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A Hybrid method of face detection based on Feature Extraction using PIFR and Feature Optimization using TLBO

Kapil Verma*, Akash Mittal**, Yogendra Kumar Jain***
*Department of Computer Science, Samrat Ashok Technological Institute, Vidisha, M.P, India
** Department of Computer Science, Samrat Ashok Technological Institute, Vidisha, M.P, India
***Department of Computer Science, Samrat Ashok Technological Institute, Vidisha, M.P, India

ABSTRACT
In this paper we proposed a face detection method based on feature selection and feature optimization. Now in current research trend of biometric security used the process of feature optimization for better improvement of face detection technique. Basically our face consists of three types of feature such as skin color, texture and shape and size of face. The most important feature of face is skin color and texture of face. In this detection technique used texture feature of face image. For the texture extraction of image face used partial feature extraction function, these function is most promising shape feature analysis. For the selection of feature and optimization of feature used multi-objective TLBO. TLBO algorithm is population based searching technique and defines two constraints function for the process of selection and optimization. The proposed algorithm of face detection based on feature selection and feature optimization process. Initially used face image data base and passes through partial feature extractor function and these transform function gives a texture feature of face image. For the evaluation of performance our proposed algorithm implemented in MATLAB 7.8.0 software and face image used provided by Google face image database. For numerical analysis of result used hit and miss ratio. Our empirical evaluation of result shows better prediction result in compression of PIFR method of face detection.

Keywords - Feature extraction, Face recognition system, pattern recognition, TLBO

I. INTRODUCTION

In recent years, face recognition has attracted much attention and its research has rapidly expanded by not only engineers but also neuroscientists, since it has many potential applications in computer vision communication and automatic access control system. Especially, face detection is an important part of face recognition as the first step of automatic face recognition [12]. However, face detection is not straightforward because it has lots of variations of image appearance, such as pose variation (front, non-front), occlusion, image orientation, illuminating condition and facial expression. Many novel methods have been proposed to resolve each variation listed above. For example, the template-matching methods are used for face localization and detection by computing the correlation of an input image to a standard face pattern [4]. The face is our primary focus of attention in social life playing an important role in conveying identity and emotions. Face recognition systems have gained a great deal of popularity due to the wide range of applications that they have proved to be useful in. Broadly, two main categories for these applications exist: commercial applications and research applications. From a commercial standpoint, face recognition is practical in security systems for law enforcement situations. It is in places like airports and international borders that the need arises for a face recognition system that identifies individuals. Another application of face recognition is the protection of privacy, obviating the need for exchanging sensitive personal information. Instead, a computer-based face recognition system would provide sufficient identification. For instance, PIN numbers, user ID's, and passwords would be replaced by face recognition in order to unify personal identification. Finally, face recognition systems can be used for entertainment purposes in areas like video games and virtual reality [1].

Figure 1: Configuration of general face detection structure.

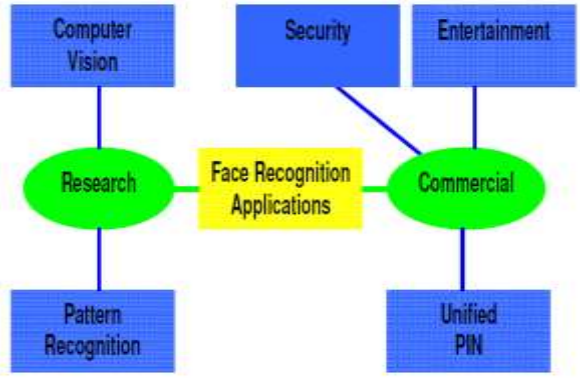

Figure 2: Applications of face recognition.

Section-II gives the information of about feature of face image. In section III discuss the method of face recognition. In section IV discuss the proposed method. In section V comparative result finally, in section VI conclusion and future scope.

II FEATURE OF FACE IMAGE

Feature extraction process play important role in face detection and pattern detection system based authentication mechanism. The goal of feature extraction is to find a specific representation of the data that can highlight relevant information [7]. This representation can be found by maximizing a criterion or can be a pre-defined representation. Usually, a face image is represented by a high dimensional vector containing pixel values (holistic representation) or a set of vectors where each vector summarizes the underlying content of a local region by using a high level transformation (local representation). In this section we made distinction in the holistic and local feature extraction and differentiate them qualitatively as opposed to quantitatively. It is argued that a global feature representation based on local feature analysis should be preferred over a bag-of-feature approach. The problems in current feature extraction techniques and their reliance on a strict alignment is discussed. Finally we introduce to use face-GLOH signatures that are invariant with respect to scale, translation and rotation and therefore do not require properly aligned images. The resulting dimensionality of the vector is also low as compared to other commonly used local features such as Gabor, Local Binary Pattern Histogram 'LBP' etc. and therefore learning based methods can also benefit from it [9].

TEACHER LEARNING BASED OPTIMIZATION

This optimization method is based on the effect of the influence of a teacher on the output of learners in a class. It is a population based method and like other population based methods it uses a population of solutions to proceed to the global solution. A group of learners constitute the population in TLBO [11]. In any optimization algorithms there are numbers of different design variables. The different design variables in TLBO are analogous to different subjects offered to learners and the learners' result is analogous to the 'fitness', as in other population-based optimization techniques. As the teacher is considered the most learned person in the society, the best solution so far is analogous to Teacher in TLBO. The process of TLBO is divided into two parts. The first part consists of the "Teacher phase" and the second part consists of the "Learner phase". The "Teacher phase" means learning from the teacher and the "Learner phase" means learning through the interaction between learners. In the sub-sections below we briefly discuss the implementation of TLBO.

Initialization

Following are the notations used for describing the TLBO

N: number of learners in class i.e. "class size"

D: number of courses offered to the learners

MAXIT: maximum number of allowable iterations

The population X is randomly initialized by a search space bounded by matrix of N rows and D columns. The jth parameter of the ith learner is assigned values randomly using the equation

$$x^0_{(i,j)} = x_j^{min} + rand \times (x_j^{max} - x_j^{min}) \quad \ldots\ldots (1)$$

Where rand represents a uniformly distributed random variable within the range (0, 1), xmin j and xmaxj represent the minimum and maximum value for jth parameter. The parameters of ith learner for the generation g are given by

$$X^g_{(i)} = \left[x^g_{(i,1)}, x^g_{(i,2)}, \ldots\ldots\ldots\ldots x^g_{(i,j)} \ldots\ldots x^g_{(i,D)}\right] \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

III.1 Teacher phase

The mean parameter Mg of each subject of the learners in the class at generation g is given as

$$M^g = \left[m_1^g, m^g_{2,\ldots\ldots\ldots\ldots\ldots\ldots m_j^g \ldots\ldots\ldots\ldots m_D^g}\right] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The learner with the minimum objective function value is considered as the teacher Xg Teacher for respective iteration. The Teacher phase makes the algorithm proceed by shifting the mean of the learners towards its teacher. To obtain a new set of improved learners a random weighted differential vector is formed from the current mean and the desired mean parameters and added to the existing population of learners.

$$Xnew^g_{(i)} = x^g_{(i)} + rand \times (x^g_{Teacher} - TFM^g) \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

TF is the teaching factor which decides the value of mean to be changed. Value of TF can be either 1 or 2. The value of TF is decided randomly with equal probability as,

$$T_F = round[1 + rand(0,1)\{2 - 1\}] \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Where TF is not a parameter of the TLBO algorithm. The value of TF is not given as an input to the

algorithm and its value is randomly decided by the algorithm using Eq. (5). After conducting a number of experiments on many benchmark functions it is concluded that the algorithm performs better if the value of TF is between 1 and 2. However, the algorithm is found to perform much better if the value of TF is either 1 or 2 and hence to simplify the algorithm, the teaching factor is suggested to take either 1 or 2 depending on the rounding up criteria given by Eq. (5). If Xnew is found to be a superior learner than Xg in generation g , than it replaces inferior learner Xg in the matrix.

III.2 Learner phase

In this phase the interaction of learners with one another takes place. The process of mutual interaction tends to increase the knowledge of the learner. The random interaction among learners improves his or her knowledge. For a given learner Xg , another learner Xg is randomly selected (i ≠ r). The ith parameter of the matrix Xnew in the learner phase is given as

$$Xnew^{g}{}_{(i)} = \begin{cases} x_i^g + rand \times (x_i^g - x_r^g) \text{ if } f(x_i^g) < f(x_r^g) \\ x_i^g + rand \times (x_r^g - x_i^g) \text{ otherwise} \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

III PARTIAL FEATURE EXTRACTION TECHNIQUE

Partial feature extraction process in image database is comprised of image rotation invariant process through sine and cosine transform function. In this technique used sin function, cosine function and tangential function for partial feature extraction are used based on boundary value of image [41]. The given image is divided into three section such as hypotenuse, opposite and adjustment for finding of three parameters hypotenuse, opposite and adjustment, before applying edge detection technique for getting X and Y parameter in the plane for better continuity of edge detection used in many edge detection methods. Now process of all deriv*ate* is explained using a formula.

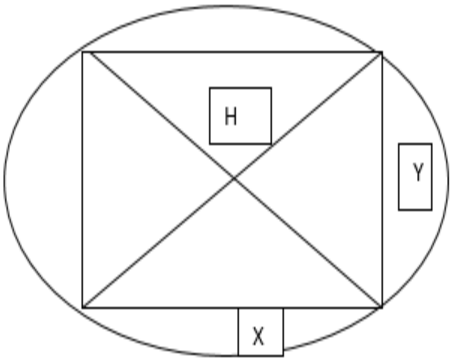

Figure 1: Shows that circular image and divide this image into three sections X, Y and H

Process of feature extraction using triangular formula of image.

Apply canny edge detection method for finding boundary value of image

After that find the centred point of boundary value of shape.

Find the Xc and Yc as

Xc=$\sum_{i=1}^{n} xi/n$.....(1)

Yc=$\sum_{i=1}^{n} yi/n$.....(2)

After getting a value of (Xc and Yc)

H=$\sqrt{\sum_{i=1}^{n} \frac{xi}{n} + \sum_{i=1}^{n} \frac{yi}{n}}$

After getting a value of H apply sine, cosine and tangent function for shape of boundary

Sin=Xc/H and cosine =Yc/H and tangent = Yc/Xc

After getting of sin ,cosine and tangent , find three consecutive matrix of shape

All three shape parameter match the boundary value of feature.

All matched value create a feature matrix

All feature of parameter converted into feature vector.

IV PROPOSED METHOD

In this section discuss the proposed algorithm of face detection based on feature selection and feature optimization process. Initially used face image data base and passes through partial feature extractor and this feature extractor gives a shape feature of face image database. The extracted shape feature passes through TLBO algorithm and selects the proper feature and optimized the feature and finally passes through the support vector machine for classification of feature and finally detected the face and calculates the hit and miss ratio of detected face. The process of algorithm discuss step by step in below section.

1. Select data set for feature extraction
2. apply partial feature extractor
3. Start generation of feature matrix in terms of shape feature.
4. convert feature matrix as row wise and make vector of these feature
5. Initialized a number of student feature N=100
6. Compare the value of distance vector with student
7. If value of feature greater than vector value
8. Processed for new set of student
9. Check the value of teacher factor value TF=1
10. After that generate new set of teacher.
11. These optimal value of teacher is passes through SVM
12. If the value of shape not classified go to the selection process of TLBO
13. Else optimized classified shape is generated.
14. the optimized shape feature passes through the liner support vector machine

15. support vector machine classified the shape value
16. finally detected the face
17. calculate the hit and miss ratio of input image
18. Exit.

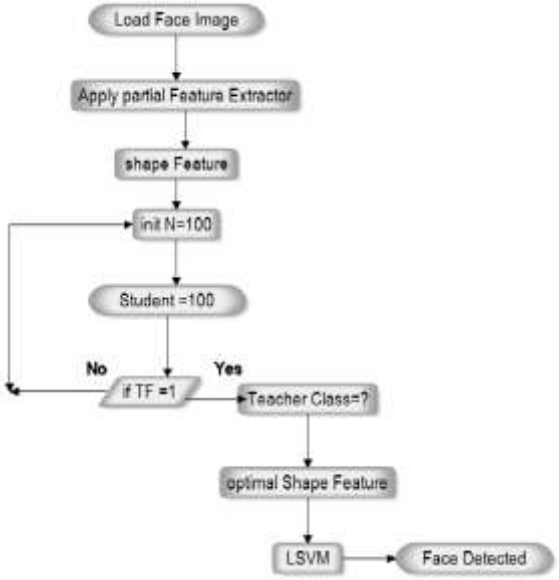

Figure 3: Block diagram of proposed model.

V EXPERIMENTAL RESULT ANALYSIS

To evaluate the performance of proposed method of Face detection we have use MATLAB software 7.8.0 with a variety of group image dataset used for experimental task.

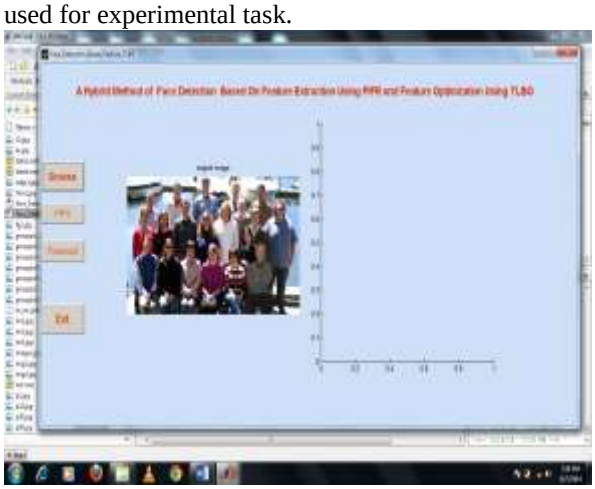

Figure 4: Shows that the input image 1 for face detection.

Figure 5: Shows that the result image 1 for face detection using PIFR method.

Group image Name	Method	Total no of face	hit	miss	Detection ratio %
Group image 1	PIFR	20	18	2	90
	Proposed	20	19	1	95

Table 1: Shows that the comparative study for group image 1 with using PIFR and proposed method.

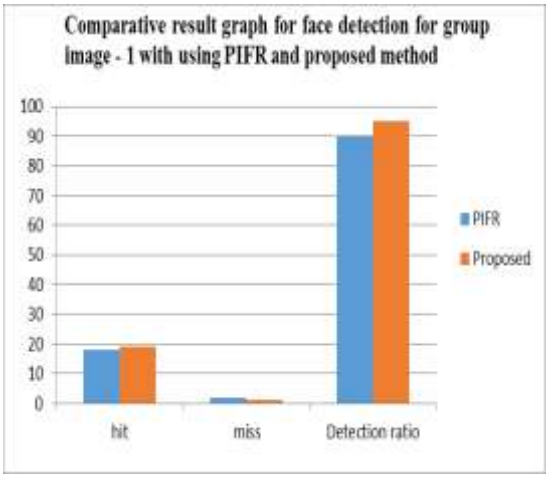

Figure 6: Shows that the Comparative result graph for group image 1 and find the no. of person in an image, hit ratio, miss ratio and detection ratio on the basis of PIFR and our proposed method, then we find that the our proposed method result is always better than the PIFR method.

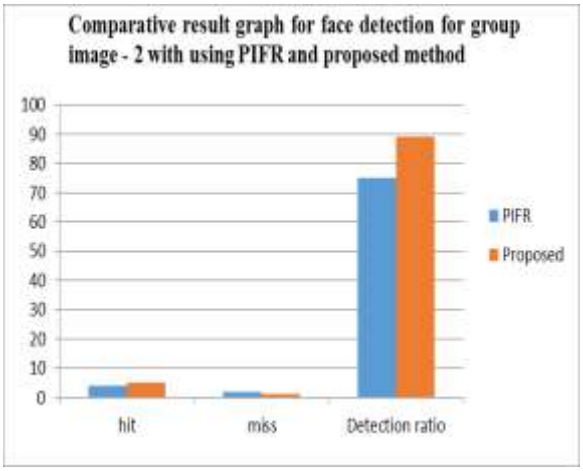

Figure 7: Shows that the Comparative result graph for group image 2 and find the no. of person in an image, hit ratio, miss ratio and detection ratio on the basis of PIFR and our proposed method, then we find that the our proposed method result is always better than the PIFR method.

VI CONCLUSION AND FUTURE WORK

In this paper we improved Face Detection System using partial feature extractor and features selection process by TLBO algorithm. After extraction of feature of face used feature optimizations technique for better selection of feature. The localized face image is transformed from layered form of transform function for extraction of facial feature. The optimized feature selection process gives better result in compression of PIFR and support vector machine based detection technique. In the process of feature extraction we used partial feature extraction function, partial feature extraction process implied as shape feature. The proposed method work in two phases in first phase used feature optimization and second phase used face detection. For the selection of feature and optimization of used two different functions in TLBO algorithm, the selection of feature process satisfied the given condition of feature constraints then select feature and passes through matching of feature for the process of optimization. The proposed algorithm implemented in MATLAB software and used standard face image provided by Google database. For empirical evaluation used hit ratio and miss ratio of face image in given dataset. The detection of hit ratio is better in case of PIFR method. The proposed algorithm for face detection is very efficient in case of individual as well as group face. The proposed algorithm used partial feature extractor function with TLBO algorithm. The process of feature optimization and feature selection is very complex for two different constraints function of optimization and detection. The optimization and detection increase the time complexity but incase the value of hit ratio. In future reduces the time complexity of proposed algorithm and improved the efficiency of overall system.

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