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Video Anomaly Detection in Confined Areas

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Abstract

This paper proposes a new supervised algorithm for detecting abnormal events in confined areas like ATM room, server room etc. In the training phase, algorithm learns the motion path and speed of objects in the video. In the testing phase, if any motion happens other than in the learned motion path or the speed of object has large variation from the learned speed then the algorithm alert it as abnormal event. The proposed method process video in groups of frames. The algorithm uses statistical functions to learn the motion path and speed of objects in a video.

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Keywords: Video anomaly detection; Dense sampling; Colour pattern; Gray scale value; Statistical methods

1. Introduction

Nowadays, the popularity of surveillance cameras is increasing. There are security cameras in public places like railway station, airport etc. Private organizations also has security cameras in their premises to deal with security challenges like robbery or terrorist attack. From these security cameras, detecting and alerting abnormal events manually requires a security person solely employed for this purpose. The accuracy of manual monitoring depends on the skill and concentration of that security person. In confined areas like ATM room, server room etc., there are chances of mysterious events like robbery, destroying the machine etc. This paper proposes a new method to detect and alert such abnormal events happening in confined areas without human intervention.

There are many research papers about detecting anomalies in a video. Previous works happened in this area can be generally classified in to two categories, supervised and unsupervised methods. Supervised methods have a training phase [1] and unsupervised methods don't have such an explicit training phase. This paper proposes a new supervised video anomaly detection algorithm with less mathematical computation than existing algorithms. The term abnormal event in this paper is meant by the events that have no similarity with the events that are used for training. If a video that contains a person is walking is used for training then the abnormal events can be the person not walking or runs

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very fast. In this paper, objects in a video is meant by the things or the persons included in the video. If the video is from the camera of an ATM room then the objects are the person who uses the ATM machine and the ATM machine itself. If the video is from the camera near to a gate in car parking area then the objects are the car that passes through the gate and the gate itself. Video event detection is the process of detecting events in a video. Video anomaly detection is the process of detecting abnormal events in a video. Video anomaly detection is a subclass of video event detection.

The aim of this paper is to introduce a new supervised video anomaly detection algorithm for confined areas using the colour pattern of the videos. Our work learns the motion path and speed of objects in the training video by processing the video in ensembles [2]. By analysing the motion path and amount of motion in training video, abnormal events can be detected from the testing videos. At training phase algorithm learns the allowed areas in the video where motion is permitted and maximum and minimum speed of that motion.

2. Related work

Detecting abnormal events in video is an active research area and so many works had done in this area. As discussed earlier, video event detection can be broadly classified into supervised and unsupervised. The method described in this paper follows supervised video event detection.

For video event detection, video is processed in group of frames because an event always spans many frames so processing video frame by frame is meaningless. An unsupervised method of abnormal event detection is described in [2]. A method of dense sampling and spatio-temporal volume construction is described in the work of [2] in which group of frames is taken and is divided into spatio-temporal volumes and collection of such volumes called ensemble is taken for processing. Then the probability of each ensemble to be normal is computed. If an ensemble of the video has large variation in probability than the computed one then that ensemble is marked as abnormal ensemble. Another unsupervised deep learning framework for irregular occasion recognition in complex video scenes is depicted in [9]. They propose Appearance and Motion DeepNet (AMDN) which utilizes deep neural networks to consequently learn feature representations. Anomaly score of each representations is predicted using various one-class Support Vector Machine(SVM) models. This anomaly score is further used for anomaly detection. A framework for detecting abnormal events in crowded scenes is depicted in [10], where common behaviour of a scene is identified by modelling the variations of local spatio-temporal motion patterns. Then the spatial and temporal relationships between this motion patterns is found to characterize the behaviour of the entire sequence and the unusual events are identified as statistical deviations in video sequences of the same scene. Convolution networks can be used to extract good features from video. In [11], they show that 3D convolutional deep networks are good feature learning machines that model appearance and motion simultaneously.

Boiman and Irani [3] describe the problem of detecting anomalies as the problem of creating the new image using spatio-temporal patches extracted from previous images. The patches of training images are stored in the database during training and in the testing phase, if the testing image can be constructed using large contiguous chunks of data from the database, it is considered as normal. The testing image that cannot be created from the database is regarded as abnormal [3]. Figure 1 illustrates the method proposed by Boiman and Irani . A method to detect abnormal events happening inside ATM room is described in the work of [4] in which motion history image (MHI) and Hu moments are used to extract relevant features from video. The dimensionality of the features are reduced by Principle Component Analysis (PCA). Normal and abnormal events are classified using SVM. A supervised video anomaly detection method is described in [13] where motion descriptors are first extracted and quantized into small blocks. Spatio-temporal filters at various scales are applied to found the smooth estimates at each spatio-temporal location for each feature descriptor. Local K-Nearest Neighbors(KNN) distance for each location is computed for training and testing video. These neighbourhood KNN distances are totaled to create a composite score for the test and training video. The melded scores are ranked to determine anomalies.

An anomaly detection system using low-level features are described in [5] where dense motion field and statistics are computed in each frame. Then motion directional PCA technique is used to extract useful principle features in time-span. Finally one-class SVM discriminates the anomaly from normal events. A method to detect abnormal events at three levels considering spatio-temporal context of video objects is proposed in [12]. The three levels namely point anomaly, sequential anomaly and co-occurrence anomaly. Point anomaly is the anomaly caused by the instant behaviour of a single object in the video. Sequential anomaly is the anomaly caused by two or more instantaneous