Anomaly Detection In Video Surveillance Over The Crowded Environments For Security Support

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Abstract

Abnormality detection including human unusual movement, unusual traffic, crime sense, group violence, etc. is inspirited by virtual data availability which is obtained from closed circuit television (CCTV). The logic of abnormality existence is made in assumption that most of the virtual data (surveillance data) is not included abnormal events with 100 % probability. The abnormal event is less probable than the normal one hence, appointing of people for surveillance who observe the data for log times is no longer appreciated due to the time and man power wastage. Automatic abnormality detection is proposed in this work using deep learning technology to perform the detection and dispense man power surveillance which ensures good performance is far less expensive budgets. Long short term neural network (LSTM) is used for the same; LSTM performance is compared with the proposed state of the art e.g. Feed Forward Neural Network accompanied with K-nearest neighbour particle swarm optimization (KNN-PSO). The proposed state of the art is outperformed in abnormality detection accuracy, the maximum recognition accuracy was 99.18345128 percent.

Keywords: Artificial Neural Network (ANN), Backpropagation, Multilayer perceptron, Classification.

1 INTRODUCTION

Image processing technologies have been developed for many years and have been become vital to human daily routine. Security related applications including data security is also begun new stage because of technology revelation and large extension of internet. Data amounts are dramatically increased after development of new generation mobile communication as users increased and internet with no obstacles e.g. (wires or speed) widely propagated [1].

The existence of strong security is required to protect web data as well as local server's data hence, the research activity on improvement of security applications as well as technologies is increased. The first attempt to protect the web based data is using the passwords protection where authorized users are required to provide their password credential to gain access into that data [2].

With further development of technology, spatially when internet and web application are being developed, passwords become stronger. Passwords become including alphabetical characters as well as special characters where more reliability is implemented so that prediction of passwords become more difficult. With development of technology and software application, a miscellaneous security crash attempts were seen. The passwords can always be predicted and penetrated so; it was required to develop another personal verification technology to tackle this problem [1].

Detection of abnormality in crowds (peoples gathering), traffic and environments have made big advancement in the recent year due to the popularity of virtual data. Such data can provide more features and information than that in numerical raw data and features. Thus, using of virtual data for unusual event detection in public human gathering is implemented in this paper.

Literature has shown large number of attempts to rely on biometrical features for abnormality detection, those features includes facial recognition which is very much popular in this regard. System relies on cameras or CCTV in order to scan the clipped (segmented) video in order to detect the crime since or in other word to verify the presence of illegitimate candidates in the gatherings or in the public places. Other than that, several approaches were found in order to detect

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particular abnormality, the following challenges of the existing recognition technologies can be listed:

a) Taking the voice recognition as example, technology is set to identify the gathering abnormality using the voice sense. It can be also applied to verify particular voice amongst many of voices, the most recent application is to identify the presence of illegitimate candidates by detection of their voice. Speaker identification might consider as one of outstanding technology of personal verification, speaker cannot be recognized in case of changing in his/her voice due to any reason such as cold effects or problem in the vocal cords [3, 4].

b) Face recognition is impacted by the age of candidate, by growing in age, face features will begin to fade off and change so, updating of dataset and retraining of the entire model is required.

c) The straight forward recognition method is recognizing the candidate by his unique PIN number of passwords; however, such technology is suffering from guessing problem as many softwires are capable to predict the password and penetrate the system [5].

d) In normal conditions, face can be occluded with many objects such as hair growing, makeup, etc. these obstacles can largely impact the face recognition system performance and lead to error.

e) Updating of dataset (as growing by age) is practically not easy to do specially when the recognition system is including large number of candidates where each of them in different age group and hence changing of dataset might be required in daily basis which increase the cost and time [6,7,8].

2 DATABASE DESCRIPTION

The context of image processing gained a lot of attention in the recent time; however, the project of this domain is very keen on data available. Data is important to accomplish the results in such projects and hence, data are available in two ways either open source data which made by particular researcher and published in datasets banks (respiratory) or data might be collected from the society by calling a candidate to participate the research process.

However, utmost, researchers are preferring using published dataset which make the research process more feasible instead of making the data which takes a lot of efforts and time. In other word, if the application demands particular data, then data is to be gathered by calling field candidates to participate in the research and provide their data.

In this project, object data was required and hence, the most reliable dataset of this regard is UMN database that consisting of eleven video clips about ESCAPE event which stands for abnormality sense. Each video clip is having both normal sense and abnormal sense, the normal sense is incorporated at the beginning of each video while the abnormal sense is incorporated at the end of each video. Figure 1 is demonstrating the database video contains which depicts the normal and abnormal senses in the database.

Figure 1: A sample of UMN image database.

3 PROCESSING CHALLENGES

In order to use the above data efficiently, preprocessing is performed in initial stage in order to prepare the data for the next training and testing process. The following steps are made in the stage of the preprocessing:

1> Frames extraction: this is called framing which involves segregating the videos into several shoots called as

clips. Program is made in Matlab in order to snapshot each video in duration of TWO seconds. However, entire video can be divided into (X groups/images) with duration of TWO seconds.

2> Each image is then processed individually in order to correct the visibility of it and to enhance the pixel information (this is detailed in the next section).

3> Dividing the images into two groups using the labels information (i.e. normal and abnormal images). In order to do that efficiently, K-nearest neighbour is being used.

4> In order to mitigate the payload on the classifiers, two measures are made:

a. Data elimination: which is performed for the unnecessary data in the normal senses which is removed in order to reduce the processing time (training time).

b. Conversion of colored version of the images into grayscale image, this can be performed in order to reduce the load on the training model.

4 DEEP LEARNING MODEL

As soon as object images are cropped and regions of interest are also detected from the object (abnormality object) image, the identification using the image information is to executed using advance deep learning methods. In this study, Feed Forward Neural network is implemented to predict the abnormality in image depending on the information of Region of interest. The feed forward neural network is made for efficiently predicting the abnormal event by learning through the features of the each image. All the object s features are to be referred from the regions of interest, feed forward neural network model will then use this data during learning stage. This method is called supervised learning where the features information as well as the target (image labels data) are both used during the learning stage. Feed forward neural network of the configuration mentioned in Table 1 are established using the Matlab.

Table 1: Configuration parameters of the feed forward neural network.

Parameter	Description
Number of epochs	100
Total nodes per layer	Input layer: thirty
	Hidden layer: ten
	Output layer: one
Total layers	Three
Mean square error (target)	1 e-200
Algorithm of training	Levenberg–Marquardt

5 RNN-LSTM

Long short-term memory neural network is a popular type of neural network that depends on a backpropagation training mechanism. LSTM is basically constricted as a recurrent neural network, the prediction of the data in a recurrent neural network is depending on the previous prediction of the same data, for example, prediction of the next word in the speech sequence (sentence) using the recurrent neural network is depending on the prediction of the previous word in the same sequence[9,10,11] (Figure 2).

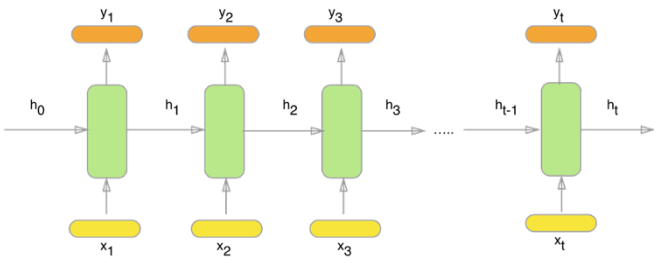

Figure 2: Recurrent neural network structure.

6 RESULTS OVERVIEW

Each algorithm mentioned in the preceding sections are tested properly using the performance metrics e.g. (Accuracy). However, the performance metrics results are given in the Tables 2 The same is graphically demonstrated under each respected Table using the Figure 3.

Table 2: PSO-FFNN accuracy levels for 10 folds.

Fold number	Accuracy
1	98.7748435
2	99.0201415
3	99.1834513
4	98.9929232
5	98.8292949
6	98.9654234
7	98.8565206
8	99.0471005
9	98.7748435
10	99.1287776

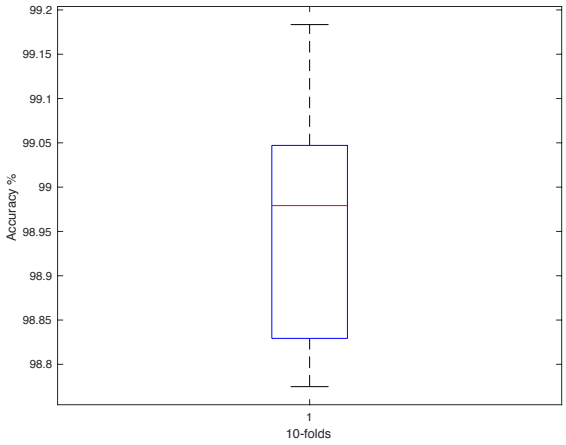

Figure 3: PSO-FFNN accuracy for 10 folds.

Table 3: LSTM VS PSO-FFNN performance comparison.

Algorithm	Accuracy	MAE
PSO-FFNN	99.18345128	0.009526402
LSTM	98.13789	0.129719

7 CONCLUSION

Large number of attempts to rely on biometrical features for abnormality detection, those features includes facial recognition which is very much popular in this regard and all reported with different disadvantage including (age impacted features such as facial recognition where features keep changing due to age or other obstacles such as masks, makeup, sun glasses, etc..). System relies on cameras or CCTV in order to scan the clipped (segmented) video in order to detect the crime since or in other word to verify the presence of illegitimate candidates in the gatherings or in the public places. Other than that, several approaches were found in order to detect particular abnormality. In this work, Automatic abnormality detection is proposed in this work using deep learning technology to perform the detection and dispense man power surveillance which ensures good performance is far less expensive budgets. Long short term neural network (LSTM) is used for the same; LSTM performance is compared with the proposed state of the art e.g. Feed Forward Neural Network accompanied with K-nearest neighbour particle swarm optimization (KNN-PSO). The proposed state of the art is outperformed in abnormality detection accuracy, the maximum recognition accuracy was 99.18345128 percent. The performance of the proposed model is examined using tenfold validation and the above accuracy is the maximum one that produced in the first fold. Mean absolute error (MAE) is calculated for both algorithms and the results of the proposed state of the art are seen with the lowest MAE i.e. 0.009526402.

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