Impact Factor (SJIF): 4.542

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 4, Issue 3, March-2017

A Survey on Abnormality Detection at Public Places

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Abstract *- Human behaviour and activity for recognition or detection of special event has attracted significant research interest in recent years. This paper presents not only updates of previous related surveys, but also a focus on contextual abnormal human behaviour detection especially video surveillance applications at public places. There are many public places where need to keep track of activities and need to put security system for protecting such public places. This paper highlights some of major works which have been done in past.*

Keywords *- Video Surveillance; Computer Vision; Histogram of Gradients (HOG); ADABOOST; HOF (Histogram of Optic Flow).*

I. INTRODUCTION

Now a day we can see that cameras are everywhere, such as campus area, residential area, institutes, banks etc. At such places it is important to maintain security. For that abnormal activity recognition aims to recognize the actions and goals of one or more people from a series of observations on the people's action and the environmental conditions. Machine learning and understanding of abnormal human behaviour is a complex, diverse, and challenging task. Human action detection, motion tracking, scene modelling, and behaviour understanding (human activity recognition and discovery of activity patterns) have received a lot of attention in the computer-vision and machine-learning communities [1]. Abnormal behaviour can be identified as irregular behaviour in comparison to normal ones. The primary technique employed is computer vision. Vision-based activity recognition has found many applications such as human-computer interaction, user interface design, robot learning, and surveillance, among others. The domain of computer vision and artificial intelligence consists of semantic behaviour learning and understanding from observing activities in video (visual) surveillance. Abnormal behaviour is derived from what is expected and normal. There are some different criteria for defining abnormal behaviours such as violation of social norms, statistical rarity, personal distress and maladaptive behaviour.

The research in this area concentrates mainly on the development of methods for analysis of visual data in order to extract and process information about the behaviour of physical objects (e.g., humans) in a scene. In automated visual surveillance systems, reliable detection of suspicious human behaviour is of great practical importance. An automated visual surveillance

(a)

(b)

(c)

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Fig. 1. Examples of abnormal activity (a) Attack on person at ATM installations [6], (b) All are walking while one is cycling [11] and (c) People gathered in a public [12].

system generally requires combination of image processing and artificial intelligence techniques. Detection of suspicious or abnormal human behaviour involves modelling and classification of abnormal human activities with certain rules. Modelling and classification of human activities are not trivial due to the randomness and complex nature of human movement. The idea is to partition the observed human movements into some discrete states and then classify them appropriately. Apparently, partitioning of the observed movements is very application specific and overall hard to predict what will constitute suspicious or abnormal behaviour of human.

II. ALGORITHMS FOR VISION BASED ABNORMAL ACTIVITY DETECTION

Research is already done in the field of vision based abnormal behaviour detection but each and every approach has its own pros and cons. There are many methods such as Markov Model Based, Gaussian mixture model, Hidden Markov Model, Bayesian Model (and classifier), Support Vector Machines, Neural Network, Fuzzy, etc. A semi-supervised adapted Hidden Markov Model (HMM) framework, in which normal event models are first learned from a large amount of training data, and unusual event models are learned by a Bayesian adaption in an unsupervised manner [5]. Hierarchical tree of HOG descriptors coupled with sliding window to identify each individual human part and combination of body parts to handle occlusion cases [10]. Kalman filter is usually used to track objects. This method can predict the velocity and location of an object by a sequence of recorded locations [8]. Histogram of oriented gradients (HOG) features for person and the indirect approach is a map based approach that maps some detected visual features to the number of people [9].

The research in abnormal human activity recognition can be categorized as supervised and unsupervised. In supervised learning, a number of models of normal or abnormal behaviour are built based on the training sample videos [2]. A video sample which does not fit any model is classified as abnormal. In unsupervised learning, there is no need of training video sample. System takes video input and classifies into normal or abnormal. Most of the abnormal behaviour detection system uses unsupervised learning method because we cannot predict human behaviour in their next move. There are many unsupervised methods which are clustering, Neural Network, Expectation-maximization algorithm, Principal Component Analysis, Singular Value Decomposition etc. Mostly of the places people do not follow some rules which are defined for them.

Unusual behaviour of a single person or a group in crowd is termed as abnormal behaviour. Now a day's public security is extremely demanded. There are two approaches for detection of abnormal crowd in public places by Momin et al. in [3]. Dense optic flow method is used to recognize regular motion of the crowd. There are abnormal events like sudden fall of a person in a crowd which is an emergency event, an unexpected action of an individual in a crowd is also an abnormal event, and a person running in a crowd can be assumed as abnormal event if all other persons are walking at a particular speed. Firstly, video is sub divided into fixed size non overlapping cuboid. In each cell optic flow vector is calculated and magnitude of optic flow is assigned to each histogram bins and they represent spatiotemporal graph in low dimensional space. K-mean algorithm is used to model regular behaviour of crowd. They use USCD dataset for the abnormality detection.

Vikas et al. in [4] proposed abnormal event detection in ATM installation. If someone enters in the ATM and does transaction and then leaves the ATM is a normal event. Firstly, video is divided into frames. Root of sum square is used to calculate the magnitude of individual pixel intensity in grey level over frames. The selected frame is compressed which reflects the action in a dense representation. Once the matrix is generated from the HOG (Histogram of Gradient), is applied to extract information of the matrix. Histogram of gradients use efficiently describes shape and appearance of local object within an image by distribution of intensity gradients and edge direction. This is how dataset is generated of the training video clips. In this paper author used random forest method for classification. Random forest is trained by some defined rule. Random forest is strong enough to remove noise in training dataset and also very stable model. Author applies this method on three different datasets which are action recognition on indoor surveillance dataset ATM, Action recognition on Caviar dataset and action recognition on HMDB-51 benchmark dataset. They calculated accuracy on basis of parameters like precision, recall and Feature measure. They achieved better accuracy on all three databases.

Abnormal activity detection plays an important role in surveillance, military installations and sports area. For the abnormal activity recognition Manosha et al. in [5] proposed method for detection of abnormality. They used two different descriptors which is motion and appearance feature. First one is silhouettes and optic flow based feature. In this method, first divide video into frames. And extract the silhouettes of characters using the background subtraction and calculate optic flow value of frames. Then concatenate optic flow and histogram silhouette to produce the motion descriptor. Feature extraction is done based on two categories which are local feature and motion descriptor. Local feature is a histogram of the silhouette of the person or objects and calculate optic flow values. The optic flow vector split into horizontal and vertical components and calculate value based on Lucas-Kanade algorithm. Each one is smooth by median filter to reduce the noise. In motion descriptor, it captures the local appearance and local motion of object or person. The frame block descriptor is projected onto data using Principle Component

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Analysis. PCA reduces the dimensions of current block. Another one is dense trajectory based features. The dense trajectory is created and then the trajectory with HOG (Histogram of Gradients), HOF (Histogram of Optic Flow) and MBH (Motion Boundary Histogram) is created. This is the representation of motion and appearance features. For classification SVM (Support Vector Machine) is used. In dense trajectories, dense optic flow is computed and points of subsequent frames are concatenated. HOG captures static appearance features and HOF computes local motion information. HOF focuses on absolute motion and it captures the motion information along with the camera motion. MBH separately computes the horizontal and vertical components of the optic flow. They used two types of dataset which are UMN datasets and other various types of activity databases such as people moving in the wrong direction at airport.

Now a day ATM is widely used to carry out bank transaction. These days' crime is increasing at ATM booth so there is need of developing such security system for prevention of crime. Tripathi et al. in [6] proposed a method to detect abnormal event at ATM. They proposed computer vision technique for normal and abnormal activity recognition. First of all, video is divided into frames. Background subtraction is used to extract the foreground object. After that the MHI (Motion History Image) is computed which is the binary image where pixel intensity is function of the motion in a video sequence. The pixel intensity is linearly ramping value as a function of time, where brighter values represent the more recent motion locations. As an object moves it leaves behind a motion history of its movements. Old motion history of object is eliminated to capture the new motion patterns. When the MHI is created, features need to be extracted from it. Hu moments provide values as an extracted feature from the image. Here MHI is used for recording activity and Hu moments for the purpose of describing that activity. Support Vector Machine is used for activity classification. Specifically, LibSVM is a binary for support vector machines. It involves two steps. First one is training a data set to obtain a model file and another one is using the model file to predict information of a testing dataset. RBF kernel is used for training and testing purpose. They created their own dataset and calculate accuracy over precision and Recall parameters.

In ATM, if someone enters with a scarf wrapped around his/her face at that time occluded face will be detected. To detect this abnormality Xihao et al. in [7] proposed a method. First of all, video divided into frames and background subtraction is applied on that frame. Gaussian model with different parameters is applied on frame for background subtraction and foreground extraction. Histogram of frame is used to detect initial position of head. There are assumptions like the shape of human face is an ellipse with ratio and the ideal binary image of face obtained from foreground extraction is an ellipse. Author proposed ellipse fitting for face with basic parameters like the length of half major axis, the length of half minor axis, centre and the angle with x axis to implement the self-adaptive function and calculate two discrete ellipses. The optimal ellipse is calculated by the ratio of the number of pixels inside the human area to the number of all the pixels on the ellipse. The abnormality is detected by checking whether face is occluded or not. Author employed two classifiers, first one is skin colour detection and second is face template and built ADABOOST to cascade those two classifiers. The skin colour detection consists of three parts which are colour space transformation, skin area searches and ratio of the calculation. Colour space transformation is RGB to YCbCr because illuminations have impact on the skin colour detection. Skin area is searched using the colour transformation. Face template is another method for detection of human face. The template is the bi-dimensional grey-level image used for matching. Face templates like front face, right face, left face and down face are used to determine whether the human face is occluded or not. ADABOOST is used to produce the strong classifier. They have applied this method on some dataset.

III. CONCLUSION

There are many methods for abnormality detection such as Histogram of gradients, Kalman filter, Histogram of optic flow, Spatio temporal and mean shift tracking etc. Spatio temporal features can recognize abnormal activities better than other methods. It is completely based on motion and appearance features. Dense trajectory based feature method performs better than others in crowd. ADABOOST is a strong classifier for classification. It cascades and concatenates different algorithms which make it a strong classifier.

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