Contour based abnormal Event detection using Hidden Markov Model

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Abstract : Visual analysis of human motion in video sequences has attached more and more attention from computer visions in recent years. In this Research, in order to detect abnormal events in intelligent video surveillance, the analysis and the recognition of motion patterns are performed using the contour, which gives the motion of moving body by quantifying changes in boundary shape of body over a time. After that by applying K-means clustering algorithm on center points of contours, two fixed point is obtained as a output. The distance between two fixed points considered as a feature of one frame of particular event. Finally, Hidden Markov Models is used for human posture modeling and behavior matching to classify the events as a abnormal or normal. Experiment results have shown that this method gives stable performances and good robustness for both outdoor and indoor environment.

***IndexTerms* - Abnormal Event detection, Background Subtraction, Contours, K-means Clustering, HMM**

I. INTRODUCTION

For Public Security , intelligent video surveillance for abnormal event detection is becoming more & more important , For this purpose human behavior recognition is one of the significant objectives of such system. Intelligent visual surveillance has got more research attention due to increased global security concerns & an ever increasing need for effective monitoring of public such as airports, railway stations, shopping malls, and military applications [1]. event detection involves the analysis and the recognition of motion patterns to produce a high-level description of actions and interactions among objects(humans). motion capture systems are costly and only effective in limited areas[2]. In our research approach , instead of the motion capture system that needs multiple cameras installed at fixed location, one camera used to recognize the human activities. An important method in determining the motion of a moving body is the change in its boundary shape over time and a good way to quantify this is to use contour. There are many standard techniques for contour. However, these techniques are computationally expensive and moreover, are highly susceptible to noise in the target boundary [3].

There are enormous challenges faced in human activity analysis process Because of element natural conditions, for example, changing light intensity, waving tree branches in the wind and shadows of object is a troublesome and critical issue like while converting the 3D images to a 2D images some information loss is occur , Noise in images, Full and Partial object occlusions, object motion is Complex, Nature of objects is Non rigid or articulated, Requirements of real-time calculations. The aim of this thesis is to improve the performance of human activity detection and tracking by detecting the movement of human in the images of continuous video frames. Automatic tracking of Human activities can be the foundation for many interesting applications. An accurate and efficient tracking capability at the heart of such a system is essential for building higher level vision-based intelligence. To make significant improvements in commonly used algorithms for detection and achieve high accuracy for more data samples. The processing of video frames come from security cameras with the aim of controlling and recognizing abnormal behaviors create an automatic care monitoring system as a human action recognizer.

The Rest of the paper is organized as follows:

Section II. gives the overview of our proposed system, Section III. present the Framework for Event detection, Section IV. presents Foreground detection and presentation using Background subtraction method, Section V & VI. present the feature extraction and Classification using HMM, and Section VII. gives the information about Dataset and Experimental result.

II. SYSTEM OVERVIEW

The method proposed here provides a simple, real-time , robust way to detect abnormal events using contour features. we aimed to classify the high impact activities like Kicking, punching, pushing, handshaking and other activities in human motion video as a Abnormal and Normal behaviors . The proposed system uses Hidden Markov model classifier approach. The main focus of this research is to classify behaviors like Abnormal and Normal from different videos. Here, we uses frame based feature extraction approach, by extracting contours from frames of video.

III. FRAMEWORK FOR ABNORMAL EVENT DETECTION

Figure 1. shows the Framework for proposed system. it represent the every steps of entire process for one video that all steps repeats in second video. First of all, we Capture the frames from motion video, and convert all frames in to gray Scale image form from RGB format. After that we use one of the Background subtraction method for foreground presentation purpose and by applying the thresholding on the foreground , we finding the contours of the foreground. Because of issues like the changing light intensity , Noise in images, human motion is Complex, and Nature of objects(humans) is Non rigid or articulated, There is problem creating in obtain contour accurately of foreground. we got the multiple contours per one object(human). Then, To find the distance between two human , we first find the center points of all contours of frame. After that, by applying K-means clustering on the center points of contour, we got the two fixe points. and the distance between two fixe point referred to as a distance between two humans as a feature of one frame. which are given to the HMM classifier as an input.

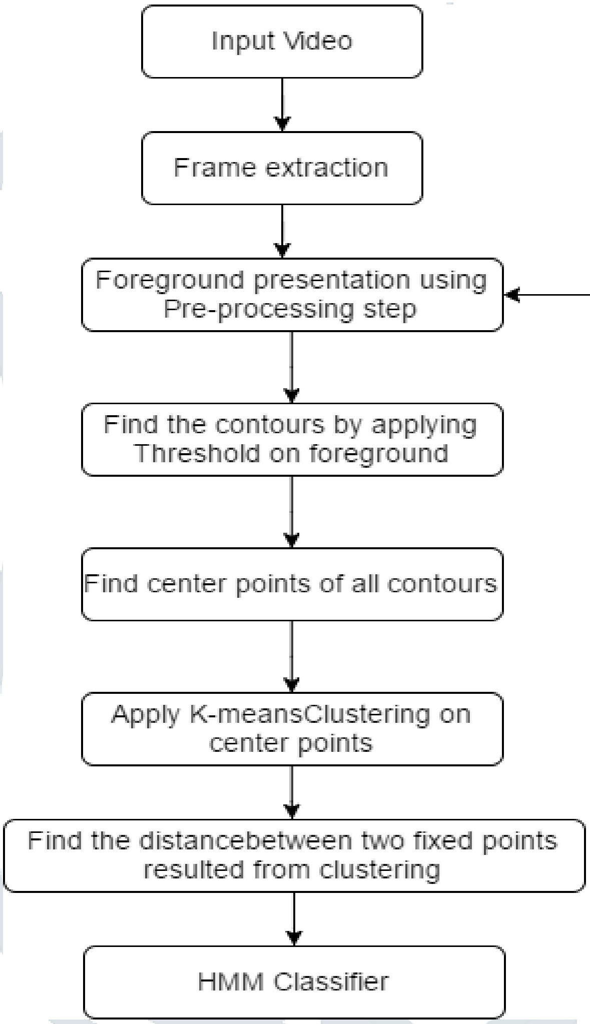


Figure 1. Framework for Abnormal Event detection

IV. FOREGROUND DETECTION & PRESENTATION

Human action and activity recognition systems often begin with human(foreground) detection . The task of this step is to separate human from different frames , Which is known as a foreground detection and presentation. For this purpose, we use Absolute difference method , which is an one of the methods of Background Subtraction.

In absolute difference method , Background frame is fixed and always compare with the input frame. Background frame is recorded during the installations and every frame is Subtracted from the background frame. The resultant image is termed as difference image, and apply Optimal threshold value to the obtained difference image. This is binary threshold for the image, if the pixel value of the difference image is greater than or equal to threshold , then it would be considered as a foreground pixel. and at last, As a output it gives foreground which contain moving object(Humans).Figure 2. represent the Absolute difference method step by step.

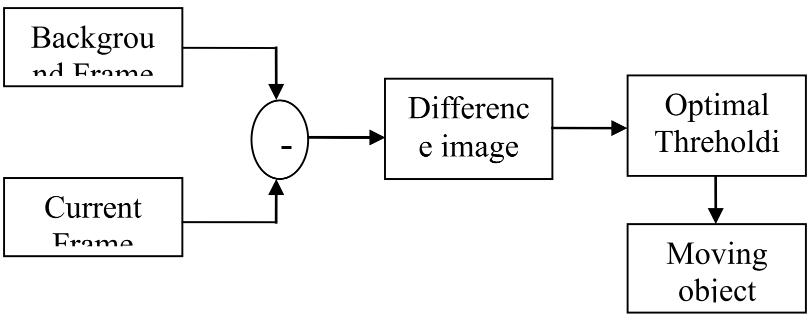
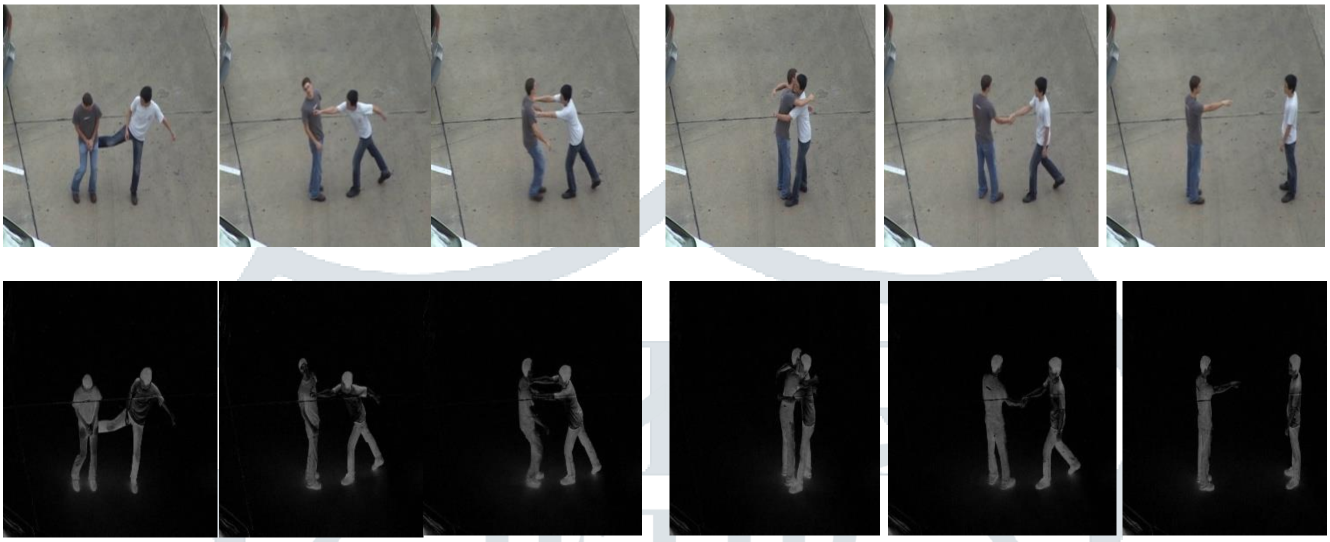


Figure 2. Absolute Difference Method

A.



(a) Abnormal activities (b) Normal activities

Figure 3. First column represent the frames of activities from SDHA Dataset and, Second Column represent the background Subtraction resulted frames for both type of behaviors.

V. Feature Extraction

Many machine learning application require feature extraction and feature selection. Feature extraction can be seen as a pre-processing step in learning process where different kinds of features will be extracted from data[4]. The feature extraction step is possibly the most important part of the activity recognition problem since classification can be handled by any existing machine learning algorithm if the features are robust [5].

In our experiment, To determining the motion of a moving body, we use contours ,which represent change in body's boundary shape over time, and also represent the human in frames. Fundamentally, Contour is a curve joining all the continuous points, having same color or intensity[6]. Because of issues like the changing light intensity , Noise in images, There is problem in obtaining contour of foreground accurately. we got the multiple contours per one object(human). Therefore , we find the center points of all contour, as shown in bellowing Figure 4.

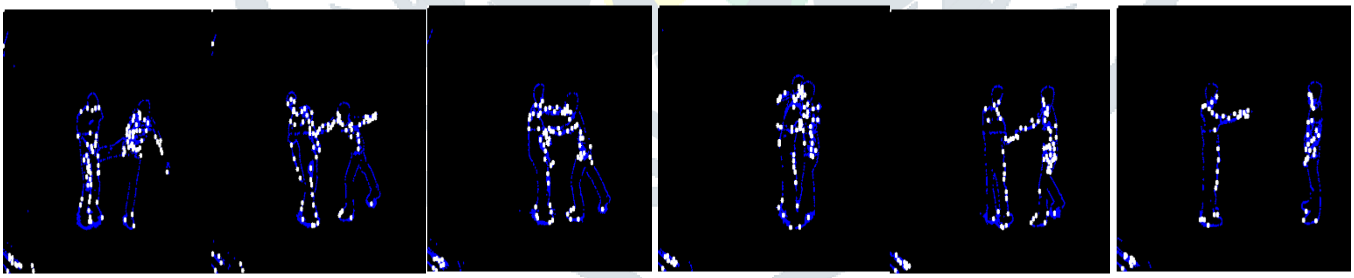


Figure 4. Human Representation using Contour and Center points of Contours.

Our main purpose is find the distance between two humans as a feature of one frame using the center points. For this Purpose , we use the K-means Clustering algorithm, which gives two fixe centroid points[7]. and the distance between these two centroid points referred to as a feature. Figure 5. shows How K-means Clustering algorithm work.

Let $X = \{x_1,x_2,x_3,........,x_n\}$ be the set of data points and $V = \{v_1,v_2,.......,v_c\}$ be the set of centers.

1) Randomly select *'c'* cluster centers.
2) Calculate the distance between each data point and cluster centers.
3) Assign the data point to the cluster center whose distance from the cluster center is minimum of all the cluster centers.
4) Recalculate the new cluster center using:

$$Vi = (\frac{1}{Ci})\sum_{j=1}^{Ci} Xi$$

where, 'c_i' represents the number of data points in i^{th} cluster.

5) Recalculate the distance between each data point and new obtained cluster centers.
6) If no data point was reassigned then stop, otherwise repeat from step 3).

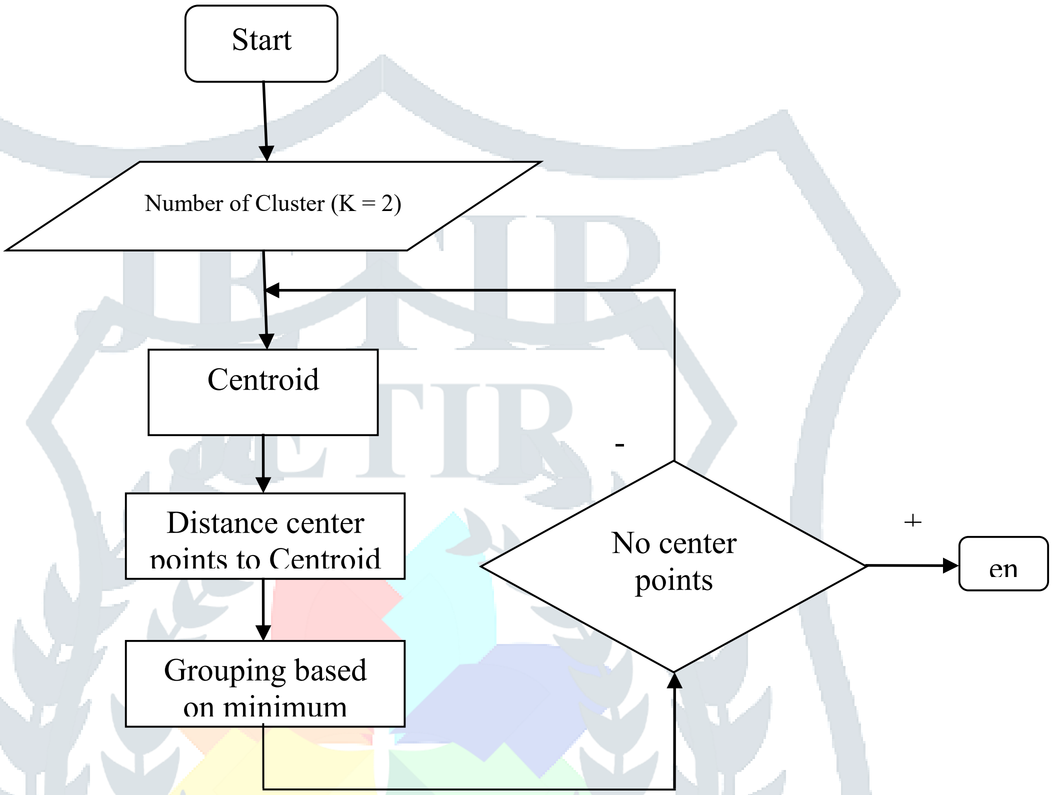


Figure 5. How K-means Clustering algorithm works?

VI. Classification using HMM

Event detection using the instance-based random forest classifier may be influenced by the occasional noises. To improve the recognition accuracy, the hidden Markov model (HMM) [8] is leveraged to make advantage of the previous observation. denotes, we built a HMM to improve event detection performance. The key idea of the HMM is to get the most likely sequence of states the model would go through to generate a given sequence of emission.

The HMM is a sequence model. A sequence model or sequence classifier is a model whose job is to assign a label or class to each unit in a sequence, thus mapping a sequence of observations to a sequence of labels [9]. An HMM is a probabilistic sequence model: given a sequence of units (words, letters, morphemes, sentences, whatever), they compute a probability distribution over possible sequences of labels and choose the best label sequence[10]. It's states are not visible, but visible on the output of states. When all the probability distribution of the output of each state is known, the next state can be predicted through the current state, or through an associated output sequence to predict the state sequence. Therefore, HMM is widely used in the timing pattern recognition [11].

The process of Event detection based on HMM is as follows:

(1) For each behaviour, each feature point, a HMM is initialized. The number of observable symbols of HMM is set to the number of different feature values in the feature set, and the number of hidden states is set To 5. The state transition matrix, the observable symbol probability matrix and the initial state probability distribution are randomly generated.
(2) Take a sample from the training set, using forward algorithm to estimate optimal path of transition among the state and update the corresponding parameters of the models, which are initialized for this sample's behaviours with different feature points.
(3) Take the feature vectors of the feature points in test set as input of the corresponding model of various behaviours, and calculate its occurrence probability with the forward algorithm.
(4) Calculate the average of all probability calculated by all feature points models with the same behaviour. Then the test sample is classified as the behaviour which gets the highest average probability.

VII. Experimental Result & Dataset

In the experiments, human Motion video were taking from SDHA dataset. During the experiment, we used 60 videos. The resolution of the video frame is depend on video size. We have experimented with motion videos like kicking, punching, pushing, hugging, handshaking and point of total length almost 4 second. Videos composed of 10 video Sequences for each class taken on a parking lot(outdoor). their backgrounds are mostly static with little camera jitter. 10 videos Resolution = 720*480 Static camera Color Video height of a person in the video is about 200 pixels.

We have also create dataset with different environment(indoor) than SDHA dataset for experimental purpose and check the performance of our system in real - time video. In this case, we give training using SDHA dataset , and than tested by a our created dataset. As a result , it gives the good accuracy for Real- time event detection Scenario. An accuracy rate of our experiments for two above mentioned dataset, presented in bellowing Table 1.

Table 1. Experimental Result

Dataset	Behavior	Accuracy Rate(%)
SDHA	Abnormal	91.66%
	Normal	66.66%
Created - dataset	Abnormal	88.66%
	Normal	66.66%

II. VIII. Conclusion & Future work

There are increased interest in the intelligent security monitoring system due to increased global security concerns & an ever increasing need for effective monitoring of public such as airports, railway stations, shopping malls, and military applications inspiring us to research novel approach in this area. Generally there are various different techniques for human behavior recognition using the motion of human body, here we use the Contour to extract the motion information of human in particular behavior, and contour gives the all information accurately. HMM classifier quite Complex but it obtains very accurate result because of training datasets. The result of this approach is depends on video quality. If the video quality is low then it obtains less accurate results but there is no drastic result difference noted. As shown in experimental result, This approach is works for both Outdoor activity training dataset, as well as work for corridor or indoor activities efficiently.

In Future work, We would try to enhance the accuracy rate of classification and classify more activities as a abnormal and normal behavior. Also this approach would be a make applicable for Commercial application , by combining it with alarm system for abnormal events.

III.

IV. References

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