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AUTOMATIC FACE DETECTION USING GENETIC ALGORITHM FOR VARIOUS CHALLENGES

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Abstract:

Face detection in various conditions such as illumination, occlusion, complex background and different pose angles plays the most important role in face recognition. In this research, we proposed an improved algorithm for automatic live facial expression detection (FED) using radial basis function. Detect edges of the facial image by Genetic Algorithm and Fuzzy-C-means (GAFCM). The experimental results used various types of databases i.e. JAFFE, FEI, LFW-a, BioID, CMU and Own database. In this algorithm, detect a face using the fdlibmex algorithm. But we improved limitations of this algorithm using contrast enhancement. We solved the problem of low contrast images. In the preprocessing stage, apply median filtering for removing noise from an image. The detection rate has reached up to100% for expression recognition.

Key Words: Face Detection, Median Filter, Genetic Algorithm, Noise & Image Enhancement

1. Introduction:

Face detection is the technique used to detect any number of faces in given image or video. Most of the human-computer interaction use faces detection as the preprocessing step. Currently, various face detection techniques are available. First, one being knowledge base techniques which have certain defined rules about facial features of human but it has some trouble in their algorithm about various head poses [1-2]. The second one is a feature based technique which will detect human with eyebrows or eyes. This method generally gives good detection but depends upon the head and background variation and this approach may fail due to poor image resolution [1-2]. To overcome these limitations we need new optimization techniques which give better results on the standard database and live database. Generally, the following steps have been followed during face detection: Firstly the image was selected from the standard database after that we enhance the image means contrast enhancement is one of the most important stages in face reorganization and deduction will help to improve the face image before performing face deduction [3]. There are some variations in face images when compared to other known methods. In the method that was proposed by us, the contrast stretching (normalization) process is used and it adjusts the brightness of the objects which was in the image to get the clean visibility. [4-6]. Secondly, we remove the noise from the enhanced image through various techniques such as median filter, threshold value, mean value etc. The noises found in the image are reduced by using a median filter [7]. This median filter is more or less like mean filter. These filters have the capability of smoothing the data without changing any small and sharp details. The median is the center value of all the values of the pixels in the neighborhood. These values are not the same as the average (or mean) but the values in the neighborhood are with the half values as larger and half smaller. The median is stronger than the average by acting as a central indicator. In the next step, we apply a genetic algorithm to extract the feature from the human face. Genetic Algorithm (GA) is a stochastic search procedure based on population to find nearly correct solutions to optimization and search problems. It was designed on the mechanisms of evolution and natural genetics, GA uses directed random searches to locate optimal solutions in multimodal landscapes and also acts as the alternative for traditional optimization techniques. The main solution for this problem is the chromosome that was present in the population. The series of populations for each upcoming and succeeding generation are designed by GA and crossover and mutation is used as operators for principal search mechanisms. The optimization of given objective or fitness function is the main aim of the algorithm. Each perfect or effective solution to a chromosome is mapped by an encoding mechanism. Each chromosome that provides a satisfactory solution to the problem is evaluated by objective functions. Finally, we identify the human face easily with the help of a fdlimex algorithm. The Nilsson algorithm is used as a base for the fdlibmex algorithm comprises a dull library containing methods. Successive Mean Quantization Transform (SMQT) and Sparse Network of Winnows (SNOW) are the methods available in this library. Successive Mean Quantization Transform (SMQT), which can be seen as adjustable turnoff between computational load and the number of quantization levels in the result. The result obtained from the original snow classifier was very well utilized by the split up snow and it can perform rapid detection by creating cascade classifier. The number of splits and number of weak classifiers is shown by random of choice within the limits of the full classifier. There are three folds in using this method. Firstly, for the illumination and sensor insensitive operation in object reorganization the local SMQT features

are proposed, secondly, the speed up of original classifiers are maintained by the split up snow which was present in it. Finally, the combination of both classifier and features performs the frontal face, multiple faces and face pose detection.

2. Proposed Methodology:

In the proposed system, there are five stages of processing:

- ✓ Image Acquisition
- ✓ Image Enhancement
- ✓ Preprocessing
- ✓ Genetic Algorithm
- ✓ Face Detection

Image Acquisition: In this input is taken by using a webcam or still image from the standard database folder. If the input selected by us webcam it returns image frame using get snapshot function. Or else browse image from the various database.

Image Enhancement: Image is enhanced after selecting the image from the standard database and the live image captured from the webcam because of the various weather condition, background complexity, and different lighting conditions. In this step, we increase the pixel value of the selecting image with a constant value. Doing this process some noise also introduced so that we will move to the preprocessing stage.

Preprocessing Stage: Resizing the image in the standard size is has to be done after enhancing the image. Noisy pixels from an image are removed by median filtering. This class of filter is a type of non-linear filters that belonged to the class of edge preserving smoothing filters which are used for two images A(x) and B(x).

$$mediam[A(x) + S(x)] \neq mediam[A(x)] + mediam[B(x)] - - - - - - (1)$$

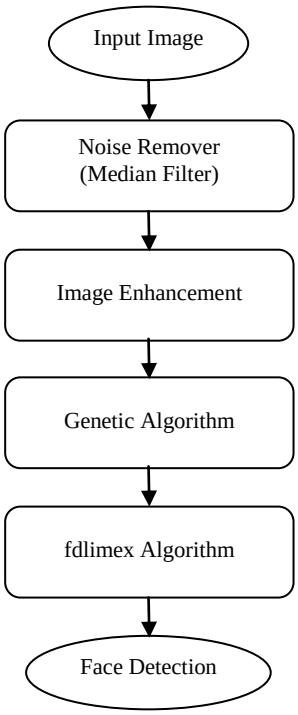


Figure 1: Flow chart of face detection algorithm

Genetic Algorithm: Sometimes the values of two neighbor class levels are nearly same this is one of the drawbacks so that it provides an ambiguous result. But this disadvantage can be overcome by a genetic algorithm with fuzzy-C means (GAFCM) proposed by us. The population generation stage as well as the crossover part to produce a better solution is improved by this GAFCM algorithm. Fuzzy C- means (FCM) Method: In this proposed Method, calculating membership function can be carried out by using GA with FCM method. The membership degree calculation and the cluster centers update are the main procedures of the FCM algorithm. The extent of each data point belongs to each cluster is indicated by membership degree and the values of cluster centers are updated by using this method. Let X = {x1, x2, xM} be data points of M patterns, where each pattern xk is a vector of features in Rn (n-dimensional space). C is the number of clusters. A distance from a data point xk to a cluster center vi is calculated using the squared Euclidean distance as follows:

$$d_{ik}^2 = \left(x_{kj} - v_{ij}\right)^2,\ 1 \le k \le M, i \le c - - - - - - (2)$$

$d^2{}_{lk}$ Denotes the squared Euclidean distance calculated in n-dimensional space. Thereafter, the distance is used in the calculation of membership degree in Eq. (3).

$$u_{ik} = \frac{1}{\sum_{j=1}^{c}\left(\frac{d_{ik}}{d_{jk}}\right)^{2/(m-1)}}, 1 \le k \le m, 1 \le i \le C ------(3)$$

U_{ik} denotes a degree of membership of x_k in the i^{th} cluster. A degree of fuzziness is controlled by the parameter m > 1. This denotes that in every cluster each data pattern has a degree of membership. The values of centroids are then updated according to Eq. (4). Once again Eq. (3) is used to calculate the membership degree of each point for taking the new centroid values.

$$v_i = \frac{\sum_{k=1}^{M}(u_{ik})^m Xk}{\sum_{K=1}^{M}(u_{ik})^m}, \le i \le C ------(4)$$

Objective Function: Most objective functions considered in the clustering problem have usually based on two indexes: compactness and separation. Variation between data within a cluster or between data and cluster centroids are indicated by the Compactness, and it must be kept small. The isolation of clusters which is used to be large is measured by separation. The compactness is formulated by the objective function Jm proposed by Bezdek as shown in Eq. (4).

$$Jm(U,V) = \sum_{K=1}^{M}\sum_{i=1}^{C}(u_{ik})^m d_{ik}^2 ------(5)$$

The squared Euclidean distance from a pattern to each centroid with the weight (u_{ik}) m attached is used to measure the sum of the squared error. Minimizing Jm is the main aim and also to optimize compactness taking into account distance and degree of membership.

Face Detection: After image acquisition, image enhancement has to be applied on face image for low illumination, poor contrast, and different pose angle. The image visibility will be enhanced by this. Now, use fdlibmex to detect the face.

3. Result Analysis:

Face Detection Results:

The proposed method was evaluated by using 6 widely used facial expression databases, i.e. Japanese Female Facial Expressions (JAFFE), Labeled Faces in the Wild-a (LFW-a) Database, CASIA-FaceV5 database, FEI face database, CMU+MIT database and Own database.

Accuracy = (No of Accurate Detected Face) / (Total no of Images)

The Japanese Female Facial Expression (JAFFE) Database: The database consists of 213 images with various facial expressions such as sadness, happiness, surprise, anger, fear and disgust of different subjects. The accuracy of our proposed methodology is 100% on JAFFE database and few of the images shown below.

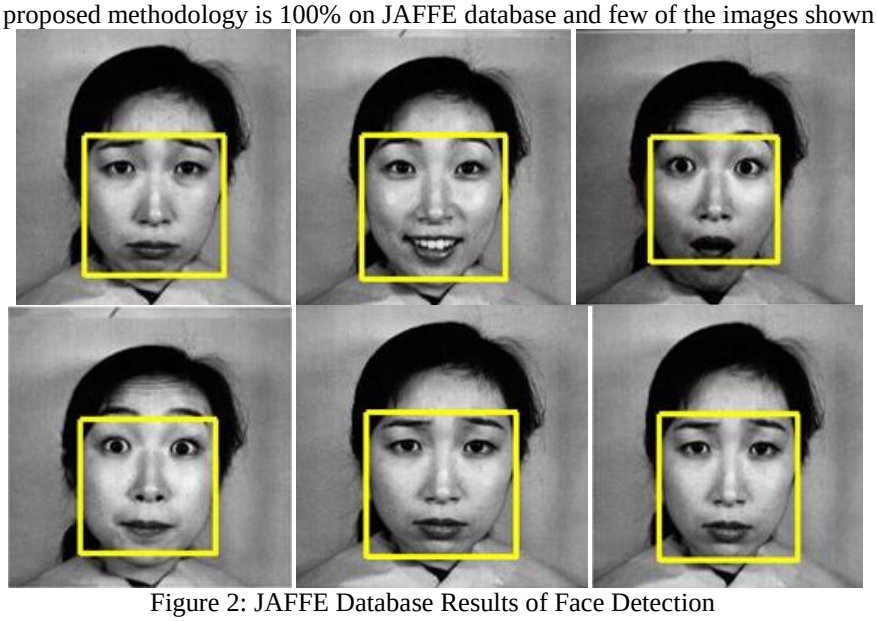
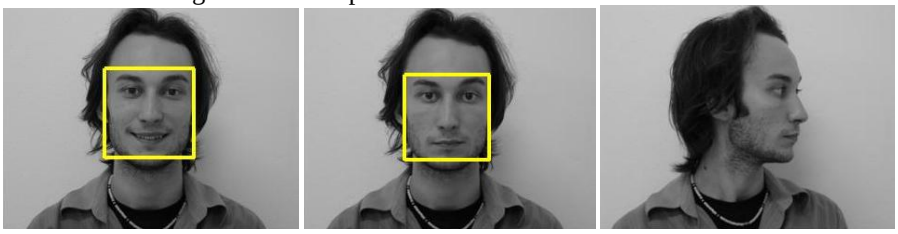


Figure 2: JAFFE Database Results of Face Detection

FEI Face Database: The database consists of 2800 images with various pose angles in a uniform background and 14 images for each 200 subjects. The accuracy of our proposed methodology is 100% with ±75 degree angle and few of the images shown below. All the images are in a frontal position with uniform colorful background and the original size of each image is 640x480 pixels.



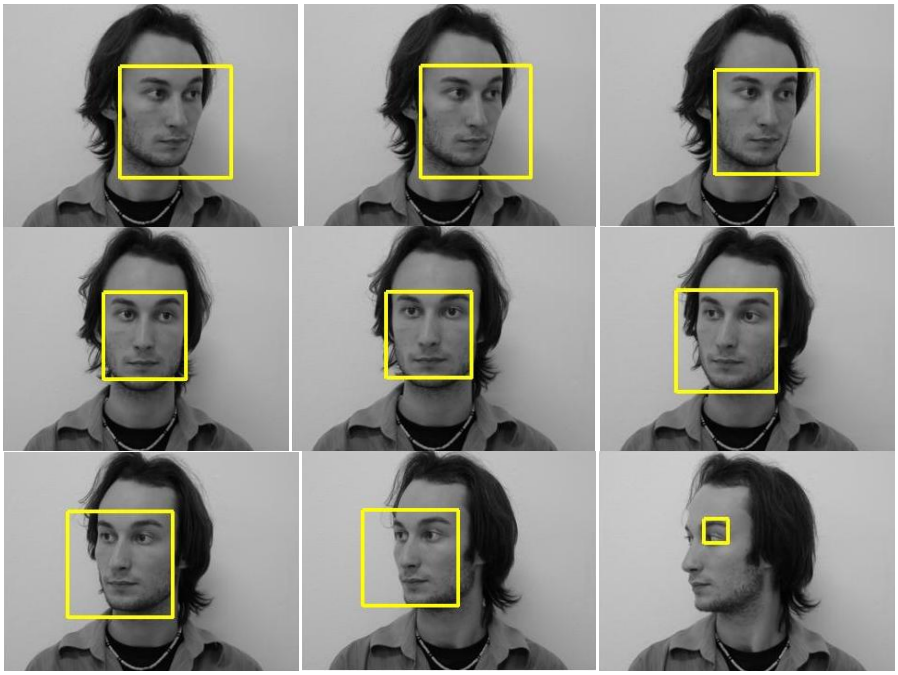


Figure 3: FEI Database Results of Face Detection

Labeled Faces in the Wild-a (LFW-a) Database: The database consists of 13,000 images with various facial expressions of different subjects. All the images are in a frontal position with a complex background and the original size of each image is 250x250 pixels have jpg format. The accuracy of our proposed methodology is 99% on LFW-a database and few of the images shown below.

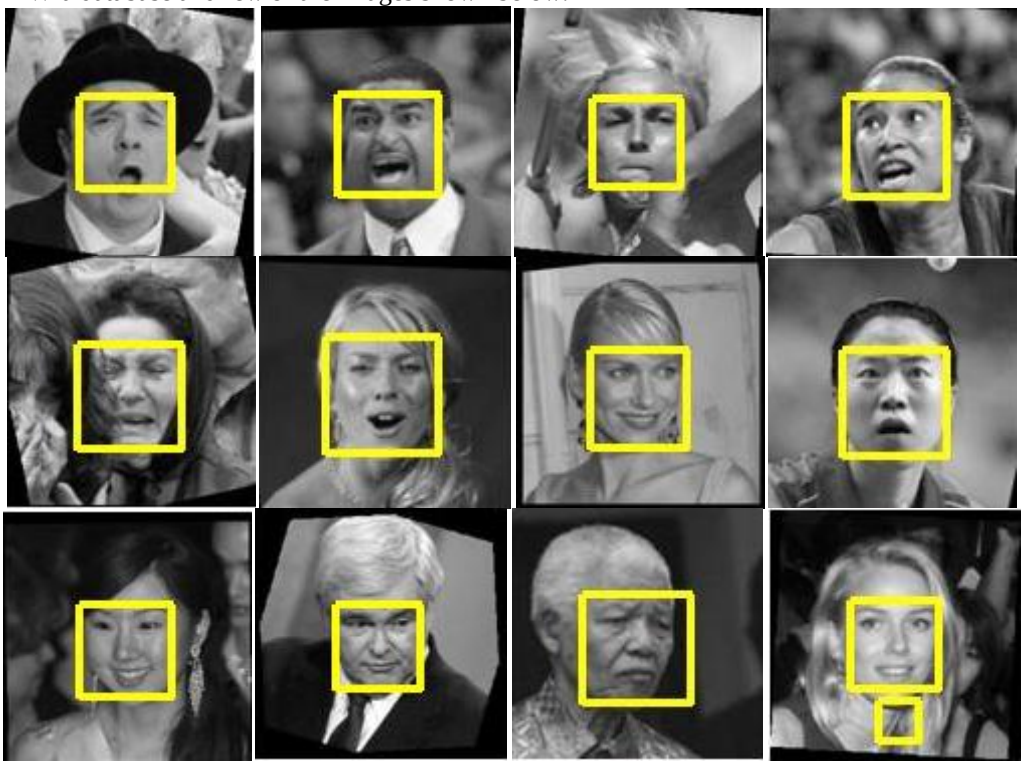


Figure 4: LFW-a Database Result of Face Detection

CMU+MIT Database: The database consists of more than 1 lacks images with various facial expressions of different subjects. All the images are colorful, complex background with frontal face image and multiple face images human. The goal of this database is to share these images with the research community to the entire world. The accuracy of our proposed methodology is 89% on CMU+MIT database and few of the images shown below.

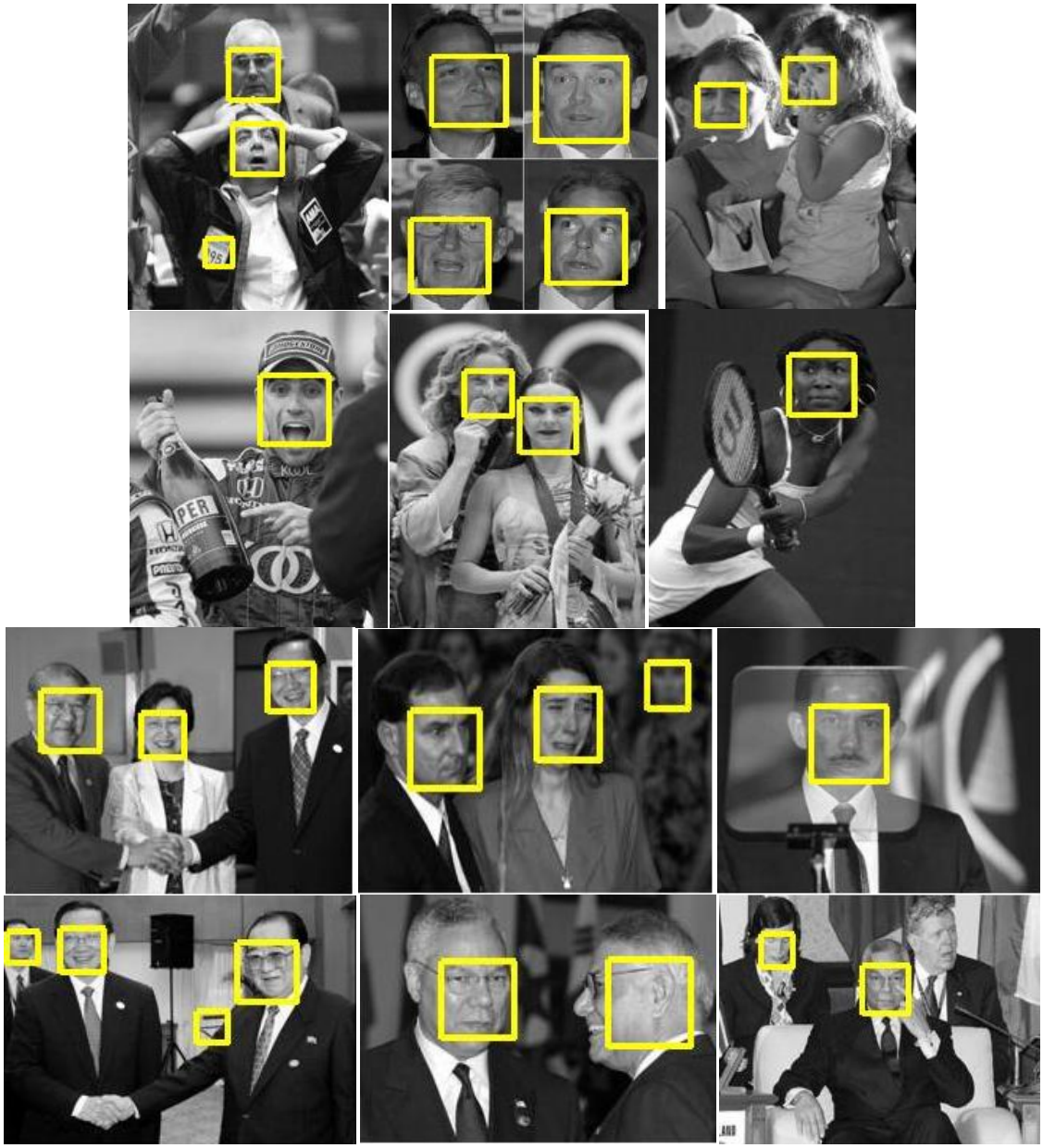


Figure 5: CMU+MIT Database Results of Face Detection

Own Database: The database consists of 50 images with various facial expressions, complex background, various pose angles and different lighting conditions. The accuracy of our proposed methodology is 83% in the own database and few of the images shown below.

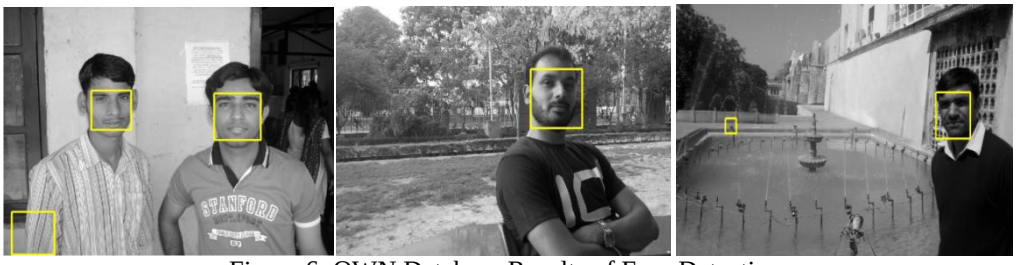


Figure 6: OWN Database Results of Face Detection

4. Conclusion and Future Scope:

In this paper, we have proposed an improved methodology for face detection for various challenges such as different pose angles, various facial expression, complex background, and illumination etc. We have used fdlimex face detection algorithm and accuracy of this improved algorithm of all the standard database is better than others already shown in the results sections. We proposed a pre-processing step including image enhancement and noise removal. At last, we identify the human face correctly. It is not yet suitable for face recognition in video surveillance. Future works will be to find out the solutions to overcome these limitations and this work will continue in future for face recognition and matching also.

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