Unusual Human Activity Detection Using Machine Learning In Public Places

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Abstract- *In this paper, we propose a novel method for unusual human activity detection in crowded scenes. Specifically, rather than detecting or segmenting humans, we devised an efficient method, called a motion influence map, for representing human activities. The key feature of the proposed motion influence map is that it effectively reflects the motion characteristics of the movement speed, movement direction, and size of the objects or subjects and their interactions within a frame sequence. Using the proposed motion influence map, we further developed a general framework in which we can detect unusual activities. Over a last decade it has been seen the rapid growth and an extraordinary improvement in real-time video analysis. Video surveillance is a prominent area of research which includes recognition of human activities and categorisation of them into usual (normal), unusual (abnormal) or suspicious activities. Due to exponential increase in crime rate, surveillance systems are being put up in malls, stations, schools, airports etc. Image processing is used to detect the criminal in particular area such as bank, ATM, public places etc.The face recognition using deep learning and image processing is used to detect the criminal in particular area such as bank, atm, public places etc. The object detection showed excellent detection and tracking results on the object trained and can further utilized in specific scenarios to detect, track and respond to the particular targeted objects in the video surveillance. This real time analysis of the ecosystem can yield great results by enabling security, order and utility for any enterprise.*

Keywords- Unusual human activity, detection, Video surveillance, OpenCV, Image processing, Machine learning, Face recognition, CNN, yolo model, object detection.

I. INTRODUCTION

Now a day's human behaviour and activity pattern researches are more important in surveillance. Detection and tracking the object of behaviour is important factor in video surveillance system. If any problem is happening in crowded area based on behaviours of persons then it depends on two types spatial and temporal. Reference [11] Over a last decade it has been seen the rapid growth and an extraordinary improvement in real-time video analysis. Main goal of video analytic is to identify the potential threaten events with less or no human intervention. Video surveillance is a prominent area of research which includes recognition of human activities and categorisation of them into usual (normal), unusual (abnormal) or suspicious activities. Main task is to locating unusual events in videos by using some surveillance system which can be manual, semi-automatic or fully automatic. Manual surveillance system is fully dependent on human. It required manual labour to analyse behaviour or to make difference between abnormal and normal behaviour. With the increase in the number of anti-social activities that have been taking place, security has been given utmost importance lately. Many organisations have installed CCTVs for constant monitoring of people and their interactions. Since constant monitoring of data by humans to judge if the events are abnormal is a near impossible taskas it requires a workforce and their constant attention. Semi-automatic system required less human intervention while fully automatic are intelligent and smart video surveillance system which doesn't required human intervention to make decision. The other method of intrusion detection is face recognition. The dataset of criminals is created and stored in system, when criminal face is recognised by camera it will create alert message to system and notify about it. Face recognition is done by OpenCV library in python. Internally image processing and deep learning is done in this process of recognition. Because of such advance technique system become more accurate. The dataset of criminals is created and stored in system, when criminal face is recognised by camera it will create alert message to system and notify about it. Face recognition is done by OpenCV library in python. Internally image processing and deep learning is done in this process of recognition. Object detection system is developed to detect hazardous or crime related objects in live camera surveillance. Image processing with the help of OpenCV and yolo model is used to detect objects. If abnormal object detect notification generated at android application for admin.

II. LITERATURE SURVEY

Numerous attempts have been made in this field to automatize video surveillance but each and every approach has its own pros and cons.

1.Modeling Framework, Learning Algorithms and Techniques[9]:

The outputs of prediction and feature engineering are a set of *label times*, historical examples of what we want to predict, and *features*, predictor variables used to train a model to predict the label. The process of modelling means training a machine learning algorithm to predict the labels from the features, tuning it for the business need, and validating it on holdout data.

2.Markov Model Based and Explicit State Duration ESD-HMM [15]:

Hidden Markov Model is used in this research for classification purpose. HMM is designed for modelling time sequential activity. First order left-right HMM classifier was trained for different activities. Four states were selected with 10 symbol output per state. Multiple videos per activity were used for training purpose. Baum Welch algorithm is used for training purpose and given the test sequence maximum likelihood estimation is used for classifying the activity.

On the basis of prior knowledge and human involvement in the learning process, the research in human activity recognition can be categorized as supervised, unsupervised and semi supervised.

A. Supervised Learning: In these types of learning, a number of models of normal or abnormal behaviour are built based on the labelled training samples. Video samples which does not fit any model are classified as abnormal. But this approach is limited to only events that are well defined and would require sufficient training data. However, real world video samples would mostly contain events that are not well defined and such events are rare and hence sufficient training samples are not available. Reference [9][10]

B. Unsupervised Learning: In this type of learning, a number of models of normal or abnormal behaviour are built based on the labelled training samples. Video samples which does not fit any model are classified as abnormal. But this approach is limited to only events that are well defined and would require sufficient training data. However, real world video samples would mostly contain events that are not well defined and such events are rare and hence sufficient training samples are not available. Reference [9][10]

Reference from : Machine Learning in MATLAB - MATLAB & Simulink

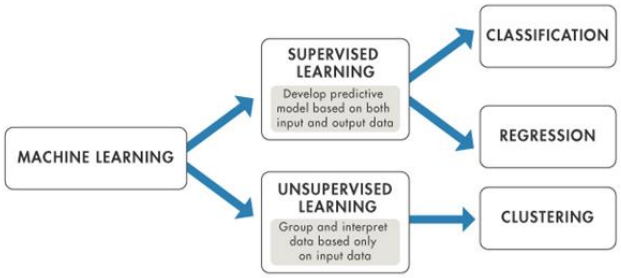

Figure1. Machine Learning Pattern

C. Semi-Supervised Learning:In this type of learning, a number of models of normal or abnormal behaviour are built based on the labelled training samples. Video samples which does not fit any model are classified as abnormal. But this approach is limited to only events that are well defined and would require sufficient training data. However, real world video samples would mostly contain events that are not well defined and such events are rare and hence sufficient training samples are not available. Human group behaviour detection has attracted increasing research interests. From the security perception, the automatic detection of group activities is very important. Some of the issues for group event detection as mentioned in are as follows: 1. Group Event Detection with a Varying Number of Group Members. 2. Group Event Detection with a Hierarchical Activity Structure. 3. Clustering with an Asymmetric Distance Metric. Reference [9] [10]

Unusual activity recognition systems are developed to make surveillance system smarter and more intelligent. Main aim is to detect suspicious or abnormal activities in videos to avoid future mishappening or to give alert whenever any type of mishappening occur. This anomalous activity recognition system classifies normal and abnormal activities of objects.

Most of previous research in anomalous or suspicious activity recognition has focused on behaviour understanding by training the system manually. Some of work shows unsupervised learning methodologies for activity detection. The main aim of this proposed work is to design a framework that can detect unusual activity in surveillance real-time videos. Our proposed work is capable of recognition multiple activities such as (Crowd Behaviour, Running, Walking, Activity of daily living) in single video and also perform detection of movements. If any anomalous activity occurs it give alert to the system which signifies the presence of such activity by labelling it. OpenCV is used for object detection and some problem domain rules are used distinguish different types of behaviour. We considered running, walking and crawling as main activities of our approach. In which motion calculation pattern and direction of object help to identify anomalous event.

Reference from : Frontiers | A Review of Human Activity Recognition Methods

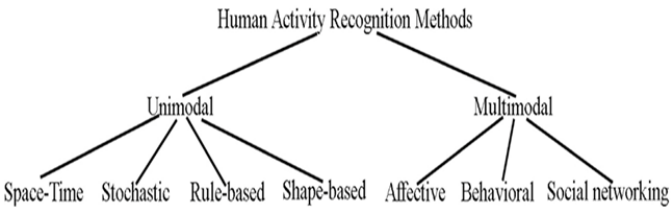

Figure 2. Human activity recognition methods

1.Determining object direction –whether all objects are moving, running or crawling in same direction or not.
2. Analysing motion pattern- whether all objects are performing same activity or some are doing same activity and other are doing other activity.

Reference from:Real time object detection and tracking using deep learning and image processing

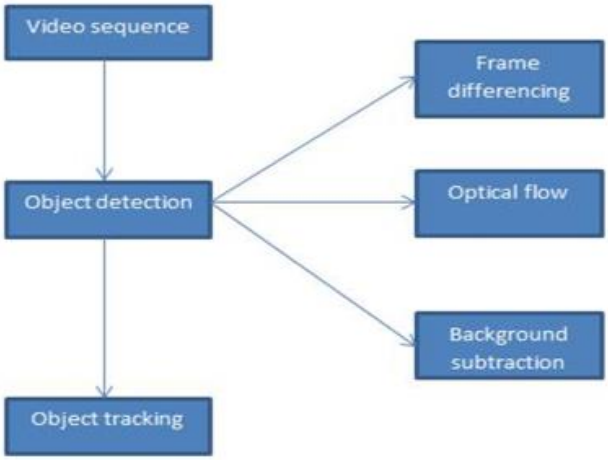

Figure 3. Object detection for intrusion detection

The object detection is implemented for detection and tracking in python environment. Object detection involves detecting region of interest of object from given class of image. Different methods are –Frame differencing, Optical flow, Background subtraction. This is a method of detecting and locating an object which is in motion with the help of a camera. Detection and tracking algorithms are described by extracting the features of image and video for security applications.

III. SYSTEM ARCHITECTURE

Following diagram is our system's architecture diagram:

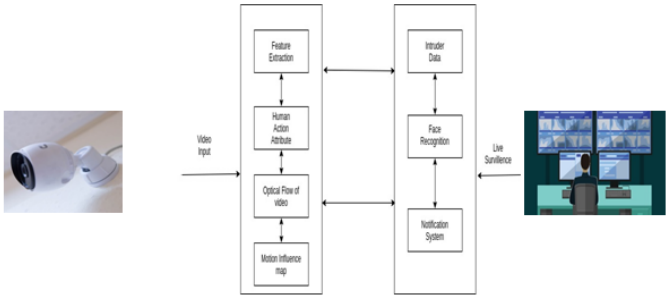

Figure 3. System architecture

The implementation phase involves the actual materialization of the ideas that are expressed in the analysis document and that are developed in the design phase. Implementation should be a perfect mapping of the design document in a suitable programming language in order to achieve the necessary final product. This section discusses about the important decisions regarding selection of the platform, the language used, etc. These decisions are often influenced by several factors such as the real environment in which the system works, speed that is required, the security concerns, other implementation-specific requirements etc. And also, we have brief discussion on the important modules and methods that are present in the project. The code is divided into 5 modules, optflowofblocks, motioninfluencegenerator, createmegablocks, training and testing. Once a frame is detected as unusual, we compare the value of the minimum distance matrix of each mega block with the threshold value. If the value is larger than the threshold, we classify that block as unusual. In this section, a method for representing motion characteristics is described for the detection and localization of unusual activities within a crowded scene. The alert message or notification is generated to system. The training and testing dataset is created for face recognition. First the user data is trained and then using CNN algorithm data is processed. The criminal face data is detected by classifier in system. The alert message or notification is generated to system. To successfully detect surrounding objects, we investigate several existing detection systems that could classify objects and evaluate it at various locations in an image. Deformable Parts Model (DPM) uses root filters that slides detection windows over the entire image. R-CNN uses region proposal methods to generate possible bounding boxes in an image.

IV. WORKING IMPLEMENTATION

A. Optical-Flow of Blocks

Reference [13] Dividing a frame into blocks. After computing the optical flows for every pixel within a frame, we partition the frame into M by N uniform blocks without loss of

generality, where the blocks can be indexed by {B1, B2, . . . , BMN}.A frame of size 240 x 320 divided into 48 blocks where each block is of the size 20 x 20.

B. Calculating Optical-Flow of Each Block

Reference [13] After dividing the frames into blocks, we compute optical-flow of each block by computing the average of optical-flows of all the pixels constituting a block. Here, bi denotes an optical flow of the ith block, J is the number of pixels in a block, and f ji denotes an optical flow of the j th pixel in the ith block. Optical-flow of a block is a vector (r, θ) which represents how much each block has moved and in which direction compared to the corresponding block in the previous frames.

C. Motion Influence Map

Reference [12] The movement direction of a pedestrian within a crowd can be influenced by various factors, such as obstacles along the path, nearby pedestrians, and moving carts. We call this interaction characteristic as the motion influence. We assume that the blocks under influence to which a moving object can affect are determined by two factors:

1) the motion direction
2) the motion speeds.

The faster an object moves, the more neighbouring blocks that are under the influence of the object. Neighbouring blocks have a higher influence than distant blocks.

D. Feature Extraction

In the motion influence map, a block in which an unusual activity occurs, along with its neighbouring blocks, has unique motion influence vectors. Furthermore, since an activity is captured by multiple consecutive frames, we extract a feature vector from a cuboid defined by n × n blocks over the most recent t number of frames.

E. Object Detection

we can detect each and every object in image by the area object in a highlighted rectangular box and identify each and every object and assign its tag to the object. Object detection using YOLO performs better when speed is given preference over accuracy [16] [17].

Reference from :Machine Learning Tutorial - All the Essential Concepts in Single

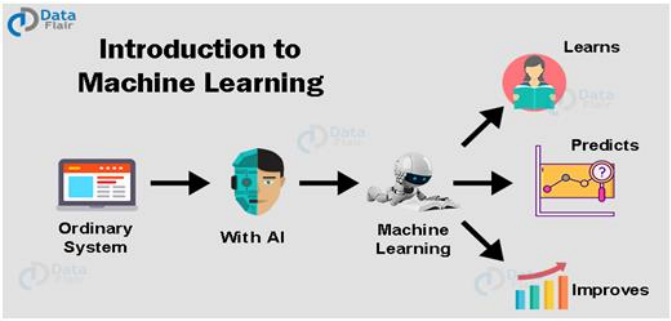

Figure 4.Machine learning interface

V. FUTURE SCOPE

1. Send notification to android application using cloud server.
2. Work on multiple activities related to abnormal behaviour of human being.
3. Improving accuracy to 85% (current system is in between 70-75 %).

VI. CONCLUSION AND RESULT

This paper enlightens all the issue, challenges and issue faced by Human behaviours. There are complex and have much variety in an unconstrained environment. In this paper we did the analysis of detection techniques such as abnormal human behaviour, motion detection. It detects the human body in CCTV Video camera. Result shows that the user is abnormal or not. We achieve real-time video processing of the actual application requirements; therefore, it can be used in practical applications, especially the process of social public.In the proposed work, Rule-based classification has been used to classify activities as normal or abnormal. In this phase classification of activities is done on the basis of problem domain knowledge i.e. rules. This method doesn't require any type of labelled or unlabelled training samples. They require some external knowledge or rules of the domain to create model. Accuracy of this approach is heavily depending on rules. In this method set of rules, pre-defined threshold is defined initially. It includes if-then rules for making decision and these rules decide whether the recognised activity belong to normal activity class or anomalous activity class. When proposed system recognize any anomalous activity it generates alarm to show the presence of anomalous activity. We also use the face recognition for the detection of theft with high accuracy system using OpenCV. The abnormal objects are detect using object detection system which is implemented using yolo model. The hazardous objects are detected and notification send to system admin.

REFERENCES

[1] Neha Gaba, Neelam Barak and Shipra Aggarwal, "Motion Detection, Tracking and Classification for Automated Video Surveillance", IEEE 1 st International Conference on Power Electronics, Intelligent Control and Energy Systems (ICPEICES), pp. 1-5, 2016.

[2] L. Weixin, M. Vijay, and V. Nuno, "Anomaly detection and localization in crowded scenes", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 36, No. 1, pp. 1975-1981, 2014.

[3] G. Gayathri, S. Giriprasad, "Anomaly Detection for Intelligent Video Surveillance: A Survey", pp. 48-50, 2015.

[4] Qiang Li and Weihai Li, "Novel Framework for Anomaly Detection in Video Surveillance Using Multi-Feature Extraction", 9 th International Symposium on Computational Intelligence and Design (ISCID), Vol. 1, pp. 455-459, 2016.

[5] Gaoya Wang, Huiyuan Fu and Yingxin Liu, "Real Time Abnormal Croud Behaviour Detection Based on Adjacent Flow Location Estimation", 4th International Conference on Cloud Computing and Intelligence Systems (CCIS), pp. 476-479, 2016.

[6] Zhang, Y., Lu, H., Zhang, L., Ruan, X., 2016. Combining motion and appearance cues for anomaly detection. Pattern Recognition 51, 443–452.

[7] Ke, S.R., Thuc, H.L.U., Lee, Y.J., Hwang, J.N., Yoo, J.H., Choi, K.H., 2013. A review on video-based human activity recognition. Computers 2, 88–131.

[8] Alvar, M., Torsello, A., Sanchez-Miralles, A., Armingol, J.M., 2014. Abnormal behavior detection using dominant sets. Machine vision and applications 25, 1351–1368.

[9] Google refence : https://machinelearningmastery.com/supervised-and-unsupervised-machine-learning-algorithms/

[10] Mr.Utkalsinha paper on Survey on Human Activity Recognition Techniques For Video Surveillance year [2015]

[11] H.Pournima Suspicious Movement Detection and Tracking of Human Behavior and Object with Fire Detection using A Closed Circuit TV (CCTV) cameras. Year[2017]

[12] Heung-IlSuk;Sung-KeePark;Seong-Whan LeeMotion Influence Map for Unusual Human Activity Detection and Localization in Crowded Scenes. Year[2015]

[13] TareshSingh , Dr B M Singh UNUSUAL EVENT DETECTION AND LOCALIZATION USING OPTICAL FLOW TECHNIQUE year[December 2016]

[14] https://towardsdatascience.com/modeling-teaching-a-machine-learning-algorithm-to-deliver-business-value-ad0205ca4c86

[15] Maheshkumar H. Kolekar, Deba Prasad Dash Hidden Markov Model Based Human Activity Recognition using Shape and Optical Flow Based Features-2016

[16] Justin Lai, Sydney Maples, "Ammunition Detection: Developing a Real-Time Gun Detection Classifier", *Stanford University*, Feb 2017

[17] AkshayMangawati, Mohana, Mohammed Leesan, H. V. Ravish Aradhya, "Object Tracking Algorithms for video surveillance applications" *International conference on communication and signal processing (ICCSP)*, India, 2018, pp. 0676-0680.