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Facial Expression Based Face Recognition Using Machine Learning with SVM Kernel: HMM and FDA

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Abstract

Face recognition is that the powerful task from the pictures that is done by a machine that is ready to determine the face of a human being. Automatic face recognition is that the still awfully acknowledged and hard to please stuffed of the image methodology thanks to that the researchers are taking the interest in it. Each face has its own characteristics and specification like size of the eyes position of the nose over the face and in addition the facial expression corresponding to Lips position and motion of lips over the face. The Face recognition has become a very dynamic space of research in recent years in the main thanks to upward security demands and its potential profitable and enforcement applications. The last decade has shown spectacular progress throughout this space, with emphasis on such applications as human-computer interface (HCI), biometric investigation, and content-based secret writing of metaphors and videos, and supervision. Feature based mostly facial expression for face recognition continues to be an extremely hot and hard task and since that we tend to our plan to propose an honest technique for it with a high performance rate towards these methods comparatively.

Index Terms— *Machine Learning, Facial Expression, SVM, FDA and HMM*

INTRODUCTION

There Face recognition may be a one in every of the difficult tasks. Currently on a daily basis it becomes an awfully common space of analysis in recent years in the main because of increasing security demands and its potential business use and enforcement applications. The last decade has shown dramatic progress during this space, with stress on such applications as human-computer interaction (HCI), biometric analysis, content-based writing of pictures and videos, and police investigation. Though a trivial task for the human brain, face recognition has tried to be extraordinarily tough to imitate by artificial means, since though commonalities do exist between faces, they vary significantly in terms older, skin, color and gender. The matter is additionally difficult by differing image qualities, facial expressions, facial furnishings, background, and illumination conditions [1].

In general, automatic face recognition systems are comprised of three steps. Their basic block is depicted in Figure 1. Here we have a bent to stipulate them one by one, the detection would possibly embrace face edge detection, segmentation and localization, significantly obtaining a pre-processed intensity face image from an input scene, either straightforward or untidy, locating its position and segmenting the image out of the background.

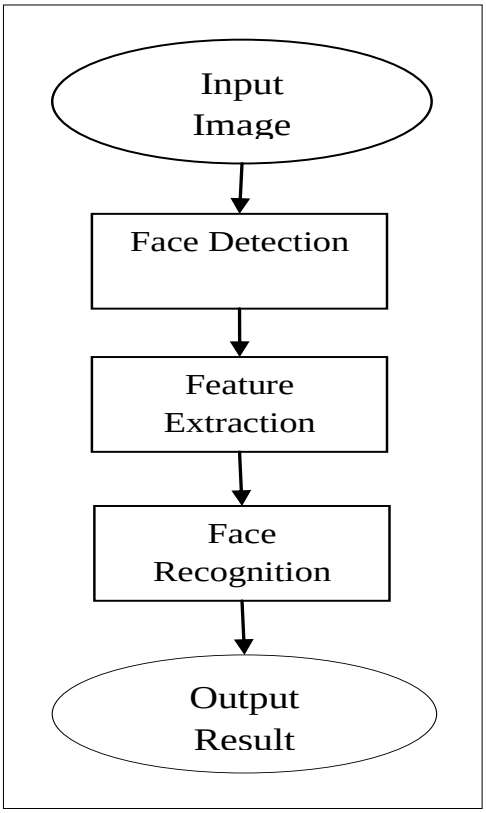

Fig. 1. The basic blocks of a face recognition system

Feature extraction would possibly denote the attainment of the image choices from the image like visual choices, mathematics part options; make other constant options, and algebraic chess, with stress on the algebraic choices, that represent the intrinsic attributes of an image. Face recognition would possibly represent to perform the classification to above image choices in terms of a particular criterion. Segmentation among three steps is taken into consideration to be trivial, straightforward and straightforward for many applications like mug shots, driver's licenses, personal ID card, and passport footage. So this drawback didn't receive plenty of attention. Students have given plenty of interest in addressing completely different problems. However, recently plenty of effort is devoted to the segmentation draw back to the advancement of face recognition systems below advanced background [2].

In face recognition systems, it's clear that the analysis and benchmarking of the algorithms is crucial. Previous work on the analysis provides insights into however the evaluation of recognition algorithms and systems may be performed with efficiency. The foremost vital facts learned in previous evaluations are as follows:

1. Large sets of take a look at pictures are essential for adequate evaluation;
2. The sample ought to be statistically as similar as doable to the photographs that arise within the application being considered;
3. Evaluation ought to be worn out the way that reflects the prices or alternative system demand changes that result from errors in recognition;
4. The system rejects-error behavior ought to be studied, not simply forced recognition;
5. Most helpful types of analysis are that based mostly as closely as doable on a selected application;
6. The accuracy, samples, speed and hardware, and human interface are extraordinarily needed for the face recognition.

Whoever a face recognition system is healthier was measured exploitation two basic ways. The primary one measured identification performance, wherever the first data point is that the share of probes that area unit properly known by the formula. The other measured verification, wherever the performance live is that the equal error rate between likelihood of warning and of correct verification [2].

Current challenges in face recognition are as follows.

- Illumination variations
- Pose variations
- Facial expressions
- Use of cosmetics and accessories, hairstyle changes
- Temporal variations

In our research we will concentrate over the facial expression based challenges in this field.

In lifestyle interactions, humans convey their emotions through facial expression and different suggests that. There are many facial expressions that replicate distinctive psychological activities like

happiness, surprise or anger. Correct recognition of those activities via facial image analysis can play an important role in natural human-computer interfaces, artificial intelligence and mimetic games. In over the work we'll concentrate on the extraction and the choice of the salient options for face expression recognition [3].

Goal

In our research the main objective is to achieve the highest level of face recognition by applying the proposed method. As we know the face recognition is the very difficult task and for that we are try to develop a best system for it which will provide us the more accurate results as compare to existing systems.

Motivation

Human face expression, controlled by a fancy mesh of nerves and muscles to a lower place the face skin, permits individuals to convey their emotions and perform nonverbal communications. Correct recognition of facial expression is important in several fields, as well as human-machine interaction, robotics, laptop game, fictional computing and scientific discipline studies. There are seven basic facial expressions that replicate distinctive psychological activities: anger, hatred, panic, joy, neutral, depression and surprise [4].

In this work we tend to propose a unique approach to acknowledge facial expressions from static pictures, via extraction and choice of salient look options. In our approach, mounted and reconciling nonlinear 2-D filters are combined during a data structure. The mounted filters are accustomed extract primitive options like edges, whereas the reconciling filters are trained to extract a lot of advanced facial expression.

LITERATURE SURVEY

In this section we analyze the past and present of the issues which are related to our area.

Face recognition is a specific and a hard case of object recognition. The difficulty of this problem stems from the fact that in their most common form (i.e., the frontal view) faces appear to be roughly alike and the differences between them are quite subtle. Consequently, frontal face images from a very dense cluster in image space which makes it virtually impossible for traditional pattern recognition techniques to accurately discriminate among them with a high degree of success [5].

Michel Valstar and Maja Pantic present the report on automatic facial expression analysis from face video with two new key features that are essential to achieve our ultimate goal, that is, fully automated fast and robust facial expression analysis from face video. The AU detection results suggest that this method works well compared to similar methods employing manually initialization of facial features [6]

Shuai-Shi Liu, Yan-Tao Tian and Dong Li suggest a survey they present the facial expression recognition research and characteristics which focus on the development in the past five years. A new classification method of feature extraction is proposed in this paper, through which they can realize the development trend of feature extraction methods. Currently, the automatic and multi-scale methods of feature extraction are widely used. With the rapid development of the technology of three-dimensional model, some novel methods are used to feature extraction. Lastly, they demonstrated the state and possible challenges of the technology of FER and provided some valuable advices about the development trend of FER [7].

Jun Ou, Xiao-Bo Bai, Yun Pei, Liang Ma and Wei Liu presents a system according to them results show that the performance of the proposed method achieved excellent average recognition rates, when it is applied to facial expression recognition system. The features for facial representation are selected by PCA. The KNN is used to classify the facial expression characterization. The effectiveness of extraction expression feature is completely dependent on the effectiveness of pre-processing of the raw images [8].

R A Patil, Vineet Sahula and A. S. Mandal present a survey paper author is study about automatic facial expression recognition systems. There are three sub problems while designing automatic facial

expression recognition system, face detection, extraction of the facial expression information, and classification of the expression. A system that performs these operations more accurately and in real time would be crucial to achieve a humanlike interaction between man and machine. This paper reviews the past work done in solving these problems for image sequences. In a system developed by Kotsia and Pitas only geometrical information is required for SVM classifier, no texture information is required. But for tracking they used optical flow computation, where illumination is an important factor. The system cannot be used for colored and non frontal facial images [9].

Kai-Tai Song and Yi-Wen Chen, they proposed an integrated facial expression recognition system with the experimental result based on BU-3DFE database show that a face recognition rate of 98.3% is achieved. The facial expression recognition rate of the proposed integrated method (using personal facial expression classifiers) is 83.8%, an improvement compared with 69.6% of using conventional classifiers [10].

As per Nazil Perveen, Shubhrata Gupta, and Kesari Verma study about the Facial Expression Recognition (FER) system, aid in modeling facial expression space for facial expression recognition by facial characteristic points and Gin index. Facial animation parameters are calculated in order to recognize one of the six basic facial expressions and got the better results from the system. [11].

The Kaimin Yu, Zhiyong Wang, Genliang Guan, Qiuxia Wu, Zheru Chi, and Dagan Feng, they develop a key frame selection method through key point based frame representation. Experimental results on the popular CK facial expression dataset indicate that recognition accuracy achieved with half of the sequence frames is comparable to that of utilizing all the sequence frames. Their key frame selection method can further reduce the number of frames without clearly compromising recognition accuracy [12].

Kai-Tai Song and Shuo-Cheng Chien in this paper they proposed a method to recognize mixture ratio of basic facial expressions and the intensity of the expression. In the basic expressions recognition test, the average recognition rate is 93.3%. In expression intensity experiment, the recognition rate is up to 95.6% when the threshold is 1.5 standard deviation. [13].

According to Hiroki Nomiya, Atsushi Morikuni and Teruhisa Hochin in order to retrieve impressive scenes from lifelog videos, they propose an emotional scene detection method based on facial expression recognition. This approach is fully flexible to detect various facial expressions from lifelog videos because it does not need to predefine the facial expressions. The detection performance of the proposed method is evaluated in terms of detection accuracy and efficiency through the emotional scene detection experiments [14].

As per Huiquan Zhang, Sha Luo and Osamu Yoshie in this paper they propose an approach for facial expression by discovering associations between visual feature and Local Binary Pattern (LBP). Unlike many previous studies, the proposed approach automatically tracks the facial area and segments face into meaningful areas based on description of Local Binary Pattern. And then it accumulates the probabilities throughout the frames from video data to capture the temporal characteristics of facial expressions by analyzing facial expressions. Through the proposed approach, the temporal variation of facial expression can be quantified in individual areas. Thus, the recognition process of facial expression tends to be more comprehensible without sacrificing results of recognition [15].

Varsha Sarawagi and K.V. Arya explain the field of facial expression recognition does have many different applications and its importance. Here in this paper they have emphasizes on color normalization and facial feature extraction which uses LBP (Local Binary Pattern) as an effective feature detection approach, where the existing algorithms have been modified to improve the facial expression recognition accuracy. The recognition accuracy on the Indian database is observed to be 94.7% [16].

PROBLEM DESCRIPTION

Face recognition of people is a challenging problem which has received much attention during recent years due to its many applications in different fields. As Face recognition is one of those challenging problems and up to date, there is no technique that provides a robust solution to all situations. Preliminary work in this area indicates that detecting pro files views of faces is more difficult than detecting frontal views, because they have fewer stable features and because the input window will contain more background pixels.

With the existing problem here, we proposed a new technique for human face recognition. This technique uses an image-based approach towards machine learning by SVM based image classification.

Suggested Solution and Methodology

Support Vector Machines Vector Models (SVMs) introduced in COLT-92 by simply Boser, Guyon & Vapnik. Theoretically effectively enthusiastic algorithm produced via statistical finding out principle with empirically very good effectiveness effective programs in neuro-scientific photograph acknowledgement. Machine finding out is approximately finding out structure via files. Even though category associated with algorithm called "SVM" is able to do much more, in this particular section we target it;

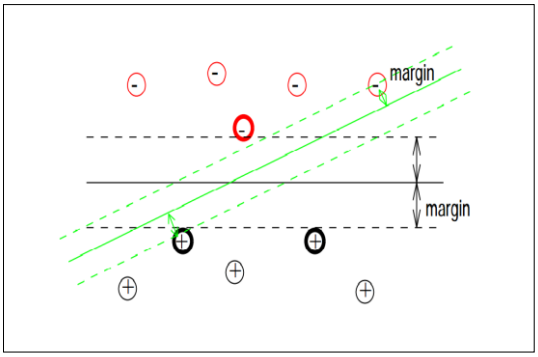

Fig 2: SVM based Classification through hyperplanes [17].

Consequently we should discover our mapping: X → Y, exactly where back x ∈ X will be many item along with y ∈Y is really a category content label.

Let's get the most convenient circumstance: 2-class group. input and output sets X , Y with training set (x1, y1),..., (xk, yk).The generalization is given as previously seen x ∈ X , find a suitable y ∈ Y. i.e., want to learn a classifier:

y = f(x,c), where c are the parameters of the function. Suppose if we are selecting our model from the set of hyper planes in R^n, then we have:

$$f(x, \{w, c\}) = \text{sign}(w \cdot x + c).$$

Approach and Methodology

Support vector machines (SVM) allow us in a platinum typical regarding accurate distinction with brain–computer interfaces (BCI). The option of the most proper classifier for a specific application will depend on many features in addition to decoding accuracy. Right here all of us take a look at the particular implementation connected with hidden Markov models (HMM) and also Fisher Discriminant Analysis (FDA) for face reorganization and also examine strategies to improve their own efficiency.

Hidden Markov models

Hidden Markov models (HMM) define a probability distribution over sequences of hidden states (h_t) and clarification (x_t).

We write the set of hidden states as [P] = [1...m] and set of observations as [Q] = [1....n], where m ≤n.

Let T ∈ R^{mxm} be the state transition probability matrix with

Tij = Pr [h_{t+1}= i; h_t = j], O ∈ R^{nxm} be the observation probability matrix with Oij = Pr [x_t=i; h_t = j]

The conditional independence properties that an HMM satisfies are:

Conditioned on the previous hidden state, the present hidden state is sampled severally of all different events within the history.

Conditioned on the present hidden state, the present observation is sampled severally from all different events within the history.

These conditional independence properties of the HMM imply that T and O absolutely characterize the likelihood distribution of any sequence of states and observations [17].

Fisher's linear discriminant

Fisher's linear discriminant (FDA) is a classification technique that initiatives high-dimensional facts on any range and also does classification with this one-dimensional space. This projection enhances the space between our ways of the 2 instruction even though lessening the particular difference in every class. This kind of describes the particular Fisher qualification, and that is maximized over-all linear projections, m:

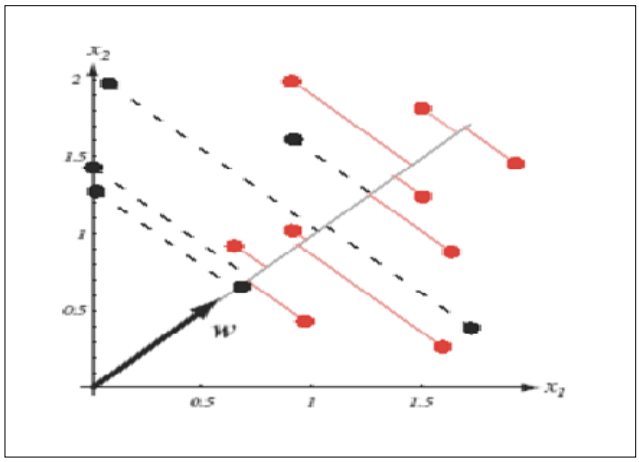

Fig 3: Two Class Problem FDA

Let 2 categories and d-dimensional samples $x_1,\ldots,x_n$
Wherever:
c1= samples come back from the primary category.
c2=samples come back from the second category.

They take into account projection on a line.
Consider the line direction tend by unit vector w.
Scalar $w^t x_i$ is that the distance of projection of xi from the origin so it $w^t x_i$ is that the projection of x_i into a 1 dimensional mathematical space.
So the projection of sample x_i onto a line in direction w is given by $w^t x_i$.
Let m1 and m2 be the means that of categories one and a pair of

$$J(w) = \frac{|m1 - m2|^2}{c1^2 + c2^2}$$

Where *m* represents a mean, c^2 represents a variance, and the subscripts denote the two classes.
Thus Fisher linear discriminant is to project on line within the direction w that maximizes [18].

The subsequent measures we wish to apply and do in order to create top dependent face recognition system through following steps.

Step 1: Apply the training method with Facial Expression based data set.

Step 2: Select the First training function called FDA from the approach. For getting all the expression based and normal face data set to training and testing of model.

Step 3: Repeat Step 2 with training and testing function called HMM from the approach.

Step 4: Now compare the results of both approaches called FDA and HMM with SVM for the results

Step 5: Here we got final results and exit from the system.

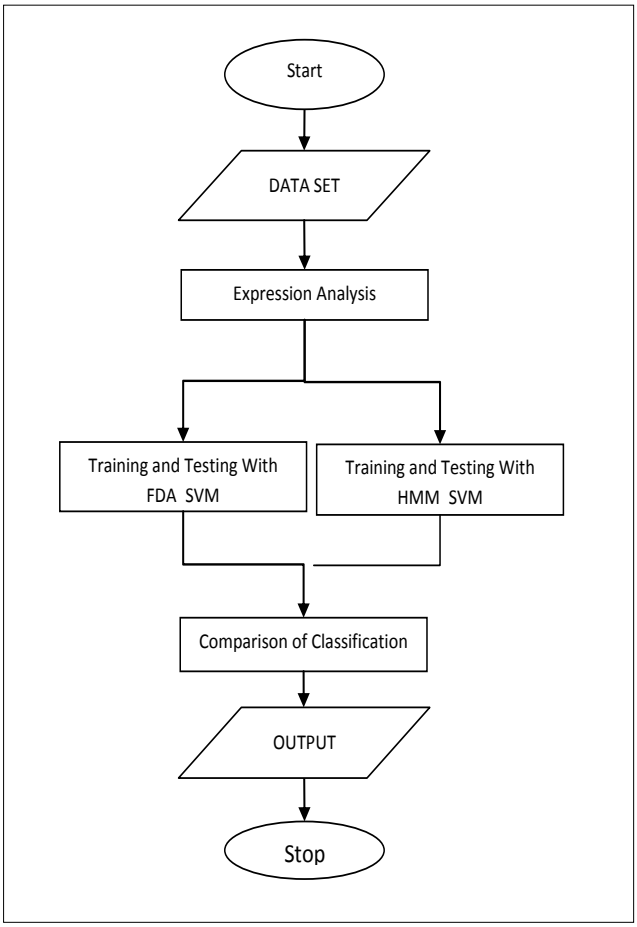

Fig 4: Flow Chart for Classification

ALGORITHM

The above listed steps are work with the following way.

Input:- Select Dtrain and Dtest data set.
//Dtrain is the training data set.
//Dtest is the testing data set.

Output: - *Train and Test with FDA_SVM and HMM_SVM //Training and Testing is gowning on*

if *(Train ==1)*
then do
for (*i*= 1; *i* ≤ *Dtrain*; *i*++) Apply FDA_SVM for traing.
// Fisher's linear discriminant classifier with support vector machine.
end
for (*i*= 1; *i*≤ *Dtrain*; *i* ++) **do** Apply HMM_SVM
// Hidden Markov models classifier with support vector machine.
end
else
do
for (*j*= 1; *j* ≤ *Dtest*; *j* ++) Apply FDA_SVM
// Results with Fisher's linear discriminant classifier with support vector machine.

if *(Test==1)**then*** *Success and Result*
end
for (*j*= 1; *j* ≤ *Dtest*; *j* ++) **do** Apply HMM_SVM .
// Results with Hidden Markov models classifier with support vector machine.
if *(Test==1)**then*** *Success and Result*
end

EXPERIMENTAL AND SIMULATION PROCEDURE

In this section we apply the above explained procedure through flow chart of the measures associated with our simulation method. This is usually found inside figure 4. We apply and tested our method on the well known JAFFE Data Set which is available on the web. The above database have 213 images with 7 facial expressions apart from this the data base have 6 basic facial expressions and one normal expression posed by 10 Japanese female. Each model image has been rated on 6 emotion adjectives by 60 Japanese subjects [4].

Fig 5: JAFFE data set sample

We apply the SVM with FDA and SVM with HMM one by one training the system with of following data set for our experiment purpose for testing our approach for the contribution to our study towards the image processing for this facial expression based face reorganization system

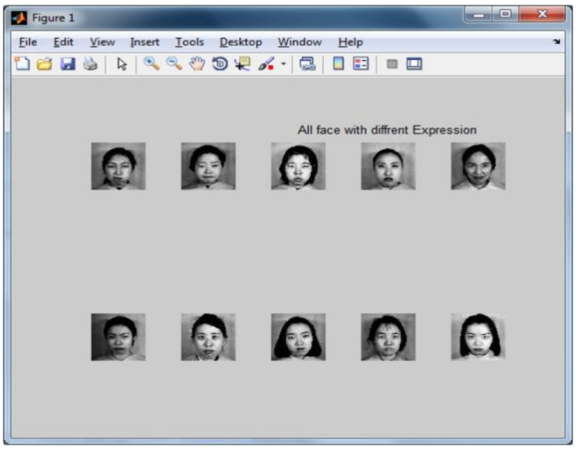

Fig 6: All Facial Expressions

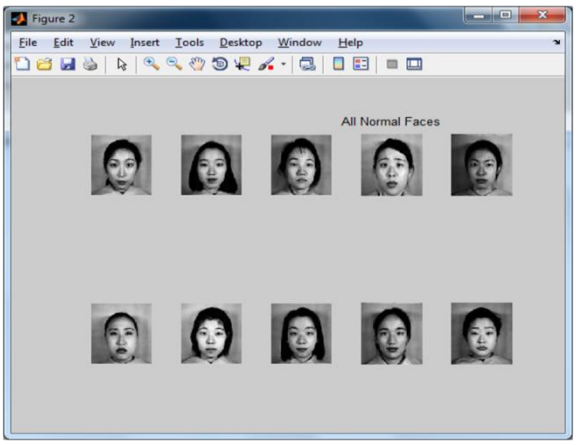

Fig 7: All Normal Faces.

Now using this training data set one by one SVM with FDA kernel is trained and then apply for SVM with HMM kernel to train this system.

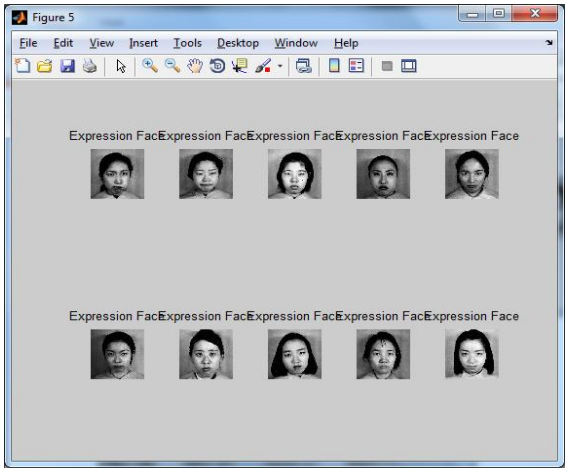

Fig 8: After applying the training**.**

In the next step we will work for the testing part of the system with the testing data set. Now we apply this testing data set step by step to test with SVM with FDA and SVM with HMM kernel to precede further work

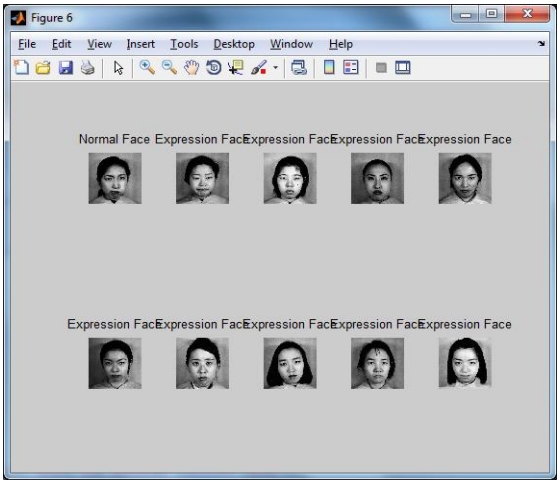

Fig 9: Testing Results.

After successful of this training and testing we got the separate results of both the approaches one by one.

RESULT ANALYSIS

The existing JAFFE data set we use for our experiment purpose and prepare face recognition system and tested it with the sample data set from the existing data set. We got the promising results from the applied method with SVM.

We performed the experiment of this over and calculation over the an Intel Core i5 Quad 1.7 GHz machine, RAM 8 GB with Matlab 13 image processing tool box.

We have performed the proposed calculation on an expansive number of face groupings caught from well known JAFFE Data Set with 213 images with 7 facial expressions of 10 Japanese female with different facial expressions.

Following results are demonstrated in Table 1. It is observed that the proposed calculation has attained to promising results, which is powerful.

Also, the processing time of is consider for real world approach to test the system to got the promising results of the successful experiment of the system

Table I. Success Rate And Computing Time Of The Proposed Algorithm

Method	Size of Data Set	Result of method in %
SVM with FDA	213 images	83.33
SVM with HMM	213 Images	88.88

CONCLUSION

In this paper we have a leaning to introduce support vector machines for face recognition with the mix of 2 kernels known as FDA and HMM. It provides each theoretical and practical approach of SVMs for well suited results on face recognition supported facial expressions. The performed experimental results are show that machine learning primarily based SVMs significantly deliver the good performance toward image process objective. With their ability to generalize well in high dimensional feature areas, SVMs eliminate the requirement for feature choice, creating approach significantly easier. SVMs show smart performance altogether experiments with FDA and HMM.

FUTURE WORK

The proposed technique can be modified to provide learning to the Robotic using Conceptual Dependency.

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