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DETECTION OF SUSPICIOUS ACTIVITIES IN PUBLIC AREAS USING STAGED MATCHING TECHNIQUE

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Abstract—Detection of suspicious activities of human crowd scenes in public areas using video surveillance has attracted an increasing level of care. A framework that contains video data receives from a fixed color camera installed at a particular location. The noise from video frames is removed by using Gaussian filtering with color and gamma correction. The foreground blob is extracted from video frames using background subtraction method. The framework obtains 3-D object level information by detecting and tracking persons and luggage in the scene. Using staged matching technique, the detection of merging and splitting in occlusion. The actions of public are identified and clustered in a crowd scene by using an adjacency matrix-based clustering and support vector machine. The features are extracted from the frames using Gabor algorithm and histogram of gradient. To predict the behaviors of human crowd based on the model and then detect if any anomalies of human crowd present in the scene that is relevant to security in public areas. The experimental results are to demonstrate the outstanding performance by using extensive dataset, fast object tracking, low computational complexity and effective in detecting anomalous events for uncontrolled environment of surveillance videos.

Keywords—Crowd behavior, suspicious activities, anomalous events, adjacent matrix-based clustering, support vector machine.

I. INTRODUCTION

The activities of human crowd behavior using surveillance videos is an vital issue for public security, as it allows detection of both anomalies and abnormal in human crowd behavior being important surveillance applications. Anomalous behavior recognition and video understanding are core components in video surveillance system. The detection of changes in human crowd, behaviors and anomalies in imagery and video is a problem in machine vision. Lately there has been much effort to devise automated real time high accuracy video surveillance systems.

This practice is almost witness in large public areas such as metro station and airport. The purpose of this paper is to identify the activities of behaviors, anomalous events and suspicious behavior of human crowd in public areas. The framework that processes raw video data receives from a fixed color camera at a particular location. The preprocessing stage is done to removes noise from video frame using Gaussian filtering with color correction and gamma correction to improve the quality of the image. The background subtraction method is used to subtract the background in each video frame and extract the foreground objects as blobs. The human crowd areas in video frames are notified after the extraction of foreground blobs. The blobs are extracted in foreground that as automatically finds human crowd and single areas. The clustered objects are obtained by background segmentation into semantic entities in the scenes.

The clustered objects are separated by using adjacent matrix based clustering. The action and various anomalous events are detecting by using support vector machine. After that individual objects are completely modeling and tracking. A complete semantic based recognition that depends on object tracking has been visualized and extensively investigated. These objects are tracked by using particle filtering with color histogram, spatiogram and structural similarity index measure. The color objects are tracked in 2-D and classified as being either animate (people) or inanimate (object) in human crowd scene. These objects are modeled by using spatio spectral algorithm to estimate the pixel color and halt update of occlusion stage. The objects are matching with blob by comparing of color histogram and histogram intersection with threshold. The matched object and blobs are move to feature calculation.

The occlusion of unmatched blob and objects are separated by using staged matching technique potential occlusion method to detect merges and splits. The unmatched blobs are processes into new object and recover the objects. The feature calculation is based on the histogram of gradient and gabor algorithm to form in the order of historical sequence by using recorded dataset and local features of human crowd scenes

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public areas. The features of individual human behaviors are calculated by using threshold and velocity to create a historical record. The features of crowd behavior are calculated by using Gabor algorithm and histogram of gradient. The classification is based on feature record to analyses the activities of human behavior in crowd scenes by using adjacent matrix based clustering and support vector machine. The detection of suspicious behaviors based on object direction and inter-object motion features. The activities of human crowd behavior have been selected to demonstrate the capabilities. These types of human crowd behavior and individual behaviors are relevant to most commonly encountered in public areas. These are related to public areas such issues as merging, splitting, walking and running in human crowd scene.

II. RELATED WORKS

The behavior recognition is depends on object tracking in 2-D, segment and classify. The behaviors are defined and detected by continuously check the feature records. The individual recognitions are adaptability and robustness with human operators but varied in crowd density [1].

Visual surveillance in dynamic areas for humans has wide spectrum of application, human identification, crowd statistics and congestion analysis detection of anomalous behaviors and interactive surveillance using multiple cameras. The framework includes modeling of environments, detection of motion, and classification of moving objects as tracking, recognizing and identifying the behaviors and data fusion for classification [2].

The video surveillance technique has increase the safety and security in public areas to enable human operators and monitoring activities across large environment. The real time image analysis is used for image transmission, color image analysis, event focusing and model sequence understanding [3].

Advisor is an automated visual surveillance system for metro stations and developed as a part of project advisor. This system is used for tracking people, crowd monitoring and behavior analysis functionalities for the purpose of visual surveillance system in public areas [4].

An abandoned object detection system is presented and evaluated using benchmark datasets. The object is tracking and using double time background subtraction. The tracking of abandoned objects is even under occlusion. The system is robust to variations in lighting conditions and the number of people in the scene. The system is simple and computationally less intensive as it avoids the use of expensive filters while achieving better detection results [6].

Automated analysis of a crowd behavior using video surveillance is used to detect people counting, people tracking and crowd behavior. The crowd behavior is analysis to understand the behaviors and based on holistic using knowledge to detect abnormalities [7].

III. PROPOSED SYSTEM

The proposed system is processing a real time event of video as taken in camera which as located at particular scene in public areas and after calibration, the video as convert into video frames. The framework contains that images are 2-D level in video.

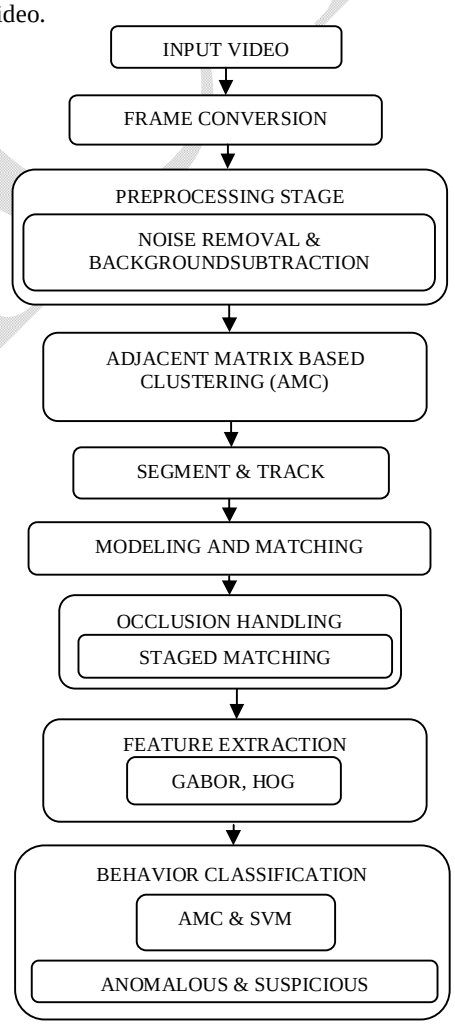

Fig. 1 : System Architecture

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The video frame is attending the preprocessing stage for removing the noise from video to clear understand of objects and extract the foreground blob from background. The foreground blobs are extracted by using conventional background subtraction method. The objects are segment as semantic entities, tracking and classify in both individual and crowd behavior in scene of public areas.

The objects are extracted from the foreground by applying some morphological operations such as open and close. The identified objects are marked. To estimate the optical flows and employ the Lucas – Kanade (LK) algorithm, which has been proved to effectively produce the results of dense flows in video sequences. Then AMC based clustering is done. Features are calculated from the frames. Finally we got the recognized activity of the human crowd.

The segmented semantic entities are processes to identify single or crowd scene in video frames. The objects are detecting and tracking in 2-D level information. The object is modeled to update the list of objects and detect occlusion using staged matching technique. The unmatched blob and objects are processed into object creation and removal. The features are extracted in 3-D level to classify the activities in single and crowd scene.

IV. PREPROCESSING STAGE

4.1 Noise Removal

The noise is removed from video frame using Gaussian filter technique. The quality of the frame is improved for object processing. The Gaussian filtering is used to remove noise from video and minimizing the rise and fall time. The behavior is closely connected to minimum possible group. These properties are important in public areas such as metro station, oscilloscopes and digital telecommunication systems.

The gamma correction is required to compensate for the properties of human vision and to maximize the use of the bits or bandwidth relative to how human perceive light and color. The images are not gamma encoded and allocate too many bits or bandwidth. The highlights are humans cannot differentiate to shadow values and to maintain the same visual quality. The pixel intensity values are represents gamma values to get a clear and improved quality visual.

4.2 Background Subtraction

The blob is a region of the image and extract from video frame using conventional background subtraction and threshold. The background of the video frame is totally subtracted to focus the goal object.

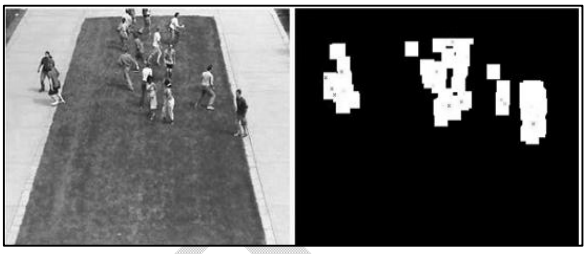

Fig. 2 : Human crowd and blob extraction

Fig. 3 : Single scene and blob extraction

The foreground blob is extracted and segmented as semantic entities using high level motion feature.

4.3 Segment and Tracking

The segmented semantic objects are tracked using particle filter and also used as color histogram, color spatiogram and similarity index measure. The each frame contain list of objects to update current frame object from previous one. The object is tracking in both single and crowd scene.

The particle filter is used for tracking the problem of single and multiple objects. The set of weighted particles are filtered to get posterior distribution of objects. The weighted particles are based on a likelihood score and then propagate these particles to a motion model. The particle filter is used to estimate the posterior distribution and system state objects in video frames.

The color histogram is used to track the color object in video frames. The histogram is graphical representation for fast and easy to compute. The color histogram is to construct as histograms of each individual object. The size of object is easily normalized and different image histograms are compared. The color histogram of object is matched for classification. The normalize histogram is to hold the frequency of color objects. The histograms are matching for color object tracking. The spatial histograms of objects are

identical to histogram and stores spatial information to calculate the mean and covariance of spatial position of all pixels of object in single and crowd scene.

4.4 Modeling and Matching

The spatio spectral algorithm introduces two techniques for modeling the objects such as photometric appearance mechanism and occlusion resolution stage. The photometric appearance mechanism is used to degree estimation of pixel colors. The occlusion resolution stage is processed to halt the update in two or multiple occlude each other. The collisions are not occur in the scene, spectral data is used and collisions are occur in the scene, multi hypothesis data is used to find occluding objects in single and crowd scene.

The blobs and objects are matched with using color histogram and histogram intersection. The histograms are used to match the blobs and objects. The value of color histogram and intersection are compared with threshold value as (0.45 to 0.6) to identify matched and unmatched. The matched blobs and objects are processed to feature extraction. The unmatched blobs and objects are processed to occlusion stage.

4.5 Occlusion Handling

The blobs and objects are not matched then it occur occlusion. The occlusion is handled by potential occlusion and to prevent the contamination of the objects. The occluded objects are merged and spitted using staged matching technique.

The staged matching technique is used for merging and splitting the objects. The objects are matched with using kalman filtering to find not matching and mismatching. The not matching get relax with old frames and mismatching get recover from old frames. The remaining all blobs are considered as new blob to process and grace period also increase with each other. The some objects are wrongly classified as blob that objects also recovery from frames.

4.6 Amc Based Clustering

The clustering with AMC method is used to estimate the optical flow using Lucas canade method. Then assume the pre clustering with the help of optical flow estimation and further cluster using AMC.

AMC Algorithm

/ Initialization /

1. Assume that the number of preliminary clusters is n.

2. For each element of the adjacency matrix

2.1 Set the element GjGk of the adjacency matrix to ‘‘X’’ if DCjCk > d

2.2 Set the element GjGk of the adjacency matrix to ‘‘O’’ if DCjCk 6 d

3. While (not all element of the adjacency matrix are marked as ‘‘X’’)

3.1 If the row elements of a cluster are all ‘‘X’’, the cluster is an isolated one.

3.2 Find a cluster Gj that is of maximum number of ‘‘O’’ in its row elements. If two clusters are of the same maximum number of ‘‘O’’, select the cluster with the minimum cluster number

3.3 Merge the cluster Gj with the clusters that are marked ‘‘O’’ in jth column and then change the mark to ‘‘X’’. Turn the mark of the elements of the merged clusters in their corresponding rows and columns to ‘‘X’’.

V. FEATURE EXTRACTION

The 3-D feature extraction is calculated by using threshold and velocity to find single and two object features. The feature extraction for crowd density is calculated by using gabor algorithm and histogram of gradient. The gabor algorithm is a number of salient visual which includes spatial frequency, orientation and spatial localization. The gabor features are robust to illumination variations and detect amplitude invariant spatial frequencies of pixel gray values. The gabor filters are directly related to gabor wavelets.

The histogram of gradient (HOG) is captured the edge and gradient structures that are indicated as local shape. HOG captures edge or gradient structures that are characteristic of local shape. Histogram of Oriented Gradients (HOG) is an image descriptor based on the image’s gradient orientations. To extract only the mathematical value is from HOG. HOG descriptor is based on dominant edge orientations. Image is divided into cells.

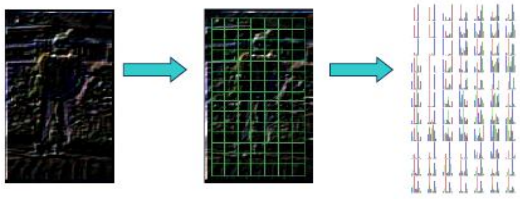

Fig. 4. Image divided into cell

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Fig. 5 : The example of HOG

The feature calculation based on gradient values and cell histograms. The feature calculation is extracted to create historical for crowd scene in public areas.

5.1 Behavior Classification

The classification is compared with records and threshold of both single and\d crowd scenes. The animate or inanimate in public areas are identified by using records. The adjacency matrix based clustering is used to identify the behavior of crowd scene in public areas and set preliminary clusters. The activities of people behavior are recognized by using adjacent matrix. The people in crowd scenes are partitioned into cluster. The element of cluster is isolated to segment and recognize the behaviors in the crowd scene.

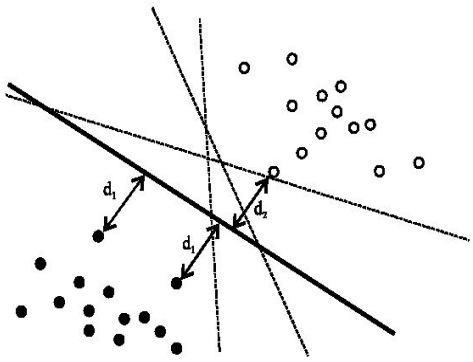

Fig 6 : Margin is d_1 and d_2

The suspicious types of activities are recognized such as abandoned luggage, fighting, and loitering in single and crowd scene. The complexity is less and easy to implement in crowd. The support vector machine is to eliminate or minimize

VI. CONCLUSIONS

The suspicious activities of both single and crowd scenes are detected by using staged matching technique in public areas. The anomalous and abnormal activities are identified by using adjacency matrix-based clustering and support vector machine in human crowd. The future enhancement is to enhance the task of object track, improve all aspect of behavior identification in human crowd of public areas. The support vector machine (SVM) is used to identify the abnormal events in crowd scene and vector that drive or restrain planned. The force is identified to support change and denser of clusters. The finally action of people has to be changed and analysis of abnormal activities.

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