

Recognition Of Human Action Under View Change

Submitted By

N.Murugappan
20084268

Ma.P.Maaniccka Sentil
20084036

G.Mohamed Shamsudeen
20084038

23rd January 2012

1 Introduction

This Document illustrates various preliminary design and detailed analysis of the Human Action recognition Under View change, the algorithm used behind automation of surveillance camera system that is used for discovering regular anomaly detection. The main advantage of this approach is the ability of the system to adapt to dynamic environment.

2 Need for the Proposed System

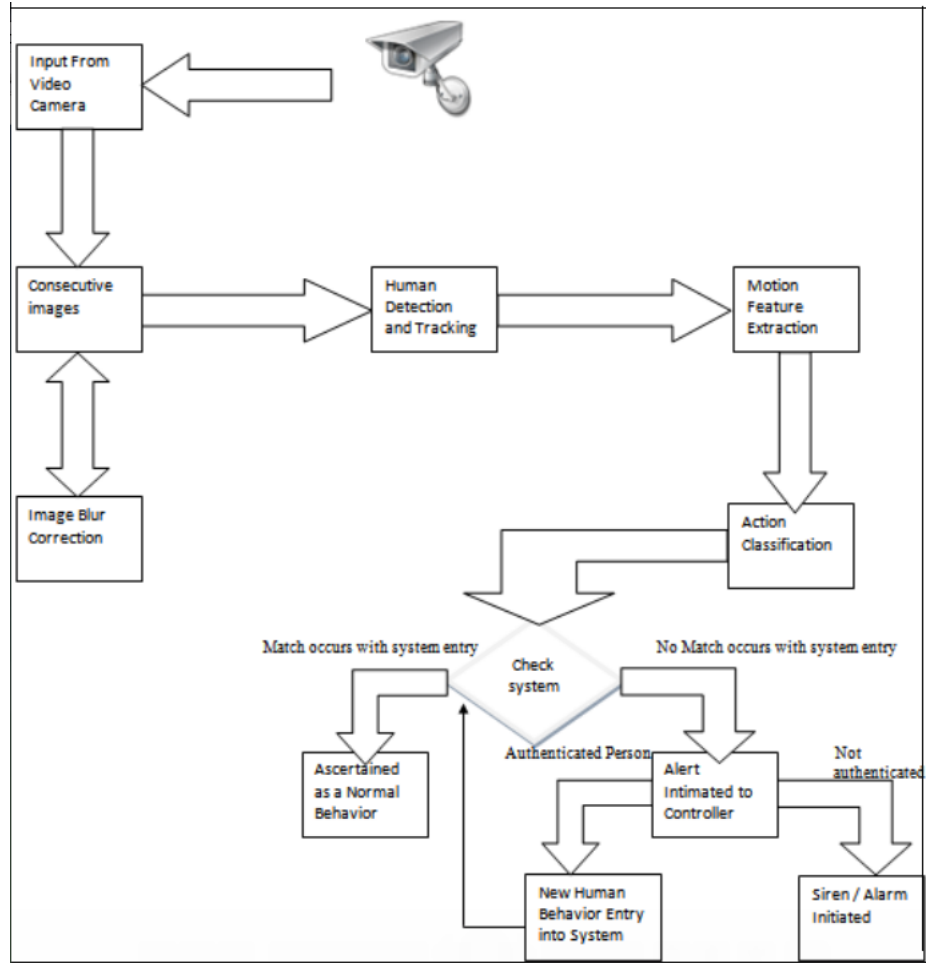
2.1 Existing System

Existing system is based on the assumption that there exist well defined and known a priori behavior classes both normal or abnormal behavior of the subject. The need for the new proposed system arises due to the potential disadvantages of the existing system which uses a complete Supervised Learning Algorithm and performs clustering on observed patterns and label those forming small clusters as being abnormal or build a Database of spatiotemporal patches using only regular Normal behavior and detect those patterns that cannot be composed from the database as being abnormal. With the increased use of Database for the content heavy video files which have been splitted into sequential frames are to be stored and retrieved very frequently leading to higher time complexity and resource complexity.

2.2 Proposed System

The proposed system of Recognition of Human Action Under View Change uses Trajectory based SSM Self Similarity Matrix for effective pattern matching and behavior analysis from the blob images extracted from the frames with the following features

- A scene event-based behavior representation.
- Behavior profiling
- A Composite Generative behavior using Anomaly Detection.



Overview of various Modules incorporated in the proposed project.

3 Design

System is designed based on a Self-Similarity Matrix (SSM) descriptor for view independent video analysis, with human action recognition as a central application.

There are three different modules used in detection of human action under view change namely

1. Behavior Pattern representation
2. Behavior Profiling
3. Anomaly Detection

SSM-Self Similarity Matrix

In a sequence of images $T = (T1, T2, \dots, Tk)$ in discrete (x; y; t)-space, a SSM of τ is a square symmetric matrix of size

$$T \times T,$$

$$[d_{ij}]_{i,j=1,2,\dots,T} = \begin{bmatrix} 0 & d_{12} & d_{13} & \dots & d_{1T} \\ d_{21} & 0 & d_{23} & \dots & d_{2T} \\ \vdots & \vdots & \vdots & & \vdots \\ d_{T1} & d_{T2} & d_{T3} & \dots & 0 \end{bmatrix}$$

is the distance between certain low-level features extracted in frames T1 and Tk respectively. The diagonal corresponds to comparing a frame to itself (no dissimilarity), hence is composed of zeros. The exact structures or the patterns of this matrix depend on the features and the distance measure used for computing the entries d_{ij} . In a video sequence, compute a particular instance of SSM where d is the absolute correlation between two frames, as depicted in The computed matrix patterns have a significant meaning for their application the diagonals in the matrix indicate periodicity of the motion. d_{ij} is Euclidean distance between the different features that is extracted from an action sequence. This form of SSM is known in as Euclidean Distance Matrix

3.1 Behavior Pattern representation

3.1.1 Video Segmentation

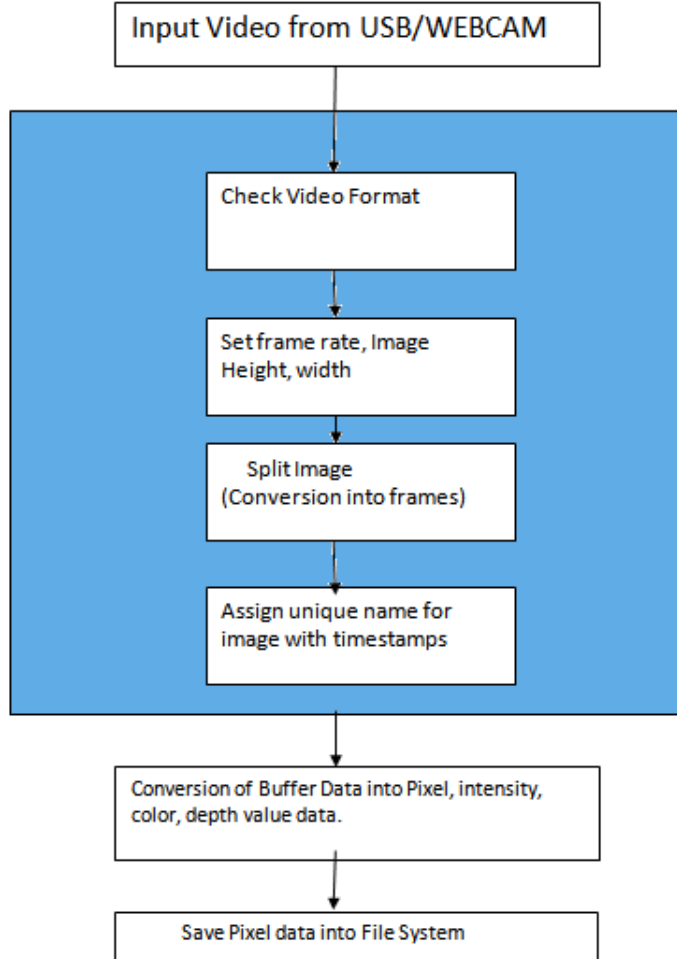
Automatically segment a continuous video sequence 'V' into 'N' segments. $V = \{v1, v2, v3, \dots, vn, \dots, vN\}$ each segment contains a single behavior pattern. A video segment Vn consists of Tn image frames. $Vn = [In1, In2, In3, \dots, InTn]$ video can be simply sliced into overlapping segments with a fixed time duration.

Video Analyzer:

The Surveillance operation is done with the help of a camera that records with JMF-Java Media Framework and this helps in storing the video in .MPEG format used by the system. The input video is splitted into sequence of frames into .jpeg images with a unique name comprising the timestamp of that particular image and its size, Various paramaters that can be set by the user are

- (i) Encoding format
- (ii) video size and frame rate.

Series of steps in segmentation of Video File



3.1.2 Event Based Behavior Representation

1. Identify the foreground and background pixel of a frame.
2. Background model stores the values of a particular pixel which corresponds to background colors.
3. Pixel change history (PCH) is represented for a pixel. Similar foreground pixels are grouped to form a blob.
4. A behavior pattern is represented as a sequence of various events.

3.2 Behavior Profiling

Various steps involved in Behavior Profiling are :

- Build training data set. Group training behavior patterns upon which a

model for normal behavior can be built.

- Must cluster(group) the behavior patterns into various clusters.
- Affinity Matrix is used for clustering and represents the affinity between two behavior patterns.
- Eigen Decomposition Dimension of affinity matrix is reduced using eigen decomposition. The eigen vectors of normalized affinity matrix are used for data clustering.
- Model Selection Select the k eigen vectors which has highest eigen values. These eigen vectors corresponds to the frequently occurring events.

3.2.1 Training Phase

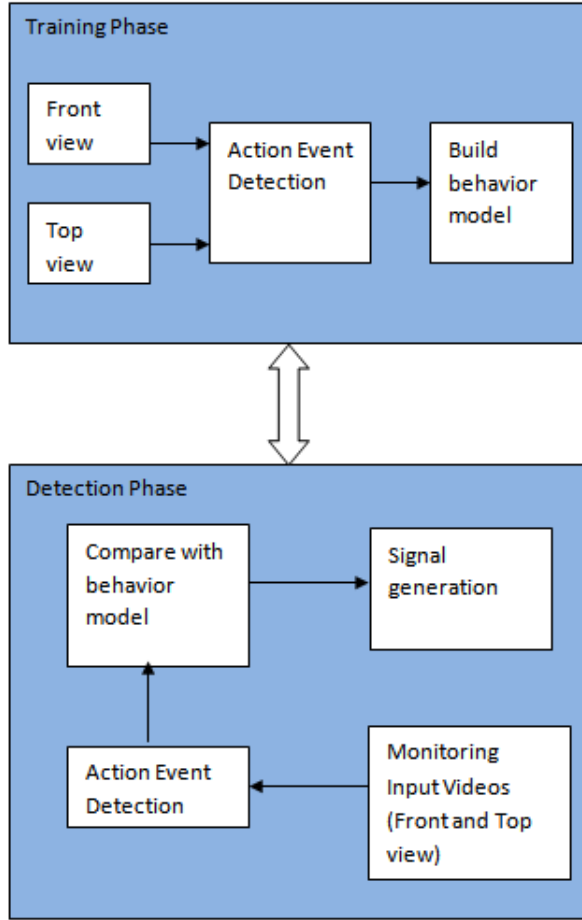
This training module would initially train the system with new input Behavior of various Authenticated people and store the modeling into System as a new system. The system is not aware of the list of valid and invalid activities. After this step the new activity has been recorded into the System and next time when the system detects the same activity by the user there will be no mismatch with the system entry and it will be ascertained as valid person. Main objective of this phase is to recognize and differentiate between the authenticated valid person and the unauthenticated invalid person. Training is a crucial Phase for the success of the automation of surveillance camera monitoring as only proper training ensures valid and authenticated behavior pattern are stored in the system which is used in the Testing Phase later.

- Training Phase shall be initiated only by the controller under his close supervision for proper recording of various trusted events.
- Each blob with an average PCH value greater than a threshold is defined as a scene event
- Detected scene event is represented as a seven dimensional(7D) feature vector. $f=[x,y,w,h,Rf,MpX,MpY]$

Where (x,y) is the centroid of the blob. (w,h) is the blob dimension.

Rf is the filling ratio of foregrounding pixels within the bounding box associated with the blob.

(MpX,MpY) are a pair of first moments of the blob represented by PCH.



3.3 Anomaly Detection

Testing Phase

After the training phase is completed the system is ready to be deployed for checking the human action recognition under the view change and when it has detected when a person enters a room, video of him is captured and stored (both side view and the top view) then it is given to the training module here the video is checked if it is a normal behavior splited image is taken, whenever the action is recognized blob images are saved, and the frame counts are taken . In case, the anomaly is detected the red color will be displayed. The abnormal behavior is achieved by tracking the videos and blob frames and checking each frame data values that are generated during the video analyzer phase.

System Response to Invalid Action:

When the system encounters an abnormal behavior by tracking the video and the blob frames and checking each frame values with that of system entry,

an alert is sent to the Admin and he determines whether the particular person whose action has been not present in the system has to be updated into trusted set of actions or not.

4 References

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