Anomaly Detection in Video Events using Deep Learning

S. Jothi Shri, S. Jothilakshmi

Abstract- The anomaly detection system gives a solution to detect anomaly in crowd event video and sets alarm for public safety in mass gatherings. The deep learning technique CNN(Convolution Neural Network) is used to detect anomaly at the initial stage from the input video and set alarm to avoid damages. The proposed system gets frames from input crowd video to detect anomaly activities are namely fighting, running, protesting, and firing. If any one of the anomaly namely fire, fight, protest and run is occurred in a video, that anomaly is detected from specified frames of video. The specified frames are extracted from a video to find the location of the anomaly. The anomaly detection system makes an alarm sound for the specified location of the anomaly. Using a GSM module, the system sends messages to the controller of the fired area. In the existing system, they used sensors and board for finding the fire. Thus, the proposed system detects the anomaly on video using computer vision based deep learning technique. Thus the anomaly detection system provides simple web camera with alarm for public safety with less cost compare with others.

Keywords: Anomaly Detection; Deep Learning Technique; Convolutional Neural Network (CNN).

I. INTRODUCTION

Nowadays the developed countries are improving the security system to defend and manage the public and private crowd. Anomaly detection is a perilous issue in a crowded place. Since Anomaly has made injuries and damages in public area. Sometimes if any anomaly has occurred in a crowded area, the anomaly detection is essential to protect people and the environment without any severe impairment. When the anomaly is perceived, alerting crowd people by an alerting system is very imperative. The alerting system is in different forms such as tones, voice and alert message. After detecting anomaly in the crowd, the alarm system should intimate message or make sound automatically. Particularly in private and public crowded area, the government needs a solution to provide safety now- a- days with low cost. People need security in mass assemblies, public and private events. Thus the Deep Learning based computer vision technique [1],[2],[3],[4] provides a lot of talented methods for private and public safety. And also the technique affords real time video surveillance system for crowd management.

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The proposed system of anomaly detection implements as an essential and requisite phase in the process of assessing the video events (Musical Function, Public Meeting, Bazaar, and Protest). The anomaly detection system will be very cooperative if the enormous detection in event videos on the web can be routinely categorized into predefined classes. Video event holds visual information of anomaly can be detected on a frame basis using Convolution Neural Network (CNN). The proposed system has initialized CNN model and implemented with high resolution video event frames. The huge amount of trained data used for working out the CNN model.

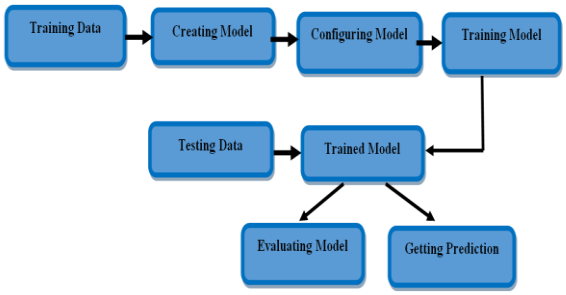

Figure1: Steps convoluted in the anomaly detection system.

The rest of the paper is organized as follows: Section 2 discusses a more brief survey of related works. Section 3 elaborates Convolutional Neural Network approaches used in the proposed system for anomaly detection. The implementation methods and extensive experimental results are discussed in Section 4, where we also briefly introduce the new dataset. Finally, Section 5 concludes the paper.

II. RELATED WORKS

The anomaly detection in real time stream [2] involves in many industrial applications preventative, fraud prevention fault and monitoring. Since the system tackles the challenges presented by real time anomaly detection. The system of ensemble learning framework [3] finds energy waste and consumption due to human faults and reports it to the building manager. If any abnormal events happen it conform it for correction. The system compares the previously recorded faults to reduce it. The system [5] capture video frames for action recognition. Using rank pooling method it finds different appearance, local motions, and deep learning features to find trajectory. It is easiest to implement to compute and effective recognizing a variety of actions The system of fire detection [6] records

fire accident when it occurs by the camera and gives alert to avoid damage. The system can detect fire from any part of the frame by using hardware raspberry pi for giving the alarm to people. In the fast method [7] of fire detection, two methods are proposed namely color model and motion detection. The video acquisition device finds fire frame by frame and color model create color space to find fire pixels.

III. CONVOLUTIONAL NEURAL NETWORK (CNN)

In this work, the concept of basic deep neural network model has been widely adopted for anomaly detection. In general terms, DNN is a mathematical model that studies from a huge amount of categorized video input frames. The essential nerve system in the brain of animals is inspired to create neural network architecture. The Network of CNN [7], [8] is a fully connected multi perceptron. The essential network has Weights and biases known as network neurons. The central processes of the network are dot product and neuron weight. The Convolutional Neural Network contains some crucial layers namely, pooling layers and fully connected layers as represented in Figure 2. The CNN network layers are involving in the main function of the convolutional network. Each neuron in the network layer is connected to a nearby small region of frame data at the same time. Each small region is called known as the receptive field.

IV. ANOMALY DETECTION

In the proposed system, the CNN model detects the anomaly in the video events. The features of anomaly events are extracted from frames of videos. The new dataset of videos collected from you tube. The features are averaged from frames of video as inputs of standard classifier of CNN for anomaly detection. The model CNN is trained by the performance of video recognition using anomaly features from the layers of the model structured with different kernels for anomaly detection. The features representations [9],[10],[11] are resultant by sequentially in a fully connected layer using a feed forward method. The proposed system has a new dataset 4000 images from a variety of anomaly event belonging to four classes namely fire, fighting, running with a fear, accident. Figure 4 shows the anomaly events of the proposed system.

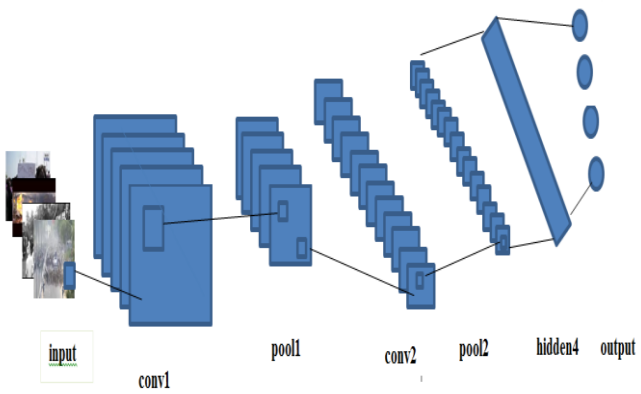

Figure 2: CNN architecture

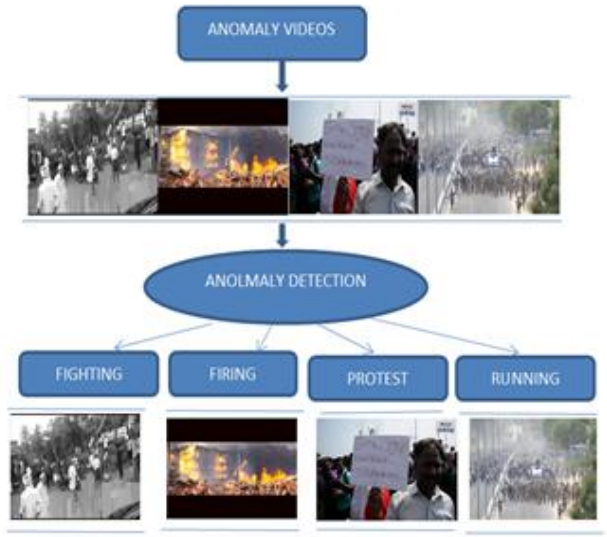

Figure 3: Anomaly detection

The CNN model takes extensive times for training ten thousands of parameters with effectively that parameterize the CNN model. The issue is considered while extending the connectivity of the CNN model architecture, since the model needs process several frames of anomaly video at a time [8],[12]. To restrain this issue, the proposed system shows that an effective method to the computational time of CNN model to change the construction to enclose two distinct models of CNN stream namely baseline and VGG16 that acquires features on the various resolve of frames that only works on the mid portion of the videos. The system implements two CNN models namely baseline and VGG-16 of CNN [5],[13],[14]. The model baseline shows a good performance for anomaly detection. The network architecture takes a different method to combine the time domain for testing input videos. The implementation work improved by connectivity layers in the CNN model and it detects the anomaly events in the testing video. The architecture involves significantly on anomaly detection and accomplishes adequate results. The proposed system achieves learning and representation of the anomaly detection with key frames.

V. EXPERIMENT AND RESULTS

A. Dataset

The anomaly detection system applies Convolutional Neural Network (CNN) to classify 5000 data sets and provides major developments in the experimental result. The CNN Model gives the detection result based on features established by training dataset. A Deep Learning is established on event classifier trained through 4000 frames of videos. First, randomly selected 1000 images per event category are a training set and 1000 images are a validation set for 4 categories. The CNN model accomplished 100%

anomaly detection accuracy on the validation data set after training.

B. *Implementation* work:

The famous recent technique of Deep learning technique is applied in the proposed system by Python 3.5 with necessary packages of Anaconda Library. The OpenCV3.3.0 library also implemented for detecting anomaly video and image files easily. The famous navigator of Jupyter Notebook is very useful for quick and easy compiling the anomaly detection system of python code.

1. Parameters:

In the proposed system, the convolutional network model is constructed with some crucial parameters. The three convolution layers are implemented by the activation function of layers namely, Relu and max pooling layer. In this layer, it has filters. The kernel size is 2×2. The model is trained for four classes. Since there are four neurons in the output layer. The special activation function of this network for classifying the dataset is categorical-cross entropy.

2. Training:

The training phase of this work has 6 epochs and 4000 training samples to implement the model for extracting crucial features and good training. The needed dataset of video frames are stored in a stack array and modified size as 150 x150. The stacked array of the dataset is changed into a batch file and provides data to the CNN model for the training process. The model extracts the features through epochs to detect the anomaly using separate labels (0,1,2,3) for anomalies namely.

3 Testing:

The final phase of testing in the CNN model detecting the anomaly is in different video events is taken and converted these into frames. 100 datasets of video events are stored in a stack array of a batch file and modified size as 150x150. The event video frames are collected from different events namely Sports, Protest, Temple, etc. From each video, 30 frames are collected and stored for a test container. In that, 10 false datasets are collected from other videos and stored in the test container. From the batch file, the testing data is sent to the trained model. The CNN model finds four categories of the anomaly and shows anomaly name for each category correctly.

Table 1: Computation Result of the experiment

Epoch	Baseline Validation	VGG 16 Validation
1	73	82
2	100	90
3	100	96
4	100	82
5	99	88
6	100	92

Table 1 compares the validation results of the CNN baseline and VGG16 model. The system found the variations of each epoch in the model of CNN baseline and VGG 16 Model. The validation resulting variations of CNN Model are shown in Figure 5. The CNN baseline gives 100% validation accuracy.

Figure 4: CNN Evaluation of Accuracy on Training

The main goal of the proposed system is used to acquire in what way to recognize anomaly on various crowd videos. The proposed system has applied CNN baseline and VGG-16 for crowd video anomaly detection. The network model predicts the scenes of the test images at that time. The performance of the CNN baseline and VGG-16 model is evaluated and calculated as true positive, true negative, false positive and false negative in Table 2. Totally 100 true datasets and 30 false datasets are taken to classify the anomaly from crowd video.

Table 2: Performance of Crowd Event Classification System

Model	No. of dataset			
	True Positive images	True Negative images	False Positive images	False Negative images
Baseline Model	100	30	30	0
VGG16 Model	100	30	30	8

The computation result of the anomaly detection system is analysed and quantified as precision, recall, and f1score. The results of CNN baseline and VGG-16 are given in Table

Table 3: Computation Results of the experiment

CNN Model	Precision	Recall	F1score
Baseline Model	100%	100%	100%
VGG16 Model	71%	92%	80%

The anomaly detection system performs test and evaluation. The evaluation results are represented graphically in Figure 6. Test samples are classified into four classes. The test results are compared and showed in different colors. The CNN baseline method gives 100% percentage of accuracy.

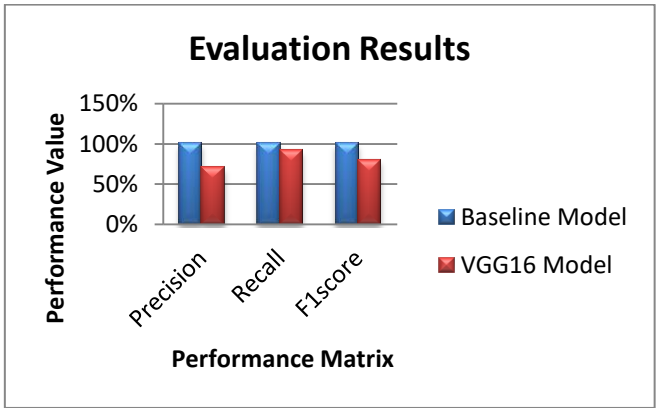

Figure 5: Performance valuation of Results

VI. CONCLUSION

The proposed system detects anomaly using deep learning based techniques. After detecting the anomaly region, automatically the system makes voice alert and alarm in three different ways. The technique works well and finds the fire location. The proposed system can implement in large space crowd area. The overall accuracy is greater than 90%. In future work, the system could be considered for implementing more different types of anomaly.

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