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An Intelligent Face Recognition based on a Hybrid Model using PCA, HMM and CNN

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ABSTRACT

This study presents the results of a face recognition system that uses a combination of Convolutional Neural Networks (CNNs), Principal Component Analysis (PCA), and Hidden Markov Models (HMMs). Every one of the outcomes was applied to the ORL database. Forty picture classes, each containing ten photographs, make up this face database. So, for training and testing, a total of 400 photos are used. Three hundred of the four hundred photographs make up the training set, while the other hundred serve as test images for the model. To achieve high recognition accuracy and other goals, this study proposes a hybrid model that combines CNN, PCA, and HMM. The suggested hybrid model has a maximum accuracy of 97%.

Keywords: Face recognition system, KNN, LBPH, neural networks, PCA.

I. INTRODUCTION

In social interactions, the face is the first thing people look at, and it plays a significant part in communicating emotions and identity. Even after being apart for a long time, we can still recognise a large number of faces that we've learnt to recognise throughout our lives. The ability remains strong even when faced with significant changes in visual stimuli caused by ageing, new conditions, and distractions like beards, spectacles, or hairstyles. Facial recognition computational models are intriguing because of the potential theoretical and practical contributions they may make. There are many potential uses for computers with face detection and recognition capabilities, such as in security systems, picture and video processing, identity verification, tagging, and human-computer interaction, among many others. Due of its complexity, multidimensionality, and significant visual Simulink, building a computer model for face identification and recognition is a challenging task. Nowadays, face recognition is widely utilised, particularly on picture storage platforms such as Facebook, Picassa, and PhotoBucket. Sharing photos amongst the individuals in the photo takes on a whole new level with the automatically tagging tool, which also offers others a clue as to who is in the photo. Someone is shown in the picture. An very excellent face identification algorithm that considers human skin tone was researched and applied in our project. Our goal, which we think we have accomplished, was to provide an approach to facial recognition that is quick, reliable, somewhat straightforward, and accurate using algorithms and approaches that are easy to comprehend and use. The instances given in this article are authentic and derived from our immediate environment.

II. FACERECOGNITIONTECHNIQUES

The goal of face recognition is to positively identify a person based on one or more of their facial images. A database of recognised faces is used for this purpose. Identifying a person from a picture of their face is a broad definition of the face recognition issue, which includes several variants beyond the most common ones. By processing and comparing characteristics retrieved from a face with similarly processed faces in a database, computer science tools may accomplish face detection and identification. In the database, a face is either known or unknown depending on whether it can be recognised. If an unfamiliar face shows up more than once in a surveillance system, it is recorded in a database for potential future identification. When it comes to identifying criminals, these procedures are invaluable. In broad strokes, there are two classes of face recognition algorithms distinguished by the kind of facial representation they use: There are two main approaches to face recognition: the first is appearance-based, which applies textural characteristics to the whole face or selected areas, and the second is feature-based, which makes use of geometric elements of the face, such as the eyes, lips, brows, cheeks, etc., and the connections between these features. Currently, the most difficult aspects

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of face recognition include adapting to changes in illumination, both general and specific, as well as in the subject's look. Accuracy still has room for improvement, even under ideal settings.
The use of artificial neural networks, fuzzy logic, and support vector machines has led to the development of several face recognition systems. Deep learning has recently been

recognition of faces. Not only that, but other optimisation methods such as Principal Component Analysis (PCA), Multi linear Principal Component Analysis (MPCA), Linear Discriminant Analysis (LDA), and Hidden Markov Model (HMM) were used to extract the image's valuable attributes. There are benefits to every algorithm. In contrast, principal component analysis (PCA) is the fastest and easiest approach. When dealing with complicated situations like face position, brightness fluctuation, etc., the combined results of MPCA and LDA, called MPCALDA, are superior. There are a number of obstacles that must be overcome before an effective AI-based facial recognition system can be developed, despite the fact that such systems have found use in several real-time applications. The developed face recognition methods may be tested in different lighting situations and with different poses to see how they handle different facial expressions. In addition, the most recent face databases and benchmarks might be used for assessment.

I. PROPOSEDWORK

An acquisition device is used to get a picture for any biometric system. It has been noted that the captured photos are partly obscured in several instances. That element of the biometric characteristic is obscured and consequently inaccessible. This kind of partial occlusion is often used for pictures of faces. Among the many causes, the following are mentioned:
1. The acquisition device is not properly positioned to capture the whole face; hence, just a portion of the face is shown.
2. People accessorise with a wide variety of items, including scarves, sunglasses, and more.
3. The person and the acquisition device may encounter obstacles.
A biometric identification system that relies on facial features need to be able to deal with partially obscured faces in any scenario. The system can make the incorrect authentication choice if it isn't prepared to deal with partial occlusion. Occlusion in such a system necessitates human involvement. As a result, the system is inadequate, and the expense rises substantially when dealing with a large number of instances manually. When it comes to biometric systems that use facial features, partial occlusion is one of the biggest obstacles. A strong method for occluded faces is crucial for practical applications since occlusions in face pictures often reduce recognition performance. The challenge is to design a system that can authenticate, or identify and verify, a person using a partly obscured facial picture.
Image segmentation has primarily relied on thresholding-based approaches that have been self-addressed. One disadvantage of categorization is the frequency with which it's required to isolate a thing from its surroundings. In the event that square determine the accuracy of classification for a multiclass issue by measuring several things in a same scene. In particular, a classification drawback has been the need to distinguish between the defective and healthy regions in order to perform fault detection. One of the main challenges with face identification is that it could be hard to find a class meaningful minimum if the image is too wide. Because of the image's level of detail, there can be several minima; picking the most important one might be challenging.
The ideal position cannot be located due to picture noise. Because of high noise or significantly varying backdrop illumination, there could not be a discernible picture in the distribution.

The suggested approach primarily aims to identify a face regardless of its occlusion. When it comes to facial recognition, occlusion is a major performance killer. Therefore, we provide a solution to the occlusion issue in order to make face recognition systems more effective.

II. PROPOSEDMETHODBASEDONCNN

This study presents a framework for item similarity measurement using characteristics that characterise them in a manner comparable to how people perceive object similarity, based on the convolution neural network (CNN) method. A CNN is a deep learning method. Machine learning algorithms like convolutional neural networks (CNNs) take in images as input, categorise them using learnable weights and biases, and then distinguish between them. CNN is able to function by aromatically extracting picture characteristics. Here are the components of any CNN:
One, the grayscale picture that serves as the input layer Second, the output layer, which may use labels with one or more classes The third layer is a fully connected neural network with hidden layers that include convolutional layers, pooling layers, and rectified linear unit (ReLU) layers.

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It must be emphasised that ANNs, which stand for Artificial Neural Networks, cannot automatically extract visual information. In this case, a mixture of convolution and pooling layers becomes useful. Similarly, a fully connected Neural Network is required for classification since convolution and pooling layers are not capable of doing so. This research presents a CNN-PCA-HMM facial recognition system. Here, the Eigen value categorised picture is chosen using PCA, and then HMM is used to provide many iterations to reduce the MSE to several decimal places.

III. SIMULATIONANDRESULTS

MATLAB software is use for the implementation of presentfacerecognitionproblem.MATLABworksfasterincalculationwhileworking withfaceimage.

A. IntroductionofMATLAB2015a:

Mathematical computing is Matlab's main purpose. When working with images, Matlab's extensive library of preconfigured algorithms comes in handy. Instant testing of an algorithm does not need recompilation. You may work creatively with your data in Matlab's interactive interface, which also helps you keep track of files, variables, etc.

1. MenuGUI tosetofdatasets:

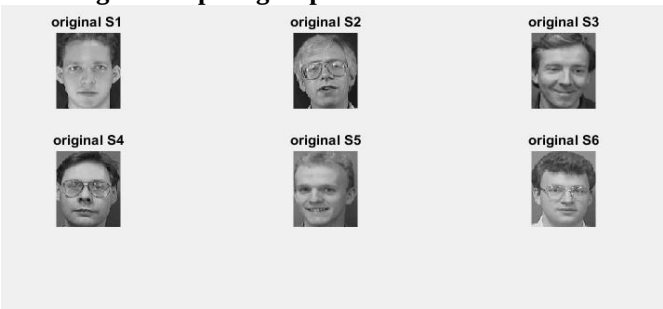
Fig.1MenuGUI toset ofdatasets.

Fig. 1 shown as GUI of our work that is mentioned ofGeneratingdatabase,CalculateRecognitionrate,Detectionimage, Exitetc

2. Generatesagrouptoset:

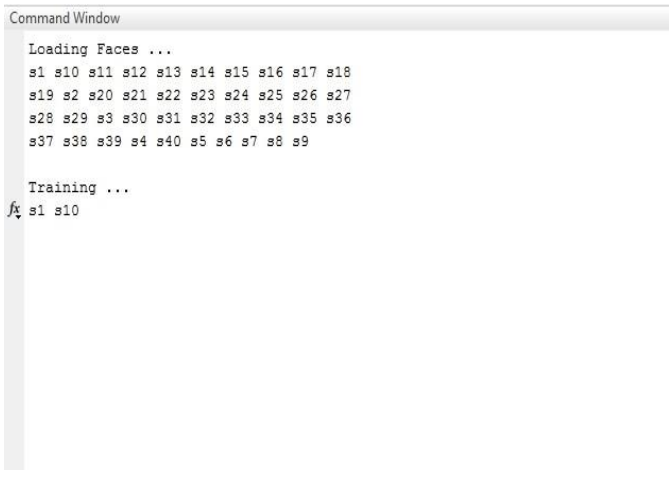
This is shown ORL data sets different class like as s1,s2,….s6.That is first sample image of each data sets class. All imagegroup ofdatabaseshowninbelow:

3. Actualoriginalsamplesagroup:



4. GeneratenewdatasetToolbar:

5. Trainingdataand loadingaface:



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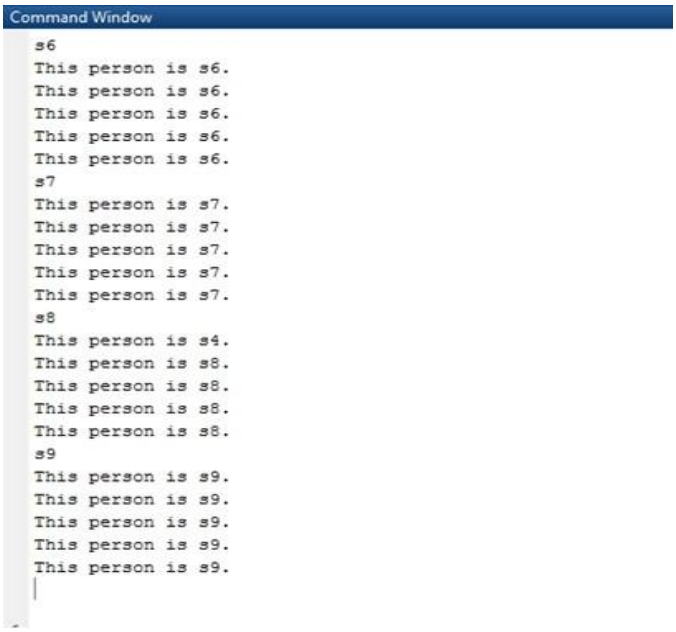
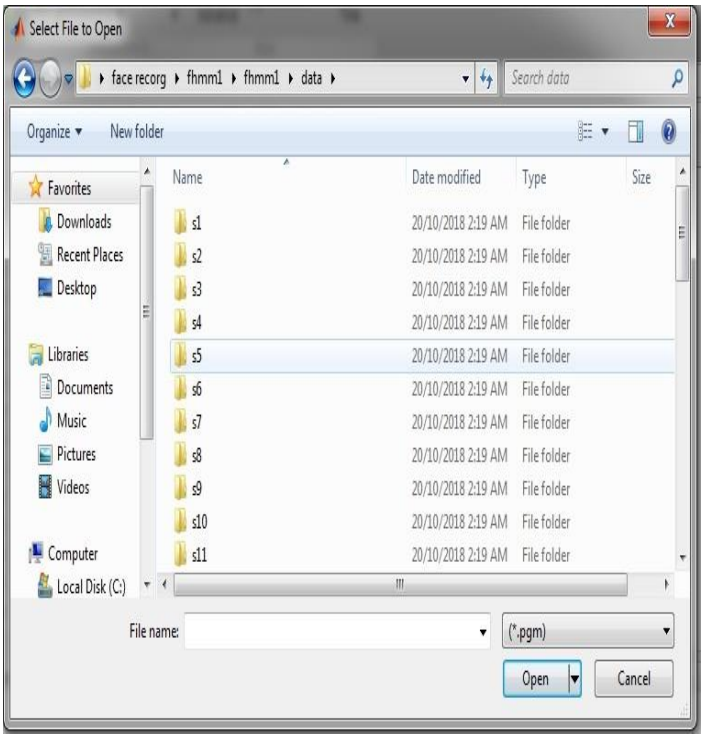


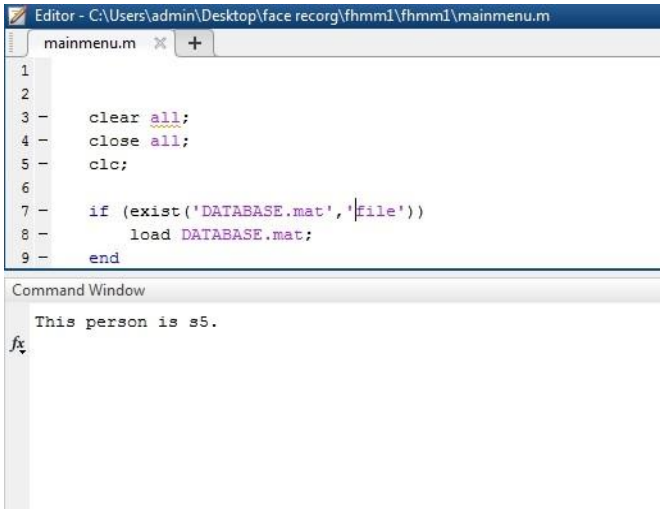
Fig.2Classification ofImagedata.

Fig.2showsClassificationofeachdatasetsclassestoidentifiedofm atchcategoriesasforastodefine .matfile.

7. Chooseforimagegroup:



8. Selectionforimagegroup:



9. Recognizedimagegroup:

Fig.3Outputoforiginalimage.

We employed a CNN, PCA, and HMM hybrid approach in our suggested study. The photos are classified using convolutional neural networks (CNNs) that create distinct levels of threshold for each data sample. After deciding on an Eigen value categorised picture using PCA, many iterations are provided by HMM. Eliminating the mean square error (MSE) to within a few tenths of a percent is what it means. Figure 3 displays the highest possible accuracy of 97% as well as the output of the classification on the original sample.

Section B. Relating the Suggested Outcome to the Original Paper

The suggested approaches give the best accuracy of

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97% in comparison to the prior methodology, as seen in the output picture.

Table1Facerecognitionaccuracy

FaceRecognitionAccuracy,%	
BasePaperResult	**ProposedResult**
96.6%	97%

IV. CONCLUSIONAND FUTURE WORK

A suggested hybrid algorithm for face recognition is based on CNN, PCA, and HMM. Improving facial recognition's classification accuracy is our goal in combining these technologies. Forty picture classes taken from the ORL database make up our database. There are ten distinct perspectives of a person in each picture class. The dimensions of each class's image are 256×256 pixels. A 97% success rate in facial recognition has been achieved. The results demonstrate the efficacy of combining CNN, PCA, and HMM for facial recognition.

PROJECT OUTLINE:

Some have proposed using YouTube Faces as a benchmark for video image recognition. Additionally, academics could take advantage of the recent emergence of emotion detection as a potential study subject. In conclusion, more research is needed to bridge a knowledge gap in face recognition systems, which is preventing them from reaching their full potential. The only thing our suggested system can do is recognise gestures. Research into further VR applications and regression models on manifolds will be the focus of future efforts. The suggested methods can be used to control a new gesture recognition system that uses wireless signals (e.g., Wi-Fi) to enable whole-home sensing and recognition of human gestures, and we can improve our system by adding more gestures to complete different system operations.

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