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Facial Feature Extraction Based On FPD and GLCM Algorithms

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ABSTRACT: Image mining is defined as the discovery of image patterns in a given collection of images. It is an effort that fundamentally draws upon knowledge in computer vision, image processing, data mining, machine learning, database, and artificial intelligence. Facial recognition helps to analyze and compare the patterns from the facial images. Facial feature extraction is an automatic recognition of human faces by detecting its features i.e. eyes, eyebrows and lips. In this research work, features are extracted from the human facial images by using the existing Face Part Detection (FPD) algorithm and the newly proposed Gray Level Co-occurrence Matrix (GLCM) algorithm. FPD uses bounding box method and GLCM uses affine moment invariants method. Performance factors applied here are feature extraction accuracy and execution time. The implementation of this work is performed in MATLAB 7.0. Based on the experimental results, it is observed that the proposed GLCM algorithm extracted the features more accurately with minimum execution time than FPD algorithm.

KEYWORDS: Feature Extraction, GLCM, FPD, Convolution, Bounding Box, Affine Invariant Moments, Binary converter and Gabor features.

I. INTRODUCTION

Image mining is used to find patterns and relationships from collection of images. It is the process of searching and discovering valuable information in large volumes of image data. Face recognition is to identify faces. Face recognition has been widely applied in security system, credit-card verification, criminal identifications and teleconference. The applications of image mining are done in face recognition. Face recognition algorithms identify faces by extracting features from an image. It is mainly used to perform two primary tasks such as verification and identification. Face recognition techniques uses algorithms which are used to analyze specific facial features like eyes, eyebrows and lips. Application areas of face recognition are computerized arrest and booking system (CABS), identification solutions, homeland defense, airport security, financial services etc. Facial feature extraction is an effective method to extract facial features like eyes, eyebrows and lips depending on their locations with the face regions and it is defined as the method of locating points in a specified image [15].

The primary objective of this research work is to extract the facial features i.e. eyes, eyebrows and lips. A new feature extraction algorithm GLCM is proposed to perform this and it is compared to the existing feature extraction algorithm FPD. The performance factors used in this analysis are feature extraction accuracy and execution time.

This paper is organized as follows. Section 2 gives the related works. The FPD and GLCM algorithms are described in Section 3. Section 4 analyzes the experimental results and conclusion is given in Section 5.

II. RELATED WORK

In [3] authors discussed smart human face detection system. In this paper he described a method for the detection of human face in an image. He examined simple form skin-color models depending on the HSV values. He finally compared his proposed algorithm with other algorithms and proved that the proposed algorithm is fast and it is used for some real-time applications. In [4] authors analyzed face occlusion detection by using active contour and skin color

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information. The author examined ear localization techniques for automatic ear detection in 2D side face images and then he proposed techniques of various shapes for template estimation and performs automatic template resizing. And also he detects ears of different shapes and sizes automatically in an automatic ear based biometric systems. Finally his proposed technique is tested on ear database with 94% accuracy. In [6] author presented real time face recognition using adaboost improved fast PCA algorithm. This paper described face recognition methods for Eigen faces which are based on the PCA technique for face representation. He also applied complex methods such as ICA for extracting face features. Finally he gave the best results by comparing all features. In [8] author analyzed facial feature extraction and pose determination. He discussed several techniques for face recognition that are based on texture, depth, shape, color information, grey level template matching and computation of certain geometrical features. Finally from experimental results he proved that he performed better on the localization of facial features and he provided accurate results for their corresponding values. In [10] author provided comparative analysis of curvelets based face recognition methods. For this comparative analysis, face recognition methods based on Principle Component Analysis (PCA), Linear Discriminate Analysis (LDA) and Independent Component Analysis (ICA) on curvelets transform are considered. The author compared different face recognition techniques based on curvelets transform and tested on ORL Database and also she presented the feasibility of algorithms for human face identification through experimental investigation. Experimental results provided that LDA based curvelets transform gives a better recognition rate and efficient dimensionality reduction technique compared to other two methods. In [13] authors described the comparative analysis of facial image feature extraction algorithms. In this paper they discussed two different types of feature extraction algorithms such as FPD (Face part Detection) algorithm and Susan algorithm. They implemented the work using Mat lab and finally analyzed by experimental results and performance measure it is found that face part detection is better than Susan in terms of its accuracy and execution time.

III. PROPOSED METHODOLOGY

The In this research work, the existing FDP and the proposed GLCM algorithms are used for extracting the features from facial images. Face part detection uses convolution technique and this method is experimented using bounding oxes. GLCM uses affine moment invariants method. The system architecture of the proposed methodology is shown in Figure 1.

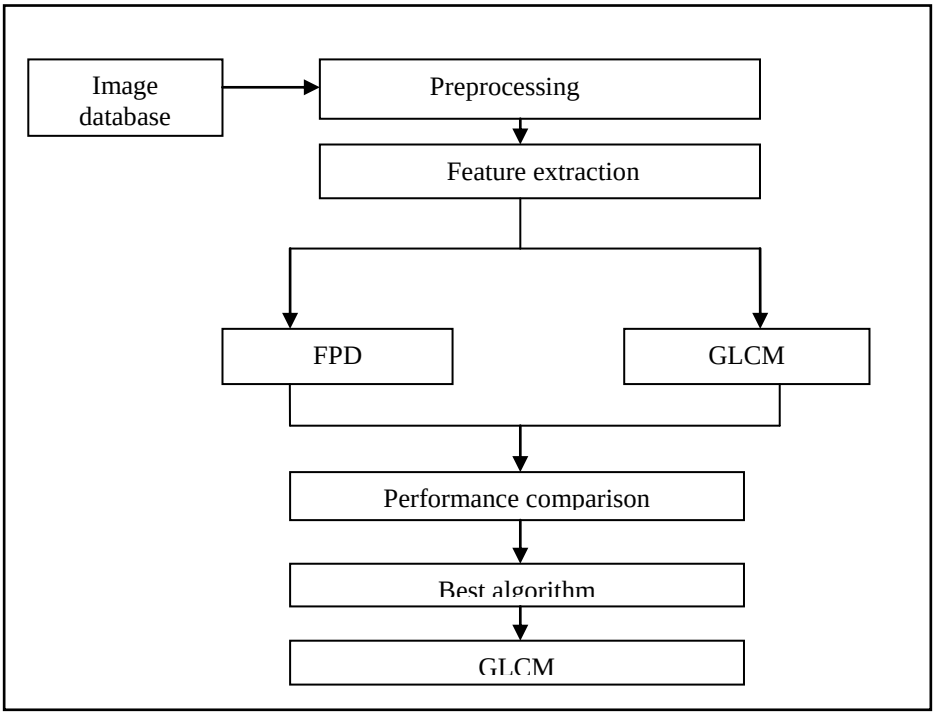

Fig 1: SYSTEM ARCHITECTURE OF FPD AND GLCM

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A. Image database

Image database is a computerized system where images are stored in an organized form. Examples: MRSID, ATERAS, PATFIT, JAFFE etc. In this paper we have used JAFFE database**.** JAFFE database contains Japanese female face expressions. It has 181 Japanese face model images.

B. PREPROCESSING

Preprocessing is done to remove unwanted noise and it gives clarity to the images. Preprocessing is the first step which is done before feature extraction of images. Preprocessing is the stage where filtering is done to remove noise. Different filtering techniques applied in this work are median filter, adaptive filter, linear filter and predefined filter. From this we observed that the median filter performance is comparatively more efficient than other filters.

C. FEATURE EXTRACTION

Feature extraction is done for extracting features from face images. In this paper feature extraction is done for extracting features like eyes, eyebrows and lips. Here FPD and GLCM algorithm is used to detect features.

D. FACE PART DETECTION ALGORITHM

FPD algorithm detects features using their correspondent values [5]. This method uses an efficient approach for the recognition on the basis of some extracted features. For face part detection, this system follows a step by step procedure that comprises face detection, and feature extraction. Once face detection is performed, feature of regions like lips, eyebrows and eyes are extracted [9]. In feature extraction the values are calculated using the height and width of the extracted images [14]. The results are obtained after implementation and this result gives accurate performance for the feature extraction using face part detection algorithm.

E. STEPS INVOLVED IN FACE PART DETECTION ALGORITHM

Feature extraction is the process of extracting features and used to classify the images into different classes [2]. Convolution technique is used in this algorithm. It works by multiplying vectors and returns values by using length and width. Gabor features are done using Gabor filters and here image decomposition is done by converting real part and imaginary part. The eyes, eyebrows and lips are being extracted from the image and results are shown in the form of bounded rectangles. The following steps are shown below:

- Input the images using JAFFE database and
- Convert the images into binary converter.
- Find the 2-d convolution of the target and template image.
- Draw the bounding rectangles by using the values of the convolution technique.
- Find the pixel value from the search region having the values of convolution.
- Find the covariance of the template image.

Bounding box of a set of points uses the covariance matrix of these points. If $p_i = (p_{ix}, p_{iy}, p_{iz})$ is the i^{th} point, then the center *C* of the set of *N* points is

$$C = \frac{1}{N} \sum_{i-1} Pi$$

And the covariance matrix *C* is

$$C = \frac{1}{N} \sum_{i-1} (pi - C)\,(Pi - C)$$

Volume of the bounding box is obtained by the covariance matrix of the set of points. As the covariance matrix depends on the distribution of points and the main axes of the bounding box is located and the values are calculated using this bounding box.

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F. GLCM (Gray Level Co-Occurrence Matrix) ALGORITHM

GLCM is defined as the gray level co-occurrence matrix. Here the texture features of images are extracted and stored in a matrix. GLCM is one of the simplest matrix methods to extract the texture features. GLCM features are extracted for all the images in the database and the input image are stored for performing affine moments. The four commonly used properties such as Energy, Entropy, Contrast and Inverse difference moment are used to reduce the computational complexity. The co-occurrence matrix is a statistical model and is useful in a variety of image analysis applications such as in biomedical, remote sensing, industrial defect detection systems, etc. Gray Level Matrix is used to extract features based on the gray level value of pixels. The features are important for every classification algorithms. Here texture features of images are extracted. The GLCMs features are stored in a matrix, where the number of GLCM is calculated. The GLCM features are extracted by the variance and difference of entropy Information. Using the affine moment invariants technique the feature extraction is done to extract features such as eyes, eyebrows and lips. It is done by using facial expression recognition of different emotions like angry, fear, sad, happy, surprise and normal [1]. Using these facial expressions the images are converted in to binary images for extracting the features. The pseudo code of this algorithm is given in Table 2.

G. AFFINE MOMENT INVARIANTS TECHNIQUE

Affine moment invariant is defined as the feature vectors that are used in pattern recognition. The moment invariants are divided in to two areas for feature extraction that are upper areas and lower areas of face. Images are converted in to binary images for extracting the features. Facial expression of different emotions like angry, fear, sad, happy, surprise and normal changes the curvatures of the face and its properties of objects such as eyes, eyebrows and lips are also changes by extracting the features for different expressions [7]. This extraction method consists of several steps as follows:

- First the color image is converted into grayscale image.
  - Then the four statistical properties of the texture are computed as,

$$\text{Energy, } E = \sum_{x}\sum_{y} P(x, y)\,2$$

$$\text{Entropy, } S = \sum_{x}\sum_{y} P(x, y) \log P\,(x.y)$$

$$\text{Contrast, } I = \sum_{x}\sum_{y} P(x, y)\,2\,P(x, y)$$

$$\text{Indifference, } H = \sum_{x}\sum_{y} \frac{1}{1+(x-y)2} P(x, y)$$

  - GLCM features are extracted using affine moment invariants technique.
  - The proposed method uses Gray level co-occurrence matrix to classify the images according to their feature values. The classified images are performed with the training sets of images and then it is tested.

IV. PSEUDO CODE

Step 1: Imread (input image. Format).
Step 2: Apply face detection code on the input image and detect faces.
Step 3: Extract each face as a separate image.
Step 4: Region props (image, 'bounding box') using convolution technique.
Step 5: Extract features as eyes, lips and eyebrows.
Step 6: Set Im2bw for binary image.
Step 7: Apply Gabor function for feature extraction.
Step 8: Calculate the values by testing the images.
Step 9: End.
Step 10: Imread (image. Format).
Step 11: Im2bw for binary image.

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Step 12: Read the JAFFE database of images.
Step 13: Apply affine moment invariants for the images.
Step 14: Convert vector into features for face recognition.
Step 15: Gray co matrix (image, 'all') for extract texture features of images in the matrix.
Step 16: Extract features as eyes, mouth and eyebrows.
Step 17: Train the images and then test it.
Step 18: Calculate the values by training and testing the images.
Step 19: End.

V. SIMULATION RESULTS

This work is implemented in mat lab tool. Mat lab provides the required data mining functions and methodologies. The JAFFE database is used for experimentation and it contains one hundred and eighty one images. The experimental results show the sample output which has fifteen images. Performance factors used are feature extraction accuracy and execution time.

A. FEATURE EXTRACTION ACCURACY By comparing FPD and GLCM it is proven that GLCM extracts features accurately. Face part detection uses fifteen images and all the fifteen images have the features extracted as eyes, eyebrows and lips. Here only the bounding box represents on the features but it does not extracts separately for all the images. GLCM uses all fifteen images, and extracts features separately as eyes, eyebrows and lips. The affine invariant moment technique is done and using this technique the features are extracted absolutely and correctly for all the images. It is clearly shown that GLCM detects features correctly than FPD algorithm. Table 1 represents the feature extraction accuracy of FPD and GLCM.

Table 1. Accuracy Measure

Algorithms	Accuracy
Face part detection algorithm	78%
GLCM(gray level co-occurrence matrix) algorithm	90%

From the accuracy measure it is proved that GLCM algorithm performs better than FPD algorithm with its highest accuracy values by using SVM (Support vector machine). SVM is done for training and testing the images and finding the accuracy. By training and testing the images it is found the highest accuracy value by extracting the features accurately by SVM parameters.

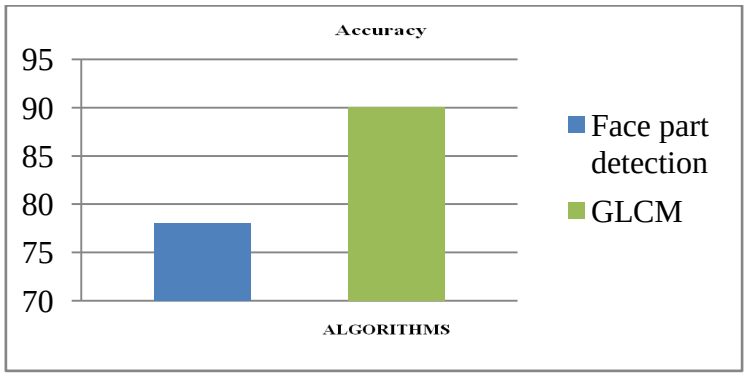

Fig 2: Algorithm Comparison for Performance Measure

Figure 2 shows the GLCM performs better than face part detection algorithm.

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B. EXECUTION TIME

Table 2 provides the execution time required for FPD and GLCM algorithms for extracting features from facial images.

Table 2. Execution Time

Algorithms	Execution Time(sec)
Face part detection algorithm	28
GLCM(gray level co-occurrence matrix) algorithm	13

From the table it is proved that GLCM algorithm performs better than FPD algorithm with its less computing time.

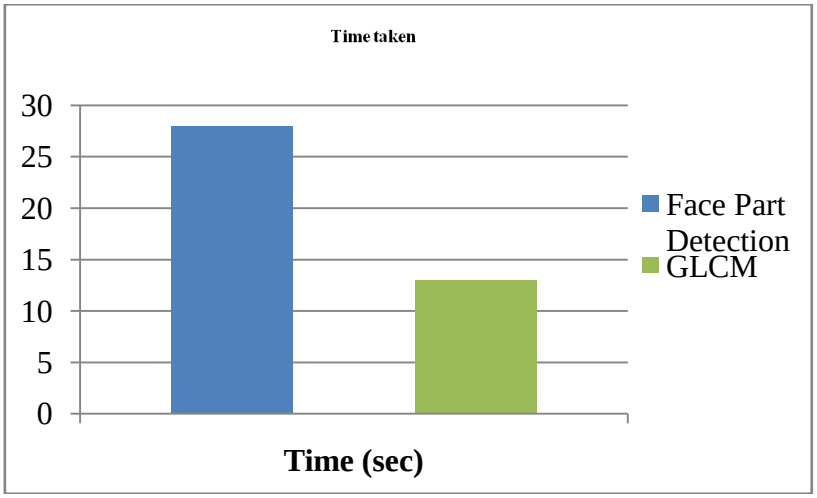

Fig 3: Algorithm Comparison for Time Execution

Figure 3 represents the execution time for FPD and GLCM. From this, we know that GLCM algorithm needs minimum execution time.

Fig4: Features extracted for FPD

Figure 4 displays the sample results produced by FPD algorithm. The features extracted are eyes, eyebrows and lips.

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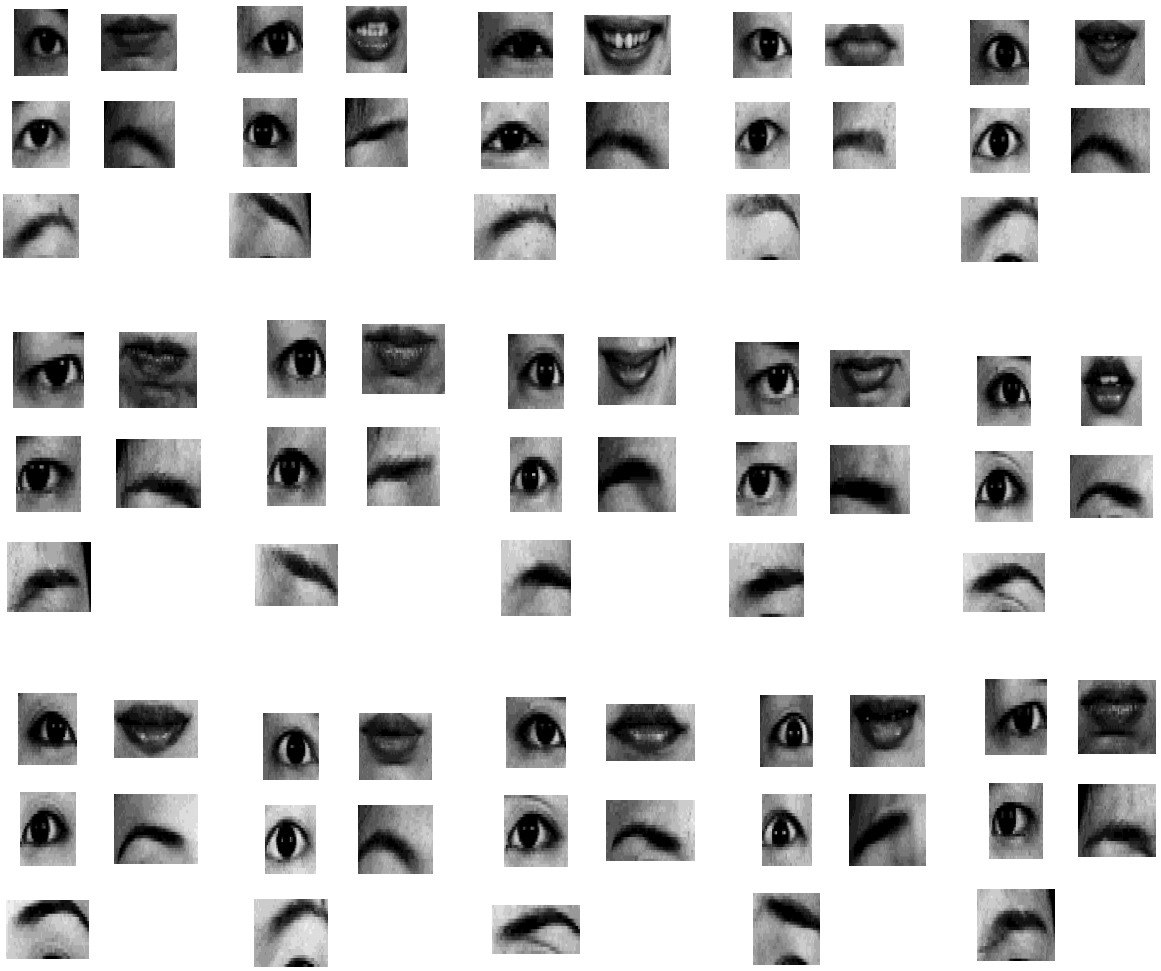

Fig 5: Features Extracted For GLCM

Figure 5 shows the output of GLCM algorithm. Here, each and every feature is extracted separately. From this, it is proved that GLCM algorithm is considered as best algorithm in detecting facial image features when compared to FPD algorithm.

VI. CONCLUSION AND FUTURE WORK

This research work analysed the performance of two facial feature extraction algorithms. From the experimental results, it is observed that the proposed GLCM feature extraction algorithm performance is comparatively better than FPD algorithm. In future, new algorithms are to be developed in order to improve the feature extraction accuracy.

REFERENCES

1. Davis L, "Human expression recognition from motion using a radial basis function network architecture", IEEE Transactions on Neural Networks, Vol. 7, pp. 1121-1138, 1996.
2. Gao Y , "Rapid Object Detection using a Boosted Cascade of Simple Features",IEEE Computer Society Conference on Computer Vision And Pattern Recognition, Kauai, HI, USA, pp. 511-518, 2001.
3. Hassan M, "Smart Human Face Detection System", International Journal of Computers, vol. 5, no. 2, pp. 210-216, 2011.
4. Jung H, "Face Occlusion Detection by using Active Contour and Skin Color Information", 11th International Conference. Control automation robotics and vision, pp. 627-632, 2010.
5. Jones M, "Robust Real-Time Face Detection", International Journal of Computer Vision, vol. 57, no. 2, pp. 137–154, 2004.
6. Kumar K, "Real Time Face Recognition Using ad boost Improved Fast PCA Algorithm", International Journal of Artificial Intelligence & Applications, vol.2, no.3, 2011.

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(An ISO 3297: 2007 Certified Organization)

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7. Lyons M, "Automatic classification of single facial images," IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 21, pp. 1357-1362, 1999.
8. Nikolaidis A, "Facial Feature Extraction and Pose Determination", Pattern Recognition, Elsevier, vol. 33, no. 11, pp. 1783-1791, 2000.
9. Padilla R, "Evaluation of Haar Cascade Classifiers Designed for Face Detection", World Academy of Science, Engineering and Technology, vol. 64, 2012.
10. Radha V, "Comparative Analysis of Curvelets Based Face Recognition Methods", Proceedings of the World Congress on Engineering and Computer Science, vol. 1, 2011.
11. Srivastava S, "Real Time Facial Expression Recognion Using A Novel Method", The International Journal of Multimedia & Its Applications, vol. 4, no. 2, pp. 49-57, 2012.
12. Song H, "Facial Feature Extraction for Face Modeling Program", International Journal of Circuits, Systems and Signal Processing, vol. 4, no. 4, pp. 169-176, 2010.
13. Vijayarani S, S.Priyatharsini, "Comparative Analysis of Facial Image Feature Extraction Algorithms", Journal of Multidisciplinary Engineering Science and Technology (JMEST), Vol. 2, Issue 2, pp. 107 – 112. 2015.
14. Viola P, "Face Recognition Using Boosted Local Features", IEEE International Conference on Computer Vision, 2003.
15. Yao Z, "Tracking a detected face with dynamic programming", Image and Vision, Computing, vol. 24, no. 6, pp. 573-580, 2006.
16. Yen G, "Facial Feature Extraction Using Genetic Algorithm", Proceedings of the Evolutionary Computation, vol. 2, pp. 1895-1900, IEEE, 2002.

BIOGRAPHY

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