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Evaluation of Different Facial Expression Behavior Recognition Techniques

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Abstract: *Over the past few decades, there has been a lot of activity in the field of behavior recognition using facial expression identification, but it is still difficult because of newly developed varieties of inventions.A number of conventional techniques are applied to a database of photos or videos, including component analysis using eigenfaces, linear discriminant analysis, elastic bunch graph matching using the Fisher face algorithm, hidden marcov model, multilinear subspace learning utilizing tensor representation, etc. but fall short on more difficult datasets with greater picture variance and partially rendered faces. Even if they work efficiently during business hours, they don't show much passion in their work. Therefore, it could constitute a barrier to the organization's expansion. The owner is now faced with the task of determining the true cause of it.. We wish to acknowledge the workers' expressions of behavior. In order to determine the employees' working interests.It would be easier for him to give an improved work environment to the employee and contribute to the expansion of the organization if he learns about the misbehavior and the reasons behind it. In order to uncover and perhaps contribute to further ways for recognizing the expression of human behavior, we will be analyzing a number of behavior identification techniques in this work, such as appearance-based models.*

Keywords: PCA, LDA,EBGM, HMM,HCI, CNN, EBG signals.

I. INTRODUCTION

Recognizing human behavior is important for interpersonal relationships and human-to-human connection. because it's a way to identify someone, their personality, and their difficult-to-extract psychological condition. One of the primary research topics in the scientific domains of computer vision and machine learning is the recognition of human behavior. This research has led to the need for multiple activity detection systems in numerous applications, such as robotics for human behavior characterization, human-computer interaction, and CCTV cameras. [1].

Face Recognition Methods

Face recognition is a demanding as well as fascinating problem that it has attracted all background researchers related to psychology, pattern recognition, neural networks, computer vision, and computer graphics.
The following methods are used to face recognition.
1. Holistic Matching Methods
2. Feature-based (structural) Methods
3. Hybrid Methods

1. Holistic Matching Methods The entire face region is used as an input in this procedure. Eigenfaces, the most popular method for face recognition, Principal Component Analysis, Linear Discriminant Analysis, Independent Component Analysis, and so on are some of the best examples of holistic approaches. To use this approach, take the following actions:
(1) Insert a set of images into a database.

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(2) Then create the eigenfaces. Eigenfaces are made by extracting characteristic features from the faces. Then input images are simplified to line up the eyes and mouths. They are then resized so that they have the same size. Eigenfaces can now be extracted from the image data by using a mathematical tool called Principal Component Analysis (PCA).
(3) After creating Eigen faces images are represented as a vector of weights.
(4) The system is now ready to accept entering queries.
(5) The weight of the incoming unknown image is found and then compared to the weights of those already in the system. If the input image's weight is over a given threshold it is considered to be unidentified. The identification of the input image is done by finding the image in the database whose weights are the closest to the weights of the input image. The image in the database with the closest weight will be returned as a hit to the user of the system .

2. Feature-based (structural) Methods: In this methods local features like eyes, nose and mouth are first of all extracted and their locations and local statistics (geometric and/or appearance) are fed into a structural classifier.

3. Hybrid Methods: Hybrid face recognition systems use a combination of both holistic and feature extraction methods. Generally 3D Images are used in hybrid methods. The 3D system follows the following steps:

Detection - Capturing a face either a scanning a photograph or photographing a person's face in real time.

Position - Determining the location, size and angle of the head.

Measurement - Assigning measurements to each curve of the face to make a template with specific focus on the outside of the eye, the inside of the eye and the angle of the nose.

Representation - Converting the template into a code - a numerical representation of the face and

Matching - Comparing the received data with faces in the existing database. In Case the 3D image is to be compared with an existing 3D image, it needs to have no alterations. Typically, however, photos that are put in 2D, and in that case, the 3D image need a few changes. This is tricky, and is one of the biggest challenges in the field today.

PCA method is used for removing correlated features, to speed up the algorithm, to reduce over fitting, improving visualization but independent variables become less interpretable on using this method and Data standardization is must before PCA.

There are several points with pixel values for the representation of a human face by linear discriminant analysis (LDA) in machine learning. LDA reduces the number of variable features to one that is more manageable and then classifies the reduced and re-projected features during classification [2].

EBG Matching algorithm is also used for the analysis of a face, gestures and other object classes. EBGM is used on the dataset of having *landmarks* like the tip of the nose or the corner of an eye. [3]

Hidden Markov Models are also applied for the recognition of 1D pattern for speech recognition, musical score analysis, and sequencing problems in bioinformatics.as well as 2D problems in the automatic face recognition area also. [4]

All the methods of human recognition system examine the video sequences or still images.On observing the human recognition systems human activities are divided into various categories as gestures,atomic actions,human to object or human to human interaction ,group discussion, behaviour and events.

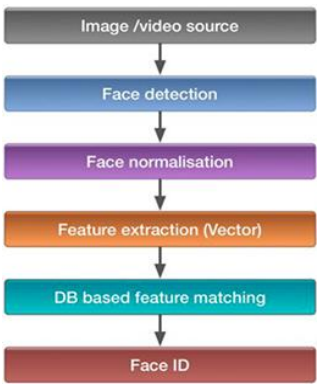

Fig.1: Crucial elements of the typical face recognition system. [5]

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On keen observation of various behaviour recognition techniques we find that there arise two basic question:"What action?" and "Where in the video?" .Both are the question of recognition problem and localization problem. Human basic activity like walking, running etc can be recognized easily but the complex activity like peeling an apple, handshaking, watching TV etc. are difficult to identify easily.

For recognizing complex activity one has to decompose them into simpler activities which are generally easier to recognize. It is a challenge to develop such type of recognition system for identifying human activity with low error due to problems of background clutter, partial occlusion, modification in scale, viewpoint, lighting and appearance etc.

II. RELATED WORK

A deep local global attention convolutional neural network (DLGA CNN) model has been suggested by Lang He et al., 2020 [6] to identify depression using attention mechanism from videos. The AVEC2013 and AVEC2014 depression databases were gathered by them. To learn deep and global re presentation, this suggested model uses weighted spatial pyramid pooling (WSPP) in conjunction with CNN with attention mechanism. To capture the complimentary information, they combined local attention-based (LA-CNN) and global attention-based (GA-CNN) neural networks. A unique framework called DLGA CNN was used to conduct numerous thorough experiments on depression databases.

Albert Mehrabian in 1967 [7] conducted a study by initiating a "3V rule" which is known as 7%-38%-55% rule. According to the rule 7% of the communication is verbal,38 % is vocal and 55% is visual. Through this study it is justified that nonverbal communication has very interesting and important role.

Taking out the features from one face to another is a difficult and sensitive task in order to have a better classification. In 1978 Ekman and Freisen[8] had developed FACS (Facial Action Coding System) in which facial movements are described by Action Units AUs. They brokedown the human face into 46 AUs action units each AU is coded with one or more facial muscles.

C.Shan et al.[9].in 2009 had used effective and efficient method Local Binary Pattern(LBP), statistical feature for recognizing facial expression which was person independent. They formulated Boosted-LBP to draw out the most distinguish LBP features and obtained the best performance through Support Vector Machine classifiers with Boosted-LBP. They also investigated LBP features for low-resolution facial expression recognition, which is a critical problem but not seen often in the existing work.

Mollahosse inietal. [10]proposed deep CNN for FER a cross several available data bases. After extracting the facial landmarks from the data, the images reduced to 48x 48 pixels. Then, they applied the augmentation data technique. The architecture used consist of two convolution-pooling layers, then add two inception styles modules, which containsconvolutionallayerssize1x1,3x3and5x5.Theyshowedtheabilitytousetechniquethenetwork-in-network, which allow increasing local performance due to the convolution layers applied locally, and this technique also made it possible to reduce the over-fitting problem.

Mohammad pouretal.[11] implemented pre-processing techniques. They propose danovel CNN for recognizing AUs of the face. For the network, they used two convolution layers, each followed by a max pooling and ending with two fully connected layers that indicate the numbers of AUs activated.

In 2018, for the disappearance or explosion gradient problem Cai et al.[12]proposed a novel architecture CNN with Sparse Batch normalization SBP.Thepropertyofthisnetworkistousetwoconvolutionlayerssuccessiveatthe beginning, followed by max pooling then SBP, and to reduce the over-fitting problem, the dropout applied in the middle of three fully connected layers. For the facial occlusion problem Li et al. [13] present a new method of CNN, firstly the data introduced into VGG Net network, then they apply the technique of CNN with attention mechanism ACNN. This architecture trained and tested in three large databases FED-RO, RAF-DB and Affect Net.

Agrawal et al.[15] in 2019 studied the FER2013 database for recognizing the rate of influence variation of the CNN parameters. Firstly they defined at 64x64 pixels, then changed the size and number with their type of optimizer chosen(adam, SGD, adadelta) on a simple CNN containing two convolution layers. The first layer perform the max pooling and second layer performed classification using softmax function. Through their study, the researchers established two models of CNN having 65.23% and 65.77% of accuracy. The main characteristics of these model was that they do not contain fully connected layers dropout and the similar filter size is used.

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Fig. 2. Different deep learning methods [14]

Kimetal.[16] proposed a spatio-temporal architect with a combination of CNN and LSTM after studying variation in facialexpressionduringemotionalstate.Atfirsttime,CNNlearnthespatialfeaturesofthefacialexpressionin all the frames of the emotional state followed by an LSTM applied to preserve the whole sequence of these spatial features.

Liang et al.[17], proposed a Deep convolutional BiLSTM architecture. They established two DCNN, in which the first one was designated for spatial features and the other for extracting temporal features in facial expression sequences. These features were put together at level on a vector with 256 dimensions, and for the classification into one of the six basic emotions, researchers used BiLTSM network. They used the Multitask cascade convolutional network for detecting the face at the pre-processing stage, then they used the technique of data augmentation to broaden database (SeeFig.3).

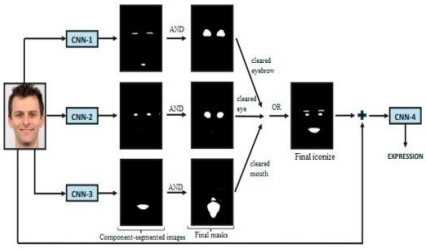

Fig.3 Different deep learning methods proposed by Liang et al. [17]

Shiquin et al.,2021 [18] have studied the tourist emotion relying on self-reports instead of explicit expressed emotion. Their main aim was to compare residents' emotional responses towards tourist facial expression and self reports .Then they interpreted identified discrepancies by investigating the psychological mechanism behind the two expression modes. They found that facial expression conveyed more desires derived emotions like happiness sadness and anger while self reports stressed on stereotype elicited emotions partially disgust. For this they proposed dual process model to interpret the emotional expressed discrepances. Hence they enhanced the theorization of tourism studies on motion. Though the identification of the discrepancies they demonstrated that facial expressions and words can tell different stories.

Rebecca Shankland et al.,2020 [19], examined the potential for mindfulness training to lessen the reliance on past information when identifying emotional facial expressions. They postulated that practicing mindfulness would speed up the top-down processing of low-frequency spatial information based on the predictive brain model. The purpose of the experiment was to compare the performance of an 8-week training course in an emotional stroop task between a waiting control group (n = 30) and a mindfulness group (n = 32).The outcome of this study contributed to our understanding of how mindfulness-based therapies affect attentional control across the board.

A modern critical survey was provided by W.Zhao et al. [20] on still and video-based face recognition research. They categorized already existing recognition techniques with detailed descriptions of each method. They also presented some psychophysical studies, system evaluation, and issues of illumination and pose variation.

Since the face detection is the first step in face recognition technique, hence Erik Hjelmås et al. [21] had presented an exhaustive and condemnatory survey of face detection algorithms. They classified the algorithms on either feature-

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based or image-based and are discussed in terms of their technical approach and performance. They also presented some proposed applications and possible application areas.

R.Chellappa et al. [22] explained the various applications of face recognition technique in commercial and law enforcement sectors through psychophysics community. They gave a review on the techniques for segmentation/location of the face, feature extraction and recognition and also summarized Global transform and feature based methods using statistical, structural and neural classifiers.

For the detection and identification of a persons's face ,M.A.Turk et al. [23] used an approach by treating a 2D recognition problem and then described it by a small set of 2-D charcteristics views. They projected the face images onto a face space that best encodes the variation among known face images. The face space is defined by the 'eigenfaces', which are the eigenvectors of the set of faces. Through this framework it became possible to learn to recognize new faces in a separate manner.

Feng-Ju Chang et al. [24] had presented a deep learning approach (see fig.5) for calculating 3D face emotion coefficients. CNN's contemporary techniques were able to approximate the forms of obscured faces that appeared under unusual in-the-wild viewing circumstances. They demonstrated that a strong, deep, landmark-free method can also be used to estimate facial expressions, which retrained those methods. They used ExpNet CNN to regress a 29D vector of 3D expression coefficients onto the intensities of a face picture. They demonstrated that when compared to expression coefficients acquired with state-of-the-art facial landmark detection algorithms, those produced by ExpNet are superior at differentiating between facial emotions.

Annemarie J. Nanne et al.[26] followed a two-step approach to examine sender presence effects in various levels of tie strength. They found that a happy facial expression significantly increases like intention and brand attitude.

D Y Liliana [27]performed a task of detecting the occurrence of facial Action Units (AUs) as a subpart of Facial Action Coding System (FACS) which represents human emotion. He employed a regularization method called "dropout" in the CNN fully-connected layers to reduce over fitting using the extended Cohn Kanade (CK+) dataset .The system performance gained average accuracy rate of 92.81%. The system has been successfully classified eight basic emotion classes. The result was the mean square error declining as the number of training data increasing. From the experiment it was concluded that the mean square error declines as the training data grows.

III. CONCLUSION

Facial recognition is that area of research in which research may be done continuously without concluding..It keeps scientist and engineers busy always. On keen analysis of several methods we find that CNN method give a fantastic result for recognizing behavior of a human being. If we use the concept of HCI with CNN we may get drastic result. It helps in finding the behavior of an employee as well as students of an organization easily which will give us the actual drawbacks of the organization for improving the best results.

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