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Video Surveillance of Abnormal Trajectory analysis and Event Detection

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Abstract

This paper proposes combination of the abnormal behaviour detection and group behaviour analysis in images of videos. The existing approaches employ trajectory based or pixel based methodologies. Unlike these methodologies, in this paper a joint channel that uses the output of object trajectory analysis and pixel based analysis for abnormal behaviour inference is presented. Through this approach it is able to detect abnormal behaviours related to speed and direction of object trajectories, as well as complex behaviours related to finer motion of each individual or group of people. By experimentation of this approach on three different datasets it is shown that this approach is able to detect abnormal group behaviour, human interface which is also observed in Things speak cloud and the results are tabulated in the form of a graph and in numerical data representation.

INTRODUCTION

The video surveillance is an important topic of discussion in recent days for observation and tracking of a particular area, the system which is designed for this action has recording device or IP network which is observed for actions and behaviours for managing and protecting people[1]. The video surveillance is mainly used for intelligence gathering, to prevent crimes, to protect people, group or valuable objects and for investigation of crimes such as robbery, kidnapping, theft, etc[2]. The major problem in video surveillance is the group behaviour analysis anomalous behaviour detection. The topic of interest is Anomalous behaviour detection and it has three main types of detection[3]. The first type is the obvious method of event modelling using supervised techniques, the second type approach developed for precise applications using knowledge based systems and it represents exact abnormal behaviour physically defined by the operator. The third type is the unsupervised method that can detect unusual behaviours. The drawbacks of the above three types are the approaches need trained data set and are used to detect irregular events[6]. The techniques and algorithms that are applied to detect and conclude with the new technique include the Background subtraction, background modelling, adaptive Gaussian mixture model, online expectation maximization algorithms, shadow detection and colour model, Frame differencing, Object and group tracking, trajectory snapping, Zone discovery for detecting the zones of interest. The complex methodologies include Trajectory based anomaly detection, Trajectory filtering, abnormal behaviour detection. The experiments were conducted using the Vanaheim dataset in metro stations, Subway data set where the videos were captured in subway and the Mind's eye data set where the videos were recorded in a university parking lot.

METHODOLOGY & IMPLEMENTATION

Edge Detection

The discontinuity encountered in an image is an edge. The major changes in an image are found for detecting various changes. The image processing technique which is used for finding the outer boundaries of images is called edge detection. The discontinuities if the image is bright or dense are detected in this technique. This technique is mainly used in image fragmentation and data abstraction where it finds its use in artificial intelligence and machine learning. Edge detection involves various mathematical approaches and all the approaches help in detection of digital data points. There are different types of edge detection with respect to each and every domain, finding incoherence in a single dimension is called step edge detection. If the coherence varies with respect to time then it is called as change edge detection[6]. The persistence to detect edges is to capture significant events and essential matters that change accordingly. The essential factor for edge detection is it finds its application in image modelling, processing, analysis, pattern recognition, artificial intelligence, Internet of things, machine learning [7]. There are different types of edge detection methodologies, in search based the first order derivative is computed and the maxima of gradient magnitude are calculated using the gradient direction. In zero crossing the second order derivative is calculated and the noise is reduced.[8]

BLOCK DIAGRAM OF EDGE DETECTION

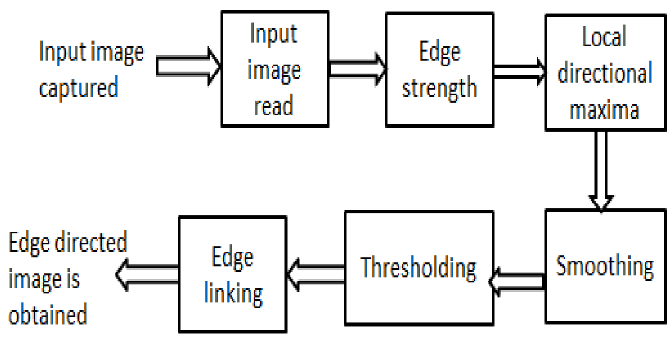

Figure 1. Block diagram of Edge detection

The block diagram consists of six different steps for step detection from the given test input image, which is considered as a baseline for feature detection and extraction as well [9]. The block diagram has different stages for identifying the image where the brightness changes sharply. The input to the block diagram is the input image, the output of the block diagram is the edge detection [10]. The edge strength of the input image is measured in the second stage which is the first order derivative expression it is also called gradient magnitude and it is processed for finding the local directional maxima of the gradient magnitude using the computed results of gradient direction. The noise component is added to the image during the image acquisition stage hence the noise should be reduced and the edges are detected from the test image. The edge detection is applied for colour as well as black and white images [11] It is then passed through the Gaussian filter in the smoothing stage. The next stage is the Thresholding stage in this stage the threshold is applied to decide the edges are present or absent in the test image. If the threshold value is less many edges are detected, if the threshold value is more less edges are detected. If the threshold value is less the edges will be more and the results captured are more vulnerable to noise and the edges are detected for unnecessary features of the test image[12].If the threshold value is high fewer edges are detected and the test image will be prone to fragmented edges which are not desired. The goal is to set the threshold value to the perfect value so that the resulting edges are neither more leading to unnecessary features nor less leading to fragmented edges. The final stage is the linking stage where the connecting of the detected edges by the previous stages takes place [13].

IMPLEMENTATION

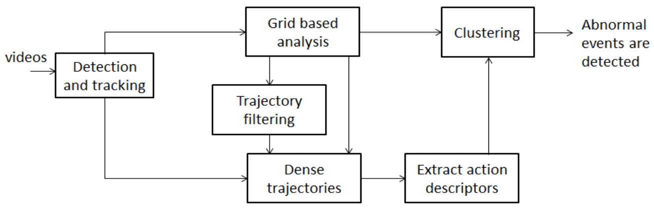

Figure 2. Implementation of the Abnormal Trajectory in Video Surveillance

The implementation consists of the videos given as inputs for video detection and tracking. The trajectories are obtained and the object is divided into to the bounding boxes for grid based analysis [14]. The trajectories are filtered for dense and illuminated trajectories. The resultant of the grid based analysis objects are the trajectories subjected to speed and direction features. The dense trajectories are subjected to dense optical flow and the action descriptors below the threshold are extracted. The resultant of the grid based analysis is subjected to speed and direction features by clustering along with the action descriptors. This is the combined framework of abnormal behaviour analysis.

FLOW CHART

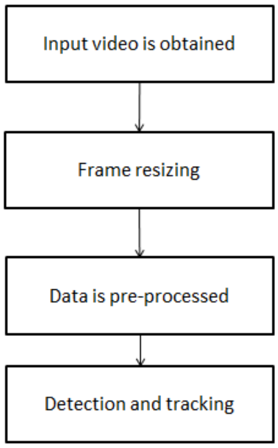

Figure 3. Flow chart of the object detection and tracking

The flowchart shows the steps implemented for the Object detection and tracking the first step is the capturing of input video, the input video captured is subjected to Frame resizing, this data is pre-processed by the certain techniques of Background subtraction and frame differencing which when analysed on an background scene of trapped video and the detection and tracking of the individual or a group of individuals along with cars, bikes are obtained in subways, stations, malls, etc

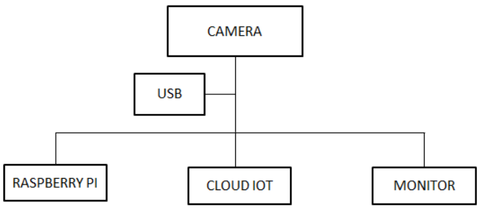

Figure 4. Block diagram of the project hardware and software used.

The input video for the analysis is captured through the camera, the USB is used to send information for the processing of the data files, the hardware used is the Raspberry Pi and it is connected to the Cloud IOT where the image is passed through different stages like Background subtraction, Expectation maximization algorithms are applied. It is subjected to Object and group tracking, Grid based analysis for the action based trajectories which are observed for speed and directional features. The next stage is the Zone discovery for tracking the zones of interest. Trajectory filtering is done and the abnormal event detection is captured[15]. IOT is an emerging technology for automation, analysis along with system integration. It can be said that it is future of technology due to the accuracy it offers as it utilizes the existing technology and offers a better platform. The important feature of IOT is the artificial intelligence, it helps to make life easier by working with collected data with the

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help of algorithms and internet. It can say when the groceries in the kitchen are running low, paying bills, automatic face recognition door opening system, alerting the last day for the day to day products. Sensors, Internet and robotics are the technologies involved for internet of things, as sensors help in converting the passive IOT system to an active system with proper working. Another important aspect is IOT needs internet for its working between the systems. The tasks achieved through IOT is real time tasks and it involves real time content, product and services. The IOT exploits smaller size devices in light weight rather than old traditional bulk devices. The output and the results are observed in the monitor.The experiments are conducted in metro stations, Subways and parking lot in an university and the results are considered in this paper the abnormality detection along with human interface is detected through edge detection and the data is shown in the things speak cloud in the form of graph and numerical data values.

RESULTS

1. No Abnormality: As seen from the figure 5 below there seems to be no abnormality found in the surveillance as the system has not encountered any sort of movement.

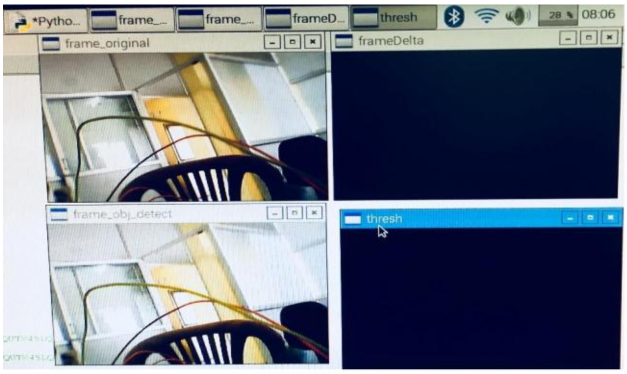

Figure 5. Image of no abnormality detected.

2. Abnormality Detected: As seen from the figure 6 below, a human appears on the screen of surveillance and the system takes note of it.

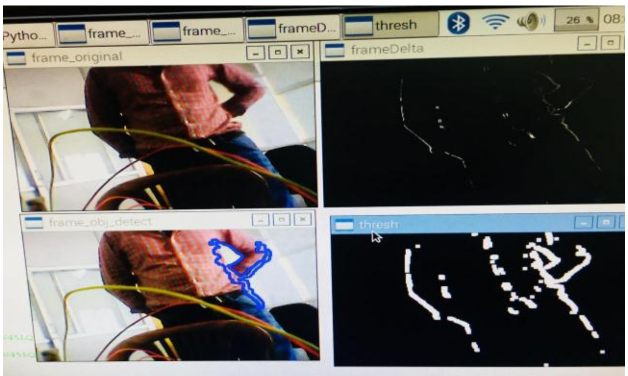

Figure 6. Image of Abnormality Detected

3. Human Interference: The particular environment in which the system is present is normal. The human in the figure 7 below seems to move abnormally as he holds an object in his hands.

Figure 7. Image of Human Interference

Results from Things Speak cloud

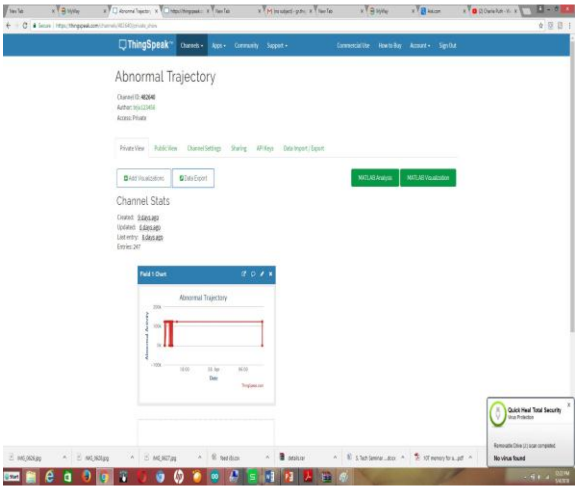

Figure 8. Things Speak Cloud Data Storage When Abnormality Detected (Graph)

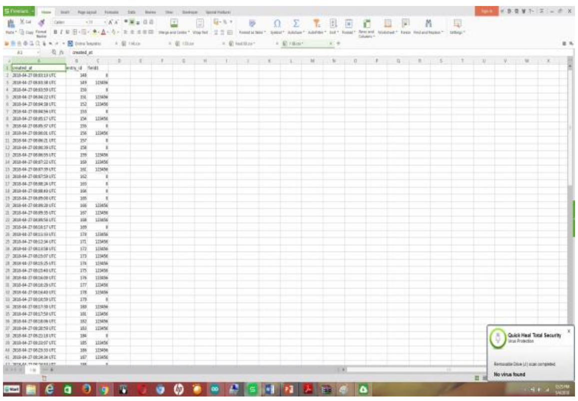

Figure 9. Things Speak cloud Data of Video Stored When Abnormality Detected

CONCLUSION

This paper shows the combined approach designed for abnormal event detection and group behaviour analysis in video surveillance with no prior training or supervision and uses basic trajectory features such as speed and direction for the experimentation completely in this analysis. Along with the existing trajectory-based and pixel-based approaches this method detects various types of events in complex environmental conditions with the camera, USB device and cloud IOT which is the novelty of this paper and the monitor is used as the visual device for visualizing the reports captured and detected. This has been tested with three datasets that include different types of abnormality. Experimentation was conducted in metro stations, subways and university parking lot and the results show that this approach is able to detect abnormal events like the individual or object but failed to detect the cars and group of individuals fighting in parking lot as there was similarily between group of individuals fighting and group of individuals stationary. Although there are some missed events, this approach detected abnormal events with very low number of false alarms when compared to existing approaches. The experimentation was conducted beginning from Background subtraction, background modelling, adaptive Gaussian mixture model, online expectation maximization algorithms, shadow detection and colour model, Frame differencing, Object and group tracking, trajectory snapping, Zone discovery for detecting the zones of interest. The complex methodologies include Trajectory based anomaly detection, Trajectory filtering, abnormal behaviour detection and the approach presented is based on unsupervised learning for future work can be the performance analysis of this approach by also identifying the flaws seen in this approach and rectifying them and presenting the results in online mode along with communication transmission to the respective authorities to overcome the faults in public places to overcome theft, illegal activities, trespassing, transportation without payment, tailgating,etc.

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