ABSTRACT—In recent years the human actions recognition in crowd video for security purpose in airport, highways or roads, metro line station, street etc. In this paper we are describing the different human actions in crowd video. In existing system, filtering parameters are sensitive in complex scenes and detected interest points are heavily affected by the cluttered background. So in order to handle cluttered background we propose a hierarchical filtered motion (HFM) with spatiotemporal interest point features to recognize more type of actions in crowd. The interest points are detected by 2-D Harris corner points detector and MHI Hierarchical motion filter is used to reduce the distracting motion and also find the characterize points. Finally the different human actions are classified by the GMM. The proposed method can detect three different human actions like boxing, hand waving, clapping. The proposed method is analyzed and validated by using KTH dataset and MSR action dataset II.

I. INTRODUCTION

Action recognition is difficult in cluttered background. Our aim of the work is to recognize human actions in crowd environments. By combining multiple features will rectify the action detection problems.

Recent work on action recognition that are based on Laptev et al.[3],[4] used local spatiotemporal invariant points(STIPs)[8] local spatio-temporal descriptors Histogram of Oriented Gradients(HOG)/ Histogram of Oriented Flows (HOF)[7],[9],and multichannel nonlinear SVMs for realistic actions in movies. Yuan et al. employed the same features (STIPs) and descriptors (HOG/HOF) and proposed a discriminative sub volume search for efficient action detection by the use of a nearest neighbor-based classifier.

II. SYSTEM OVERVIEW

In this paper we propose a hierarchical filter motion is used to extract motion information and reduce distracting motions. The 2-D Harris corners and MHI for interest-point detection. To eliminate the distracting motions we are applied hierarchical filtered motion

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method in crowd. Finally it will classify by the GMM.
The proposed approach achieves the results on the standard KTH dataset that has clean background. We perform action recognition on the MSR action dataset II that consists of three actions (hand clapping, hand waving, and boxing).

IV. HIERARCHICAL MOTION FILTER

A. Global Motion Filter

We apply a motion smoothing step at the MGI to remove the isolated motion directions to get filtered motion field-smoothed gradients of the MHI. For local filtered motion field processing, we decompose the MHI as a number of layers with different motion directions.

B. Local Motion Filter

we apply a local filtered motion field at each interest point between the pixels in the local region and the interest point. the local region is the window to calculate HOG-MHI. Let \( d(P_0, B) \) denote the minimum distance between \( p_0 \) and all the points in \( B \).

SPATIOTEMPORAL INTEREST POINT FEATURE

A novel spatio-temporal (ST) feature which is based on the SURF (Speeded-Up Robust Feature) features For designing a new ST feature, we use only moving interest points where ST features are extracted and discard static interest points, because we expect that it is a local feature which represents how objects in a video are moving. We calculate the variation between the each frames. This values will be used as a feature values of video.

\[
\text{====} \quad (1)
\]

V. FEATURE DISCRIPTORS

The window is divided into an \((mx, ny)\) grid of patches. We use Histograms of Oriented Gradient (HOG) without considering the directions and Histograms of Oriented Gradient in Motion History Image (HOG_MHI) the action recognition is decreases without considering directions. The multiscale process will heavily increase the size of the feature vector for training and testing. The size of each window is calculated by \( w_{x} = k_{mx} \) and \( w_{y} = k_{ny} \), we use randomly selected window sizes between \( w_{min} \) and \( w_{max} \).

VI. ACTION CLASSIFICATION

GAUSSIAN MIXTURE MODEL

We employ a GMM to have the ability to model any given probability distribution function when the number of mixture component is large. Given a K-component GMM, the probability of a patch \( x \) is,
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\[ P_x(x|\Omega) = \sum_{k=1}^{K} N(x; \mu_k, \Sigma_k) \]  

(2)

\( N(x; \mu_k, \Sigma_k) \) denotes the normal distribution with mean \( \mu_k \) and variance \( \Sigma_k \). The set of all the parameters of the GMM is denoted as \( \Omega = \{ w_k, \mu_k, \Sigma_k \}, 1 \leq k \leq K \).

Suppose there are C category corresponds to a GMM with K components \( \Omega_c = \{ w_k, \mu_k, \Sigma_k \} \). This can be solved by the EM algorithm that is an interactive method between performing an expectation step (E-step) and maximization step (M-step).

\[ p_k = \frac{w_k N(x; \mu_k, \Sigma_k)}{\sum_{c=1}^{C} w_c N(x; \mu_c, \Sigma_c)} \text{ for } x \in \mathbb{R}^C \]  

(3)

After obtaining the GMM parameters \( \Omega_1, \Omega_2, ..., \Omega_C \) we can easily classify a new video clip according to the action category.

**VII. EXPERIMENTS RESULTS AND DISCUSSION**

The KTH dataset was used as standard benchmark for action recognition. It has four controlled environments with clean background (indoors, outdoors, outdoors with scale variation, and outdoors with different clothes.)

The current video database containing six types of human actions (walking, jogging, running, boxing, hand waving and hand clapping) performed several times by 25 subjects in four different scenarios: outdoors s1, outdoors with scale variation s2, outdoors with different clothes s3 and indoors s4 as illustrated below. All sequences were taken over homogeneous backgrounds with a static camera with 25fps frame rate. The sequences were down sampled to the spatial resolution of 160x120 pixels and have a length of four seconds in average.

The MSR action dataset II consists of three type of action like, boxing, hand clapping, hand waving, GMM is trained from the KTH dataset for six actions to recognize the actions on the MSR action dataset II. Figure 2 shows the Interest points are detected by 2-D Harris corner detection, MHI calculation. Processing of both global and local filters and calculation of HOG and HOG-MHI.

**MSR ACTION DATASET II EFFICIENCY ANALYSIS**

(a) Background subtraction  
(b) Motion History Image  
(c) Corner points detection  
(d) Feature extraction

**Fig. 2** the action recognition from Boxing

Figure 3 shows the background subtraction for separated foreground image and interest points are detected by 2-D Harris corner detection, MHI calculation and feature extraction.

(a) Background subtraction  
(b) Motion History Image  
(c) Corner points detection  
(d) Feature extraction

**Fig. 3** The action recognition from Handclapping

Figure 4 shows the background subtraction for separated foreground image and interest points are detected by 2-D Harris corner detection, MHI calculation and feature extraction.

(a) Background subtraction  
(b) Motion History image
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