang et al. [4] gives a tracking algorithm to track multiple workers on construction sites using video cameras. In order to address the challenge of multiple workers within the camera's field of view, a tracking algorithm based upon machine learning methods is developed. Optimization of the system is done by multiple tracking management modules. A spatial model and a color model are used for kernel covariance tracking. To handle occlusion or interaction, there needs to be a multiple tracking management module. The tracking system's output – workers' trajectories would then be the input for safety monitoring or progress analysis.

Giovanni Gualdi et al**. [6]** use contextual information to reduce computations and to increase accuracy for person detection. The pedestrian is detected using a LogitBoost classifier,. polar image transformation is used to exploit the circular feature of the head appearance and multispectral image derivatives that takes chrominance variations and also luminance . It is used to detect persons without hat in the workplace.

Víctor Escorcia et al. [7] proposes a novel method for real-time tracking and action recognition of multiple interacting construction workers using the Microsoft Kinect Sensor. The focus is on indoor operations, and in particular typical drywall construction operations. The specific objectives are to create a comprehensive method to track construction workers and their body skeleton in real-time, track worker actions under various body postures and Kinect configuration, and to test and validate the proposed method in real-world settings.

SangUk Han et al .[8] gives an algorithm to detect unsafe actions in site videos based on computer vision-based motion capture techniques. Database representing unsafe actions is constructed by experiments to identify similar actions in site videos. Ladder climbing motion data is used for testing. 3D human skeleton models and prior models are transformed onto the same space for motion detection.

III. METHODOLOGY

The algorithm uses HOG to detect construction workers in construction sites.HOG stands for Histogram of oriented Gradients. It extracts the features of an object by gradient computation. It generalizes the object in such a way that the same person produces as close as possible to the same features descriptor when viewed under different conditions. SVM training is used to classify HOG descriptors of people. The different stages of HOG is as shown in Figure 1

Calculation of Gradient Histograms

HOG person detector uses a detection window that is 64 X 128 pixels. The detection window is organized into cells with overlapping blocks of 8 X 8 pixels and HOG descriptor is applied to each overlapping block. Within a cell the gradient vector is computed at each pixel.

Gradient Vector

A gradient vector can be computed for every pixel in an image. It is a change in the pixel values along the X direction and the Y direction around each pixel. Several gradient detectors like [1,-1], 1,0,-1], [1,-8,0,8,-1] can be appliedl. The [1,0,-1] detector gave promising results. The gradient calculation is as shown in Figure 2.2

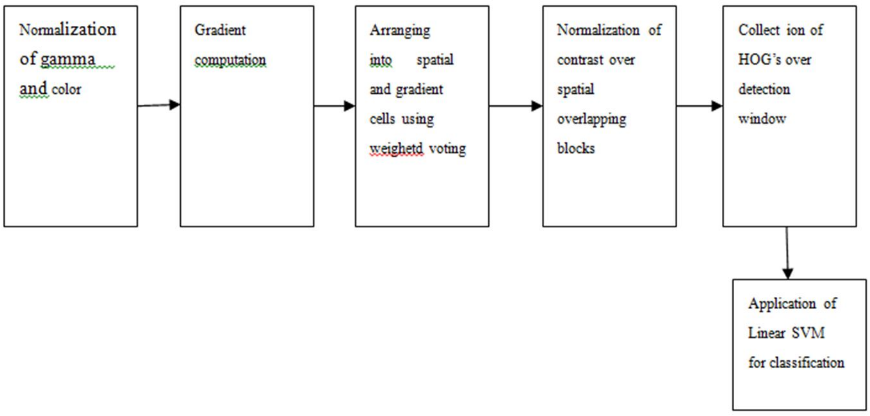

Figure 2.1 Steps to calculate HOG

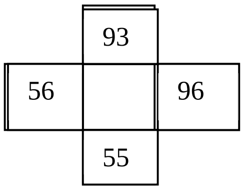

Figure 2:Matrix for Gradient calculation

In x direction gradient is 94-56 =38 and in y direction gradient is 93-55 =38.Putting these two values together we get gradient vector

$$\begin{bmatrix} 38 \\ 38 \end{bmatrix}$$

Figure 3: Gradient Vector

The gradient magnitude is $\sqrt{38^2 + 38^2}$ = 53.74 and the Angle of Gradient is given as arctan (38/38)= 0.785 rad = 45 degree.
Note that the difference in pixel values can range from -255 to +255.These values are mapped to 0-255 range. For mapping the pixels with large negative values will be black, pixels with a large positive value will be white and pixels with little or no change will be gray. 64 gradient vectors are obtained from8 X 8 pixel cells. These 64 gradient vectors are put into a 9 bin histogram. The histogram varies from 0 to 180 degrees. And each bin occupies 20 degree. The magnitude of gradient vector is considered for the histogram representation. The magnitude value of gradient vector is split between the two closest bins. This will minimize the problem of gradients which are at the boundary between two bins. Therefore histogram gradient is a form of quantization which reduces 64 vectors with 2 components each down to a string of just 9 values.

Normalizing the gradient vector

Gradient vector normalization is used for making them contrast invariant and illumination invariant.

Histogram normalization

If every pixel is multiplied by 15 in 8X8 cell, then magnitude of the cell will be increased by a factor of 15. normalizing the histogram makes it invariant to the type of illumination change. Block normalization is applied. Cells are first grouped into blocks of 2 cells and blocks have 50% overlap.

SVM

SVM is applied to detect person or non person. SVM stands for Support vector machines. It is a classification algorithm to predict if something belongs to particular class. In the human detection algorithm proposed by Dalal et al[13], the HOG features are extracted from all locations of a dense grid and the combined features are classified by linear Support Vector Machine (SVM). They showed that this HOG features significantly outer-performed existing feature sets for human detection.SVMs have yielded excellent results in various data classification tasks. Let { f_i , t_i } for i=1 to N and (f_i ε R^D, t_t ε {-1,1} be the given training samples in D dimensional feature space. The classification function is given as z=sign ($w^{T\ fi}$ –h) where w and h are the parameters of the model.

IV. Implementation And Results

The algorithm is implemented using opencv. It is tested with INRIA database and also collected at construction sites The algorithm gives an efficiency of 99%% for INRIA database and 90% for the data collected at constructed sites. The false detection rate was high in collected data due to illumination conditions and for the HOG to work properly the person should be visible to the whole length. The results are as shown in the figure

figure

V. Conclusion

The Histogram of oriented gradients algorithm is applied to detect workers at the construction site. It is highly challenging task as the construction sites are very much cluttered. The algorithm is tested first on INRIA database which yielded an accuracy of 99% and also on real time videos acquired at the actual construction site which gave an detection rate of 90% due change in illumination conditions.

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