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Application Expansion inside Optimized RBF Kernel of SVM in Robust Face Recognition System

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Abstract

Information is critical in light of the fact that it assists us take a decision. Yet, it needs security. With these worries, picture is the most ideal method for representation of data to to read, write, and and comprehend the data. Face recognition is secure since we can't change our faces, not at all like secret word signature, credit card and debit card that may be abused by others. Appearance, brightening and postures change are the significant testing issues in face acknowledgment. The unwavering quality of face recognition frameworks relies on upon limit of database of facial pictures and testing methodology to assess the face acknowledgment framework. Our examination is concerned with the testing method. This exploration proposed another algorithm of support vector machine. In Experiments we have discovered some tasteful actualities and results. It gives the most noteworthy exactness 97.9 %. This is superior to anything moderately offered results. In the most recent decade, the face recognition framework has advanced with more noteworthy than 90% recognition rate.

Keywords: *Principal Component Analysis, Support Vector Machine, Kernel Optimization, Face Recognition*

1. Introduction

Machine face recognition framework is a image analysis issue. It is done either by verification or identification. In verification, we take after a face against set of faces. In identification, a face is looked at against every face in databases. Face recognition t [1] alludes to a programmed or semi mechanized procedure of coordinating facial pictures. Normally, two dimensional face recognition is utilized by many people, in light of the fact that it is simpler and less costly contrasted with three dimensional.Face acknowledgment comprises of three noteworthy steps [1-2]. Firstly, detection that may be characterized as obtaining optical picture utilizing a decent quality sensor, changing over it into digita picture. The second phase of method is feature extraction where components are removed from countenances. Various feature extraction strategies are in inclination as Principal component analysis (PCA),), linear discriminate analysis (LDA), independent component analysis (ICA), Wavelet transforms, geometry based, color segmentation, template base and others. Third phase of system is classification. The procedure of arranging data in classes as per closeness in attributes is called classification. As classifier gears are accessible as PCA, ICA, LDA, ANN (Artificial neural network) system, SVM (Support vector machine), Adaboost and the rest. Face Recognition has advanced in the most recent decade with recognition rates greater than 90 %. On the other hand, numerous difficulties still stay to be handled to make it powerful to impediment and different connections. For instance expression, illumination, and uncontrolled pose change can bring about a significant performance drop of face recognition frameworks. We don't yet know how to handle these issues adequately. Face recognition is still a developing and open examination territory. These days, in light of most recent exploration study reports from

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2000 to 2015 [3] to [11] in face recognition, it has risen that combining PCA and SVM may be a standout amongst the most potential systems to yield better results.

The paper is sorted out as takes after. In Segment 2 writing survey is represented. Segment 3 clarifies the issue. Segment 4 portrays the proposed model and algorithm. Part 5 communicates the trial setup and dialog of discovering certainties and result investigation. At last, in Segment 6 and 7, different closing articulations and future bearings are displayed.

2. The Literature Review

The combination of PCA-SVM and PCA-ANN methods for face recognition has been effectively found as of late. A few analysts came up to enhance PCA-SVM and PCA-ANN mixes. Between these two, which one is ideal to utilize? This inquiry emerges to survey these mixes. Face recognition issue endures the scourge of dimensionality. The Paper [12-13] claims that PCA can be utilized as an feature extraction algorithm that is the best component extraction gizmo. The mix of PCA-SVM may be better blend systems contrast with PCA-ANN in different conditions of undertakings [13]. Accordingly, we have to survey just PCA-SVM Combinations. Table [1] is speaking to a profitable depiction of PCA-SVM blends for face acknowledgment framework.

All survey strategies concentrated either on just accuracy or error rate rate concerns. Accuracy,Traning time, Testing Time, Robustness, Scalability, Goodness of fit and Comparison with existing systems may be the issues in assessing the execution of the PCA - SVM blend.

Table 1. Review Summary of Combination of PCA-SVM

References	Proposed Methods	Databases used	Authors' comments
Kwang In Kim, Keechul Jung, and Hang Joon Kim [14] (2002)	KPCA+SVM	ORL	Proposed combination method of KPCA and SVM stumble on lowest error rate 2.5 %.
Ergun Gumus a, Niyazi Kilic b, Ahmet Sertbas a, Osman N. Ucan b [15] , (2010)	PCA+Wavelet+SVM (Three type of kernels) and nearest distance classification	ORL	Classification accuracy 98.1% with Wavelet+SVM. Researchers were doing experiments on the dissimilar environment of source code. It is our opinion, PCA-SVM may be better if we use similar environment.
Chengliang Wang ,Chongqing Univ., Chongqing, , Libin Lan ; Yuwei Zhang , Minjie Gu, [16] , (2011)	PCA+SVM	ORL	The experimental results show that the recognition rate of the proposed method under small samples circumstances, is better than the other two methods.This method is applicable only small number of faces.
U. Raghavendra, P. K. Mahesh,Anjan Gudigar [17] (2012)	PCA+LDA+SVM	ORL	The proposed method was consisted of three steps. First is dimension reduction, second feature extraction and the third is classification. Finally, the authors find satisfactory results.
Rakesh Kumar Yadav, A.K Sachan, D.Rai,[13] (2012)	PCA+SVM(Survey)	ORL,FERET, Yale,AR,CMU, Facebook, VISIO Owned created by authors	This article concluded that if we decide on all the four parameters such as preprocessing, feature extraction, classification, and optimization in better and synchronized mode, then the accuracy rate may be enhanced and computation time reduced. Lastly, as per author's examination, a combination of PCA and SVM system offers better results.

Rakesh Kumar Yadav, A.K Sachan, D.Rai [18] (2012)	Histogram+ PCA+SVM (Optimized kernel)	It is only theoretical and logical proposed	The authors have suggested that two parameters are answerable of better performance of a system. First is optimal feature and, second best kernel. The authors have also been mentioned about the scalability aspects.
Sompong Valuvanathorn, Supot Nitsuwat,Mao Lin Huang [19] (2013)	2D PCA+SVM	Authors were used 115 face images for learning and testing	The consequences experimentally give about 97.83% accuracy. This is considerably better.
Wenkai Xu and Eung-Joo Lee [20] (2014)	WT+2D PCA+SVM	ORL & Yale	Experiments with ORL & Yale database show that the proposed method has accuracy, and robust for face recognition. The Authors found the accuracy of ORL database is 98.3 % and 98.9 % of Yale database.
Alireza Tofighi, Nima Khairdoost, S. Amirhassan Monadjemi, Kamal Jamshidi [21] (2014)	Skin color segmentation and AdaBoost (Detection) PCA+LDA+SVM (Classification)	ORL	The proposed algorithm to make a rational tradeoff between the time, complexity and accuracy and develop a high performance face detection algorithm .Getting a high recognition rate of 93.5% on ORL Database.
Ghali Ahmed, Benyettou Mohamed [22] (2014)	PCA+SVM (Optimized by DWT of LSVM,PSVM and RBFSVM)	ORL	We obtain recognition rates as high as 97.9% in the ORL face database with polynomial kernel (PSVM).
Lixin Shen,Hong Wang, Li Da Xu,Xue Ma, Sohail Chaudhry, [23] (2015)	KPCA+SVM	ORL	This method can be applied simultaneously to solve both the over-fitting problem and the small sample problem. Recognition accuracy of the proposed method reached 95.4 %.

3. Problem

In perspective of the way that the blend of PCA-SVM experiences the impediment of dimension reduction, kernel optimization of SVM, lower accuracy,greater training and testing time. In any case, to choose which kernel is the most appropriate for a specific case, is a troublesome proposition. Analysts, till date, have not utilized all progressions of face acknowledgment process in a superior and synchronized way. For improvement t of these factors, we must propose another algorithm. As specified above, PCA and SVM may be utilized as a part of mixes for face recogniton, because of its capability to yield better results.

4. Proposed Model of Face Recognition with Proposed Algorithm

This research design GKSVM-OFRS (Genetic kernel support vector machine based optimal face recognition system) model. It includes all steps of face recognition except detection, because of easy availability of standard databases, as ORL, YALE, MIT, FERET and others . The genetic combination of PCA [12] and SVM [24-26] suffers from low accuracy, high traing and testing time.

4.1. Proposed Model

Figure [1] demonstrates a complete model of face recognition. We proposed a face acknowledgment framework GKSVM-OFRS (Genetic Kernel Support vector machine based - Optimal Face recognition System). The data set ORL is isolated into two sets, one

of them called training set. The other set called, test data set. It is utilized for testing the classifier's performance. Both sets follow the two instructions s. To start with is a segment equal size block of each image of sample sets. The second is separated the feature utilizing PCA. A Modified Feature extraction methodology of PCA (MPCA) is additionally utilized as a part of proposed algorithm. Presently, features of training set will encourage into modified SVM (MSVM) classifier for training. Here, streamlined SVM piece classifier is utilized for preparing. SVM can be enhanced utilizing two routines. By first approach, optimize input features. Secondly, we may optimize kernel parameters.. In this proposed algorithm we apply optimize kernel parameters utilizing genetic algorithm. RBF(Radial Basis Function) kernel is considered to have converted the feature into multidimensional space. The feature of the testing phase is utilized for classification to analyze trained feature. On the off chance that circumstances are met, then last yield is appeared, generally ,go into genetic operation to optimize the outcomes.

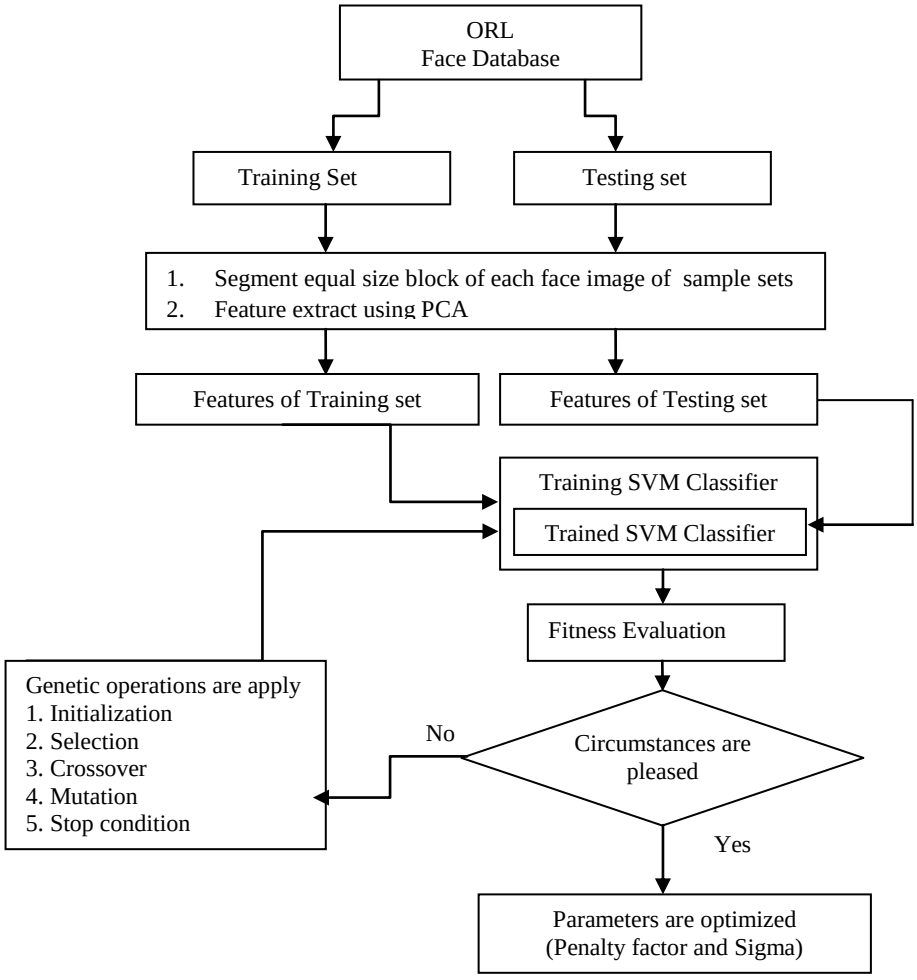

Figure 1. Proposed Model

4.2. Proposed Algorithm

OFRS-GKSVM (ORL Database)
{
MPCA (Training Data, Test Data)
MSVM (Selected Features, RBF)
{
Fitness fun (Accuracy)
If (Condition met)
{
Output (Accuracy, Training Time, Testing time)
}
Else
{
"Go to Classification process via Genetic Process"
}
}
}

4.3. Modified PCA Algorithm

In this approach, each face image in the training set is divided into N smaller images. Hence the size of each sub- image will be (row* column)/N that is L^2/ N. Where L is the number of rows and column, which are equal. The sub-image can be represented mathematically as $\Gamma_{ij}(m, n)=\Gamma_i\left(\frac{L}{\sqrt{N}}(j-1)+m\frac{L}{\sqrt{N}}(j-1+n)\right)$ for every i,j : Where I varies from 1 to M , M being the number of Image in Training set, j varies from 1 to N , N being the sub-Image and m and n vary from 1 to $\frac{L}{\sqrt{N}}$.

1. Constitute the training set Γ_t Where it is total number of sets.
2. Each face image in the training set is divided into N smaller images
3. Calculate the mean of all the training sub-images $\Psi=\frac{1}{M.N}\sum_{i=1}^{M}\sum_{j=1}^{N}\Gamma_{ij}$
4. Subtract mean from each face: $\Phi_{ij}=\Gamma_{ij}-\Psi$ for every i,j
5. Calculate the covariance Matrix $C=\frac{1}{M.N}\sum_{i=1}^{M}\sum_{j=1}^{N}\Phi_{ij}\Phi_{ij}^{T}= AA^T$
6. Calculate eigenvectors and eigenvalue of covariance matrices
7. Select the principle components: from M eigenvectors U_i Only M' should be chosen which have the highest gain values

4.4. Modified SVM Algorithm

1. After following all above steps from 1 to 15 we have found that the classification of sample x is given by the equation $f(\mathbf{x})=\sum_{i=1}^{N}\alpha_i y_i K(\mathbf{x}_i,\mathbf{x})+b$

   Where K is the kernel function, x_i are the training samples and $y_i \in$ (-1, +1) their respective class labels. α_i and b is the parameters of the model after training at the test time.
2. Select RBF kernel of SVM
3. Set the fitness function in the form of accuracy and RBF kernel parameters.

4. Optimize kernel parameter sigma using genetic approaches.
5. Stop

5. Implementation and Results

Performing the analysis we will utilize MATLAB 7.1 variant and AT&T Laboratories Cambridge (formerly ORL) database. The database is made out of 400 pictures comparing to 40 unmistakable persons. The first size of every picture is 92x112 pixels, with 256 gray levels for each pixel. Every subject has ten distinct pictures taken in different sessions changing the lighting, outward appearances as open or shut eyes, grinning or not grinning, and facial subtle elements. Every one of the pictures were taken against a dull homogeneous foundation with the subjects in an upright, frontal position.

We can classify our parameter in three categories. The first is called feature parameters like vector and block size, no of faces, No of Samples per face. Second is optimization parameters like like tolerance, population size, and maximum generation, maximum time, and minimum and maximum sigma. evolution parameters as training time , testing time, TPR(True Positive Rate), TNR(True Negative Rate), FPR (False Positive Rate), FNR (False Negative Rate), Accuracy, Precisions, and Comparison with existing strategies. Two factors are critical during the process of testing face recognition algorithm and second is the quantity of pictures of every class utilized for training. The experiments have performed with a put away face picture and assembled a framework to locate and recognize faces. We have conducted our research to assess the performance under known varieties of lighting, scale, and orientation.

In this examination we fixed a few parameters. Here, vector size taken four and block sizes as eight. The estimations of tolerance are settled .01. Populace size is 16. Max gen, Max time, Min sigma and max sigma are set 100, 20, 0.05, and 1 respectively. Presently, given beneath Table demonstrates the investigation measuring relating to the above parameters of the experiment number 1-6.

The Tables 2 to 7 present the outline of performing examinations. To know the general performance of the proposed classification algorithm, we can draw a ROC (The receiver operating characteristic) bends. The Figure [2] and [3] at given underneath shows ROC bends .Accuracy is measured by the region under the ROC bend. A territory of 1 speaks to an impeccable test. Now, we can infer that the Figure [2] show better exactness in light of the fact that the range under the bend (r2) is .9752 that is close to esteem 1. Thusly, the proposed model is superior to anything the current model.

Table 2. Summary of Experiment no. 1

Parameters	PCA +SVM (Existing)	MPCA+ GKSVM (Proposed)
Number of Faces	5	5
Sample per Face	6	6
Training Time (Sec)	2.8968	3.5065
Testing Time (Sec)	0.92953	0.074587
TPR	0.6800	0.7700
TNR	0.9200	0.9000
FPR	0.0800	0.0100
FNR	0.3200	0.1200
Accuracy	0.8000	0.9278
Precisions	0.8947	0.9871
Recall	0.7419	0.8824

Table 3. Summary of Experiment no. 2

Parameters	PCA +SVM (Existing)	MPCA+ GKSVM (Proposed)
Number of Faces	10	10
Sample per Face	6	6
Training Time (Sec)	1.108	885.2962
Testing Time (Sec)	0.29881	0.2408
TPR	0.7000	0.8100
TNR	0.9500	0.9400
FPR	0.0300	0.0230
FNR	0.1200	0.0320
Accuracy	0.9167	0.9695
Precisions	0.9589	0.9724
Recall	0.8879	0.9671

Table 4. Summary of Experiment no. 3

Parameters	PCA +SVM (Existing)	MPCA+ GKSVM (Proposed)
Number of Faces	15	15
Sample per Face	6	6
Training Time (Sec)	2.8456	3.4231
Testing Time (Sec)	0.8466	0.0723
TPR	0.7500	0.8500
TNR	0.9300	0.9500
FPR	0.0220	0.0240
FNR	0.0600	0.0290
Accuracy	0.9535	0.9714
Precisions	0.9715	0.9725
Recall	0.9393	.0.9704

Table 5. Summary of Experiment no. 4

Parameters	PCA +SVM (Existing)	MPCA+ GKSVM (Proposed)
Number of Faces	20	20
Sample per Face	6	6
Training Time (Sec)	3.4566	4.1112
Testing Time (Sec)	0.8523	0.0112
TPR	0.7300	0.8800
TNR	0.8900	0.9500
FPR	0.0230	0.0180
FNR	0.1100	0.0200
Accuracy	0.9241	0.9797
Precisions	0.9695	0.9801
Recall	0.8900	0.9793

Table 6. Summary of Experiment no. 5

Parameters	PCA +SVM (Existing)	MPCA+ GKSVM (Proposed)
Number of Faces	30	30
Sample per Face	6	6
Training Time (Sec)	4.3234	5.1122
Testing Time (Sec)	0.9231	0.0021
TPR	0.7900	0.9000
TNR	0.9400	0.9400
FPR	0.0190	0.0260
FNR	0.0800	0.0230
Accuracy	0.9459	0.9740
Precisions	0.9765	0.9719
Recall	0.9216	.0.9761

Table 7. Summary of Experiment no. 6

Parameters	PCA +SVM (Existing)	MPCA+ GKSVM (Proposed)
Number of Faces	40	40
Sample per Face	6	6
Training Time (Sec)	5.8322	6.09242
Testing Time (Sec)	0.8252	0.31223
TPR	0.7800	0.9200
TNR	0.9600	0.9600
FPR	0.0270	0.0200
FNR	0.1500	0.0240
Accuracy	0.9077	0.9771
Precisions	0.9665	0.9787
Recall	0.8649	0.9756

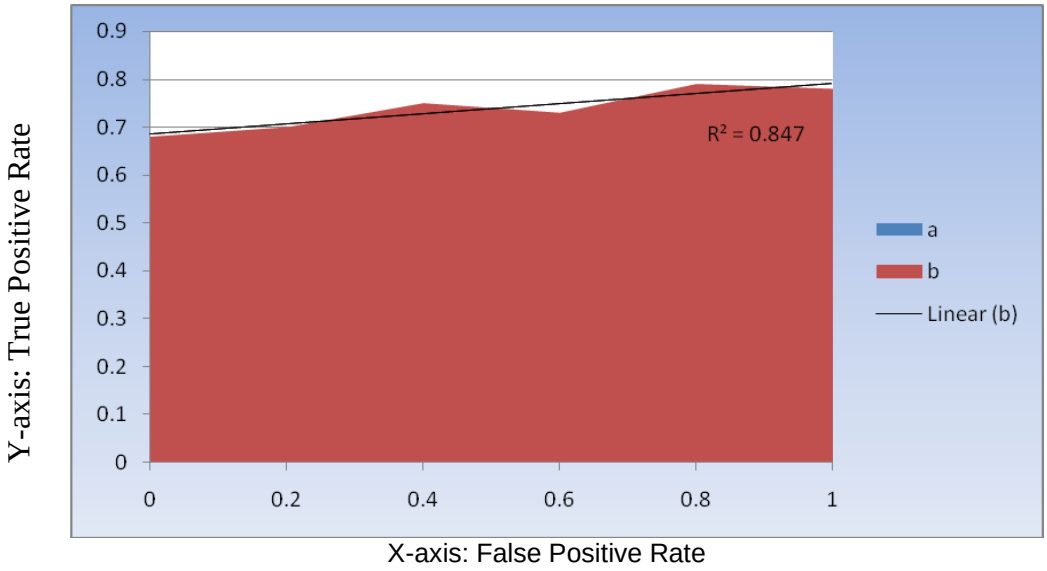

Figure 2. ROC Curve for PCA+SVM (Existing Model)

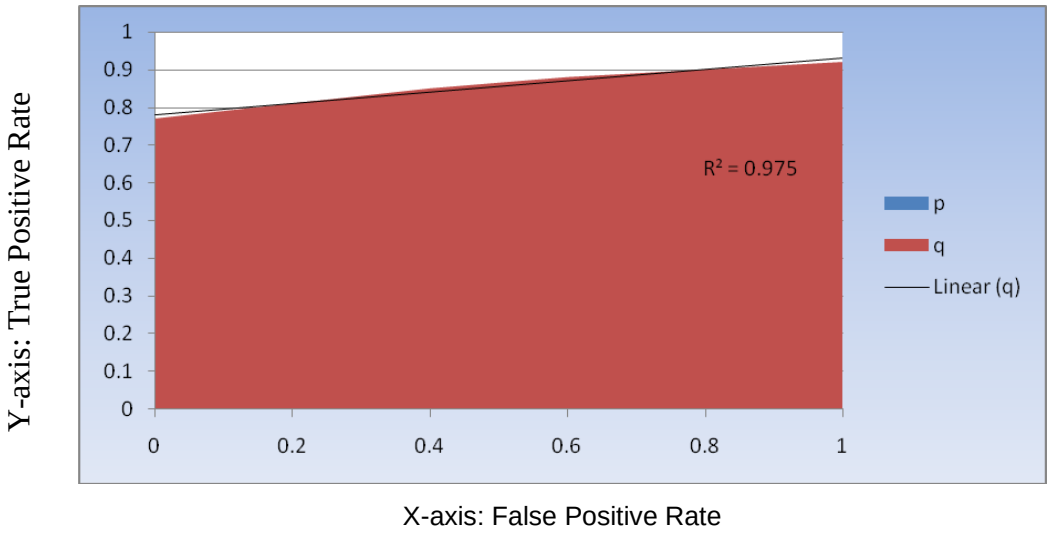

Figure [3]. ROC Curve for the (MPCA+GKSVM) Proposed Model

5.1. Finding Facts & Results investigation:

The exploration have discovered the accompanying actualities

1. Training time of the proposed model is more high up than the current model, while the testing time of the proposed model is smaller than the current model. Proposed strategy discovers general classification time not as much as exiting model.

2. If number of dimensions in PCA is expanding then it enhances the face acknowledgment exactness however traing time is additionally in expanding.

3. The fourth examination discovered the higher exactness rate 97.9 %.

4. As the training data is expanded the training time is likewise expanded, however the accuracy made improved.

5. As we increase the data relating to pose and enlightenment transforms, it expands the accurac.

Thusly, proposed algorithm demonstrates a strong classification. it implies that it's immunity power is strong. In this manner, it is likewise applicable in noisy, outlier and missing data. This property of classifier is called robustness.

6. Conclusions

We have built up a novel strategy that is called GKSVM-OFRS. The prediction model was developed by utilizing genetic algorithm for optimization of kernel function RBF of SVM. The most elevated accuracy 97.9% is accomplished in the six analyses, tests done on ORL datasets, PCA+SVM versus Modified PCA + optimized SVM respectively. It additionally depicted the Training time of the proposed model is more noteworthy than leaving methodology while the testing time is lesser than exiting approach. Proposed system discovers overall classification time is not as much as existing models. Also, Comparisons with some best in class methodologies showed that GKSVM-OFRS is more profitable and exact. All in all, it is expected that GKSVM-OFRS will be a complementary tool for identification of face images.

7. Directions for Future Research

In the Future, some functionality may be modified or added to the proposed model.

1. In the proposed model, MPCA is utilized as feature extractor and GK as Optimization. Both are mindful to expand the training time. Some feature extractor as mean, fluctuations, scattering, skewness, kurtosis and others may be utilized as a part of spot of MPCA. mean, variances, dispersion, skewness, kurtosis and others may be used in place of MPCA.

2. The artificial swarm, ant colony, MEB (minimum enclosing ball), fuzzy logic and other techniques may be used as an optimization.

3. The offered framework performs on constrained size and sort of database. Later on, we may apply it on large and noisy data. Yet,we considered just components of lighting, pose, brightening, and expression in the database. We might likewise including the age and gender orientation variables.

4. To make secure framework, the proposed model may incorporate with other biometric framework as Iris, Fingerprint, Retina and others.

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