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Facial Identification Using Convolution Neural Network

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Abstract*—Facial identification is a common biometric authentication technique used to analyze the face images and extract useful recognition information from them, which are always called as a feature vector that is used to distinguish the biological attributes. Face identification process begins with extracting the coordinates of features such as width of mouth, width of eyes, pupil, and compare it with a stored face template. The aim of the proposed system is to design an autonomous security system that performs face recognition based surveillance combined with a hardware mechanism to lockup the secured region. HaarCascade algorithm is used to detect and extract the face from an image thereby storing samples in order to train the system. The camera locates, tracks people entering the secured room, recognize the individual and message is passed to the control room which is stored in the log file. Any unauthorized access is logged along with a buzzer alarm to notify the control room followed by locking the exit points of the system. This system focuses on system security using facial identification which can be installed at banking suits.*

Keywords—biometric authentication, facial identification, feature vector, recognition, unauthorized access.

I. INTRODUCTION

A biometric system is a technological and professional system that uses data about a specific human (or other biological organism) to identify that person. Biometric systems depends on specific data about unique biological traits in order to work productively.Biometrics refers to metrics related to human characteristics and features. Biometrics authentication (or realistic authentication) is used in computer science as a form of identification and access control[16].Biometric authentication is mainly based on physiological and behavioral characteristics. The traits such as uniqueness, permanence, measurability, performance and acceptability is checked in an individual for biometric verification [8].

There are various types of biometric authentication like fingerprint identification, Iris scan, retina scan, face recognition, voice analysis etc. Fingerprint identification is most commonly used form of authentication in biometrics. But the disadvantage is that a person's fingerprint's pattern or form may change over time and fingerprint scanner does not take this into consideration.

In current scenario, there are lot of facial identification approachesand algorithm found and developed across the world. Face recognition therefore, has received a great deal of attention in various applications in the field of image processing, computer vision,etc. due to several advantages it has over other biometric method. For example, in public security system, it can identify the identity of the suspect; in the bank and customs control system, it can identify and prove the identity; it also helps users safeguard its own confidential information and experience more secure financial transactions. We show the performance of machine learning for face recognition using partial faces and other manipulations of the face such as rotation and zooming which we use as training and recognition cues.

The proposed system is instructed and trained to only recognize a set of authorized person. HaarCascade system is used to create dataset of authorized person dynamically by identifying and extracting the facial features of face helping the system to recognize the face. All others who enter the guarded area are considered strangers. Neural network is used to train the system in order to identify the stranger by comparing the dataset of all authorized person. When an unauthorized person is detected in secured

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region, the buzzer alarm alerts the control room and the system triggers the hardware which closes all the exit points at the same time.

FIGURE 1: Facial recognition and machine learning in react

II. RELATED WORKS

The algorithms commonly used for face recognition are active contour model and deformable template model . This model is based on the geometrical characteristic, which is first applied to the face recognition problem. Its basic idea is the difference of everyone's face because of difference in components of every face, like the eyes, noses, mouths and jaws are different. Thus the system uses the set of architectures and shapes of these components to be the features for the face recognition problem.
There are five useful methods for face recognition developed in the past study.

The sub-space analysis method is often used in face recognition, which contains two methods such as Principal Component Analysis(PCA) and Linear Discriminant Analysis(LDA).PCA is a method used for identifying of a smaller number of uncorrelated variables known as principal components from a larger set of data. The technique is widely used to emphasize variation and capture strong patterns in a data set. Principal component analysis is considered as a useful statistical method and used in predictive model and exploratory data analysis. Themost classic method is PCA-based Eigen face which was put forward by Turk [4] in 1991. This method take the face images as random variables, which turns the N× N vector of a face image to a N2 × 1 vector, and after minuses the mean data vector, uses the K-L transformation to get a set of orthogonal basis, then after keeps part of the principal components, the reduced dimension vector space of face images is obtained. LDAis aimed at the reparability of the samples. It tries to find a projection direction, which can make the distance of within-class, is small and the distance of between-class is large based on the training samples' projection to that direction.
Based on this model, the features observed treated as a sequence of unobserved states. Different people use different HMM parameters, and for the same person, system uses the model with same parameters to represent the observed sequence of gestures and facial expressions. Samaria first proposed the face model, which used a rectangular window sampling face images from top to bottom.

Another commonly practised method for face recognition is Neural network (NN). Neural network uses its ability of learning and classifying to extract and recognize face features. Lin, etc. uses the positive and negative samples for reinforcing learning to get an ideal probability result. And then increase the learning speed by applying a modular network.

Proposed system was inspired by Ya Wang's Deep learning method[5] for Face Recognition in Real-world.This system automatically generates dataset from real world surveillance videos.This helps in datasetwith various light illuminations with different facial expressions etc.

Another inspiration is Ze Lu's system[6] that performs extremely well.It improves face recognition performance of Convolutional neural network (CNN's) by using non-CNN attributes.The non-CNN features showcase the characteristics from a different perspective of the targeted face images.

In terms of results, Facial identification based on deep neural network works the best.The system uses CNN which is a neural network capable of handling image data.It comprises of three layers, one convolution layer, one pooling layer and one fully connected layer.CNN can learn the variations of data without prior knowledge.This method also helps in identifying a person

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using additional features. The system useslabelled Faces in the Wild (LFW) dataset for its implementation. A dataset of face photographs designed for studying the problem of unconstrained face recognition, known as LFW (Labelled Faces in the Wild) contains more than 12,000 images of faces collected from the web.

III. PROPOSED SYSTEM

3.1 SOFTWARE IMPLEMENTATION

Software system is used to identify the unauthorized person and trigger the hardware to take appropriate action. Now, when system has a clear view that there are limited number of images in some of the classes, the data can be bifurcated further into training, validation and testing datasets inclusive of few basic operations.. For a human to correctly recognize a new face, 50 images are said to be more than enough, whereas for a ideal machine learning, training set is considered a small sample.Software implementation is carried out in following ways:

3.1.1 IMAGE PRE-PROCESSING

The selection of a appropriate dataset plays a very important role in the proposed system. The dataset should consist of valid labelled images in each class in order that the neural network can learn every label. Having no restriction to the number of images per class, better results can be obtained through a wide range of images in the LFW dataset. The main purpose of the LFW dataset is to verify whether two images are of the same individual or not as well as facial verification.

FIGURE 2: Sample of LFW dataset [12]

3.1.2 ELIMINATION OF CLASSES, WHICH CONTAIN LESS IMAGES

Using all of the classes (individuals) would result in a useless model as many of the individuals have only a single image. Limiting the data to only 10 individuals with the most images in the dataset, is considered by the proposed system in order to give the model a chance to learn all the classes resulting in 10 classes with at least 50 images per class. It is indeed considered a feasible idea to avoid using all the images from the LFW dataset. It is quite baffling for a neural network trained on such a dataset where 4096 individuals have only a single images of themselves.

3.2 TRAINING USING INCEPTION MODULE

Considering the latest and updated Inception V3 model which comprises of the parameters learned through training on the Image Net dataset, Google's pre-trained Inception Convolution Neural Network is selected to perform image recognition as building and training the CNN is not needed.

3.2.1 PERFORMANCE MEASURE

3.2.1.1 LOSS FUNCTION

To measure the performance of a classification model whose output has a probability value between 0 and **1**, Cross-entropy loss or log loss is used. It increases if the predicted value diverges form the actual labels[17]. If the actual observation label is 1 and a

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probability of 0.012 is predicted the it is not assumed to be good and may result in high loss value. A perfect model has log loss log 0.
For binary classification, the Cross-entropy can be calculated as follows [number of classes (M) equals to 2] :
–(ylog(p)+(1-y)log(1-p))
For multi-classification [number of classes(M) > 2], a separate loss for class label per observation is carried out followed by summing the results:–∑c= 1Myo,clog(po,c)

3.2.1.2 OPTIMIZATION FUNCTION

It is considered as one of the best optimizer till date. With a learning rate of 0.01, the proposed system uses Adam Optimization function as it is able to measure top-1 accuracy. In order to save the model during training and restore it for later, an initialize is used followed by a saver.

3.3 RESULT

After training the neural network, checking for usefulness is the next step. It can be done by carrying out evaluation against the test set, which is completely unseen by the model. The training will b done by going through the test set one batch at a time. 62% of individuals are correctly identified at the first attempt in this proposed system. Not quite impressive for a machine learning system (although it outperforms most humans), it is successful in displaying the fact that the network has learned during training. Even if not satisfies by the performance so far, various steps are available to improve the neural network which avoids building their own CNN.

IV. EXPERIMENT

We can carry out our experiments on two publicly available datasets namely, the controlled Brazilian FEI and the uncontrolled LFW dataset. Our results will display that individual parts of the face such as the eyes, nose and the cheeks have low recognition rates though the rate of identification goes high when individual parts of the face is in combined form which are presented as probes.

4.1 INCREASING THE NUMBER OF IMAGES BY AUGMENTATION

The system increases the accuracy by expanding the dataset. The two main approaches used here are increasing the amount of training data and augmentation. The system gathers more labelled images to improve the performance of machine learning system.For image, we apply various shifts that do not change the identifiable features in the image.Likewise,itis applied to the face as well other applied transformations include altering the background in the image changing the contrast and lightning, adding noise etc.The altered image is then appended to the original image with the correct label.

4.1.1 SHIFTING AND FLIPPING THE IMAGE

Number of image of a particular class can be increased in two ways i.e. by shifting and flipping the existing images.Image can be shifted in four directions(left,right,up and down).Flipping is done by mapping the image present in left to right to right to left and vice versa.

4.1.2 TRAINING ON AUGMENTED DATA

The new dataset created by augmentation is used again for training the system in order to increase the accuracy of face recognition.

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TABLE 1
COMPARISON BASED ON AUGMENTATION

	No. of images before augmentation	No. of images after Augmentation	Accuracy before augmentation	Accuracy after augmentation
Before Augmentation	30	-	64.8%	-
Shifting	40	210	69.4%	73.1%
Flipping	220	490	73.3%	81.8%
Illumination	450	780	83.7%	86.2%

V. CONCLUSION

In conclusion, it is found that this system identifies a person with improved accuracy,when compared with previous system from [4] and [5] and this can be used for safeguarding banking system in an automated manner.To further improve this system one should train system with more number of samples which will help in improved authentication. The facial expression recognition system presented in this research work contributes a strong face recognition model based on the mapping ofbehavioral characteristics with the physiological biometric characteristics. In future, with improved dataset one can use it for safeguarding army weapon rooms. The use of LFW datasets can be further improved with use of data augmentation.

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