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APPEARANCE BASED CLASSIFICATION OF RIGID AND NON-RIGID OBJECTS FROM VIDEO

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Abstract— **With high accuracy it is difficult to classify rigid and non-rigid objects. In this paper, a few set of small videos has been taken and different features are extracted from them based on their appearance. Here, rigid and non-rigid objects are restricted to vehicles and human beings. Primarily, moving objects are detected by using background subtraction, which is widely used to identify foreground objects in video surveillance. LPGMM model is considered which can work even on dynamic background. Feature extraction based on appearance are carried out using various methodology which are mainly focused on blob analysis viz., SURF (Speeded-Up Robust Features), edge detection and HOG (Histogram of Oriented Gradients). SVM (Support Vector Machine) supervised learning model is used for the binary classification of rigid and non-rigid objects. .**

Index terms- **Background subtraction, LPGMM, SURF, HOG , edge detection, SVM,**

I. INTRODUCTION

Accurate detection of moving object in a video surveillance is an challenging task, irrespective of background, brightness, color or environmental condition. The better idea to deal with such situation is the use of background subtraction. Foreground objects detection using LPGMM [1] which is an extension of GMM [2]. Foreground object detection has two phase: training phase and testing phase. In training phase, few of the video frame sequence are taken and reference model is constructed i.e, LPGMM background model. In testing phase, remaining video frames are compared with background model.

Features are extracted simply based on their appearance. Here, mainly we are concentrating on local- and texture- based appearance feature extraction. [3] since primary level of blob analysis is sufficient for the classification of rigid and non-rigid objects. Global based features are more suitable for large scene or images (ex : color histogram).

Appearance based models with local features includes region-based and corner-based with respect to pixel or patch-level feature extraction. Edge detection can be best suited to analyze and detect the object boundaries. These edges are detected using local gradients. SURF, is the extension of SIFT (Scale Invariant Feature Transform). Interest points detection, blob analysis and detection can be performed more efficiently using SURF. HOG [4] is mainly used for identifying humans. Gradient based features are extracted against contract variations.

SVM [3][4] used for supervised classification and regression. It enhances the geometric margins. It includes two phase. In training phase, a set of features are trained by using vector file. Similarly in testing phase, a set of features are taken and compared with trained features.

II. SYSTEM ARCHITECTURE

Figure 1 shows the system architecture which includes two phases : Training phase and Testing phase.

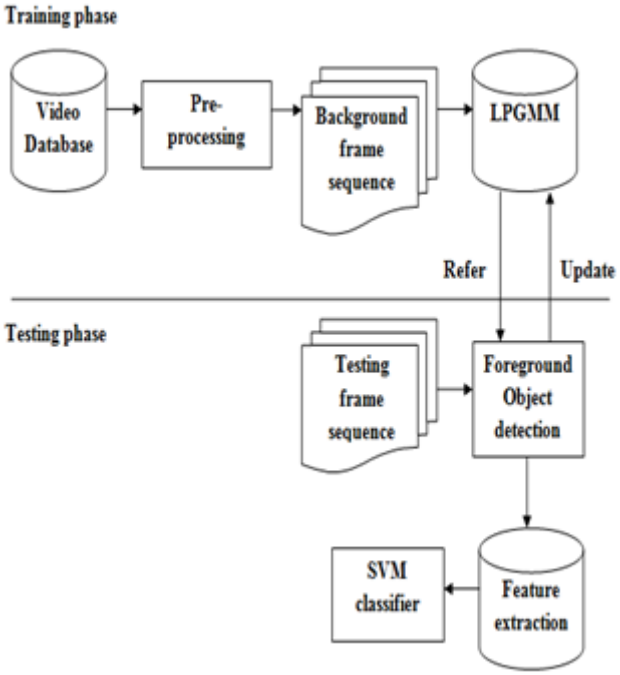

Fig. 1 System Architecture

Training phase:

In Training phase, input video frames are pre-processed first. Pre-processing includes resize, grayscale conversion, noise removal. Initial few image sequence are used to build LPGMM background model.

Testing phase:

In Testing phase, new image sequence is compared with reference background model. If the observed pixel is matched

to a Gaussian distribution and the mean difference falls within 2.5 times the corresponding deviation, then that pixel is classified as background and updated. Features are extracted using HOG, SURF, edge detection (Height, Width, Area), Color Histogram. SVM classification is done based on the maximum feature matching whether it is rigid or non-rigid objects (i.e., humans and vehicles).

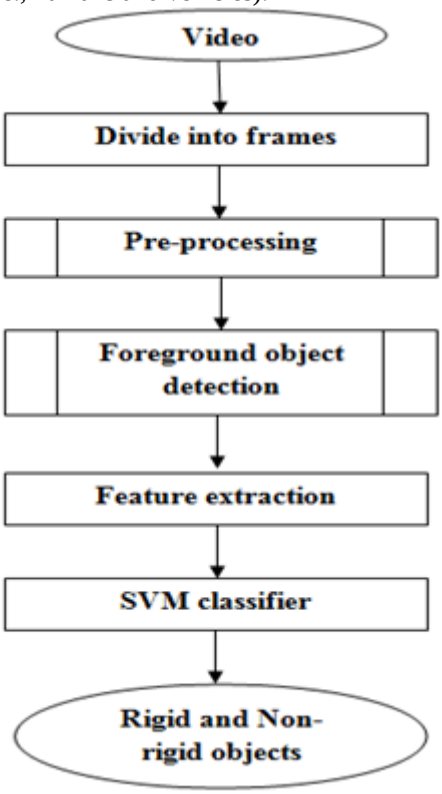

Fig. 2 System Flow

III. PREPROCESSING

In order to have a better accuracy primarily the video frames has to be preprocessed. On video frames resize, grayscale conversion, noise removal and morphological operation (dilation and erosion) are carried out.

IV. FOREGROUND MOVING OBJECT DETECTION

In order to get foreground moving object background need to be subtracted from the frame. This can be done using background subtraction approach. Here, the current frame is compared with the reference background model and features are extracted.

Traditionally, moving objects are detected using GMM model [2] with the static background. LPGMM approach is capable of handling dynamic background as well. Features like Intensity, Mean and Standard deviation are extracted from each pixels in the frames. These features are extracted from both training frames as well as testing frames. They are compared with each other. If the mean difference falls within 2.5 times the actual standard deviation, then it is considered as background, if not it is classified as foreground objects.

V. FEATURE EXTRACTION

In order to classify rigid and non-rigid objects feature extraction based on their appearance plays a major role. Here we are applying three methods to extract various features. These feature vector is used for the classification purpose.

A. Edge detection

This is one of the basic tool used in Image Processing. The sudden change in the pixel points are identified as an edge and marked. It mainly acts when the frame brightness or intensity changes in huge. Matlab offers many functions for edge detection. Here we have used prewitt edge detector function, it computes n approximation of gradient of frame intensity. Once the edge has been detected corresponding height, width and area of the bounded box are extracted.

B. SURF (Speeded-Up Robust Feature)

It involves blob detection approach which identifies the region which are similar and dissimilar. A blob region is nothing but the region with similar properties like color, brightness etc. SURF has many applications. SURF used for segmentation purpose during histogram analysis, to find interest points in texture analysis. Hessian blob detector is used in order to detect interest points. Haar wavelet is responsible for maintaining feature description.

SURF algorithm involves three steps : (i) Detection of interest points, Hessian matrix is used to find interest points. (ii) Description of local neighborhood, to create awareness about surrounding pixels and their properties locally. (iii) Comparing and matching pairs to generate blob regions.

C. HOG (Histogram of Oriented Gradients)

HOG is a feature descriptor which is mainly used to track humans. It collects the number of occurrence of gradients locally.

Primarily, the frame is divided into small cells, for each cell histogram of gradient directions is calculated. Each cell is distinguished into angular bins with respect to the gradient orientation. For the corresponding angular bins, weighted gradients are contributed by each cell's pixel. These cells are combined to form block of rgion. On combining all the blocks, features are extracted.

VI. SVM CLASSIFICATION

SVM (Support Vector Machine) classifier is one of the widely used classifier which offers supervised way of learning methods that analyze the data used for classification. SVM has many applications in the field of Image Processing like tone recognition, text classification , image classification etc. it mainly separates among a set of objects having different properties or features. SVM is also termed as linear classifier, which guarantees good predictive performance. SVM kernels are more flexible in distinguishing humans from non-humans irrespective of linearity.

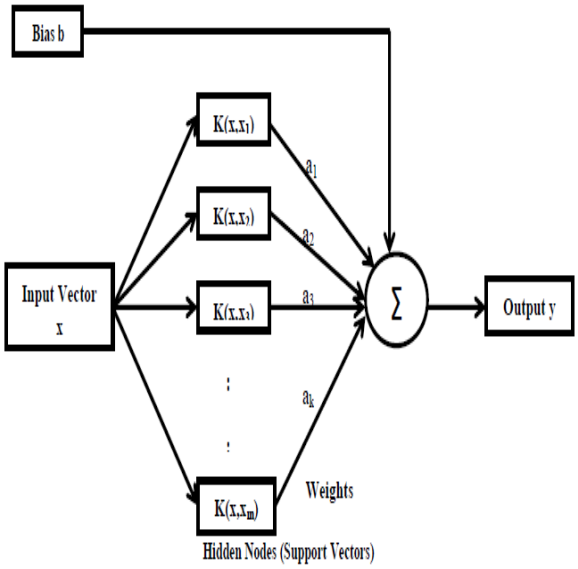

Fig. 3 Architecture of SVM

The input vector is the features obtained from Edge detection, SURF and HOG methods. The centers of hidden nodes are support vectors(SVs) which compares feature vector of both training and testing frames to output classification of objects. Here, $k(x,x_k)$ compares x features obtained from training frames with x_k features of testing frames.

VII. RESULTS AND DISCUSSION

In our work we have considered two video surveillance. One on the roadways and another one on the public place. In the first video sample (Fig 4) we can see cars moving on the road. In the next video surveillance we can see two persons (Fig 5) walking.

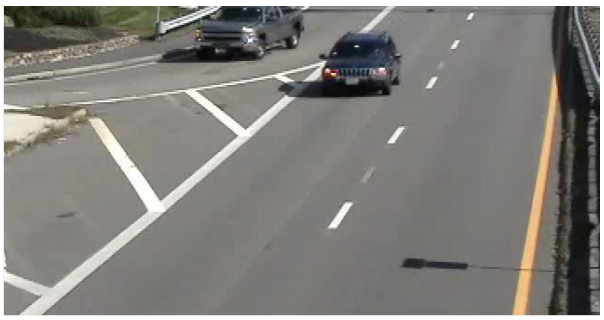

Fig. 4 input video frame

Fig. 5 input video frame

Results after classification is done is as shown below (Fig 6 and 7).

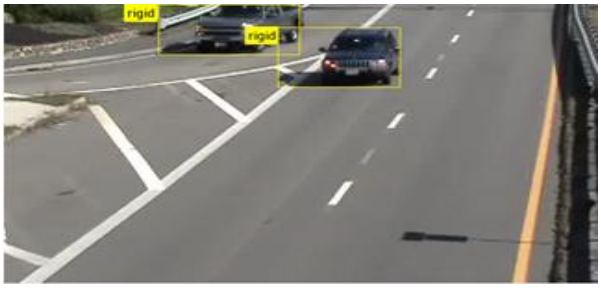

Fig. 6 classification result for Fig 4 input frame

Fig. 7 classification result for Fig 5 input frame

VIII. CONCLUSION

In this paper we have attempted to extract various features using Edge detection, SURF and HOG methods based on the appearance of the objects. This combined methods extraction results in a better classification among rigid and non-rigid objects. These extracted features are classified using SVM classifier to classify rigid or non-rigid objects.

Classification using any single method for feature extraction is less accurate. They do not deal with different positions, textures of objects. Here the person can be with no limitations to the pose and appearance, the same implies for vehicles too.

IX. FUTURE WORK

Once the classification is done further work can be carried out in the individual identification of rigid and non-rigid objects. Like identifying whether a particular rigid object is car, bus or bike. Person identification whether a person is male or female.

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