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Face Recognition Using Enhanced Gradient Patterns

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ABSTRACT: In this paper, a face recognition method named Enhanced Gradient Patterns using features of both image gradients and LBP is proposed**.**The target of this paper is to develop robust face recognition system that has the capability to recognise the facial images of a dataset, after getting trained with the images of the dataset**.**In recent years, Use of image Gradients is quite common in face detection and local pattern based methods have attracted increasing interest in object detection and recognition systems. Local Binary Pattern (LBP) method is widely used in texture classification, face detection and recognition. According to the definition of LBP, it is not suitable for humanrecognition and detection, due to bigger human sizes and their variations. Variants of enhanced LBP are proposed for better results than LBP. The image gradient method only use the values of 4 neighbour pixels to calculate the edge direction and gradient value, which it not powerful to classify some curves with different radians, it is disturbed from the noise. Face recognition using these Enhanced Gradient Patterns exhibit profound robustness against various facial image variations, in particular illumination.The experimental results on AT&T Dataset show that Enhanced Gradient Patterns achieves the best recognition rate of 92% compared with other methods.

KEYWORDS: Enhanced Gradient Patterns (EGP);Local Binary Pattern (LBP); Image Gradients; AT&T Dataset; Computer Vision.

I. INTRODUCTION

Face detection is a key problem in computer vision, which is widely used in image analysis, intelligent vehicle and visual surveillance. However, the task of face recognition is rather challenging because of high variations of clothing, pose, occlusion, scale and illumination. In face recognition systems, feature extraction and training or learning method are two important parts and hot research topics. [1] Although face detection techniques have become practical, face recognition in images and videos is always an active research topic in computer vision, with a number of applications that have the potential to impact quality of life.

Enhanced Gradient Patterns method is proposed in such a way that gradient information and texture information are intra-combined. Compared with other gradient based features, this method can get more powerful edge direction information and remove some pixel noise. EGP can read images of different poses at different illuminations by getting the gradient information for each pixel to focus the important part of the images. The recent increase in popularity of gradient feature descriptors has opened the door to new lightweight computer vision applications. Most research efforts thus far have been dedicated to the introduction of new gradient features, which are primarily used for key point description and facial matching.

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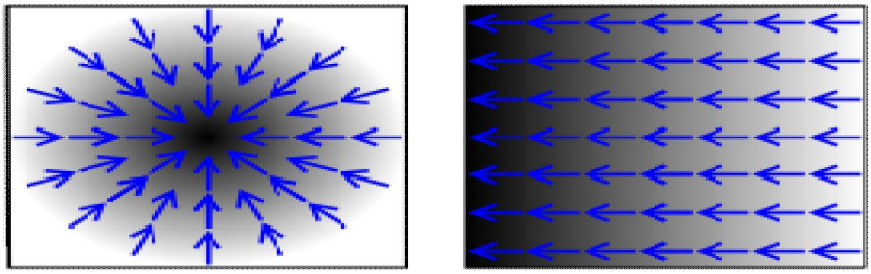

Fig.1.Image Gradient

The main purpose of this paper is to perform face recognition on a trained dataset. This system performs robust facial recognition which gives best results in limited illumination and variable poses. It also gives better results in discrimination, robustness and complexity. Enhanced Gradient Patterns is divided into three main steps: 1) Creating a facial database, 2) Training the facial dataset of the images, 3) Testing the recognition phase with an input image.

II. RELATED WORK

In [2] Ning jiang et al. usedGradient Local Binary Patterns Method for Human Detection where a patterns cutting algorithm for reusing the lost information from non-uniform patterns, and a new formula for gradient valuecalculation using binary values of LBP are proposed. But a Window size used here is fixed here. In [3] Weilin Huang et al. presented a compact and efficient yet powerful binary framework based on image gradients for robust facial representation, but it is yet to use in real time application. In [4] Md. Abdur Rahim et al. proposed Face Recognition usingLocal Binary Patterns (LBP) and it Provides similaritymeasure between images but it is Prone to facial occlusions. In [5] Timo Ahonen et al. proposed Face Description with LocalBinary Patterns:Application to FaceRecognition, it Provides robustnessagainst face localization error but Prone to pose and lightingvariations. In [6] Timo Ojala et al. proposed Multiresolution Gray Scaleand Rotation InvariantTexture Classificationwith Local Binary Patterns and it provides very powerfultool for rotation invariant texture analysis but it is prone to expression and age variations. In [7] Marko Heikkila et al. proposed Description of InterestRegions with LocalBinary Patterns, it very robust to occlusionand illumination changes but it is prone to extreme lighting. In [8] Semin kim et al. proposed Image based coinrecognition using rotationinvariant region binarypatterns based on gradientmagnitudes and it provides robustnessagainst rotation and hashigh accuracies for imagebased coin recognition but it is prone to variation in size ofthe objects. In [9] Guoying zhao et al. proposed Dynamic TextureRecognition Using LocalBinary Patterns with an application to FacialExpressions and It provides localprocessing, robustness tomonotonic gray-scale changes but it is limited by extra lighting. In [10] Shengcai Liao etal. proposed Learning Multi-scale BlockLocal Binary Patterns forFace Recognition, but it is prone to lighting variations. In [11] Caifeng shan et al.Robust facial expressionrecognition using localbinary patterns, it is used in real-worldapplications where onlylow-resolution video input is available but it is prone to local deformation.

III. PROPOSED ALGORITHM

A. *Design Considerations:*

- A facial database is needed and in this paper AT&T database is used, the image size should be 180 * 200 pixels.
- Select training and test database paths&Select path of the test image.
- Run 'CreateDatabase' function to create 2D matrix of all training images.
- Run 'EnhancedGradientPatterns' function to produce basis's of Gradient faces.
- Run 'Recognition' function to get the equivalent image in training database.

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B. *Description of the Proposed Algorithm:*
Aim of the proposed algorithm is todevelop robust face recognition system that has the capability to recognize the facial images of a dataset that exhibit profound robustness against various facial image variations, in particular illumination.The proposed algorithm is consists of three main steps.

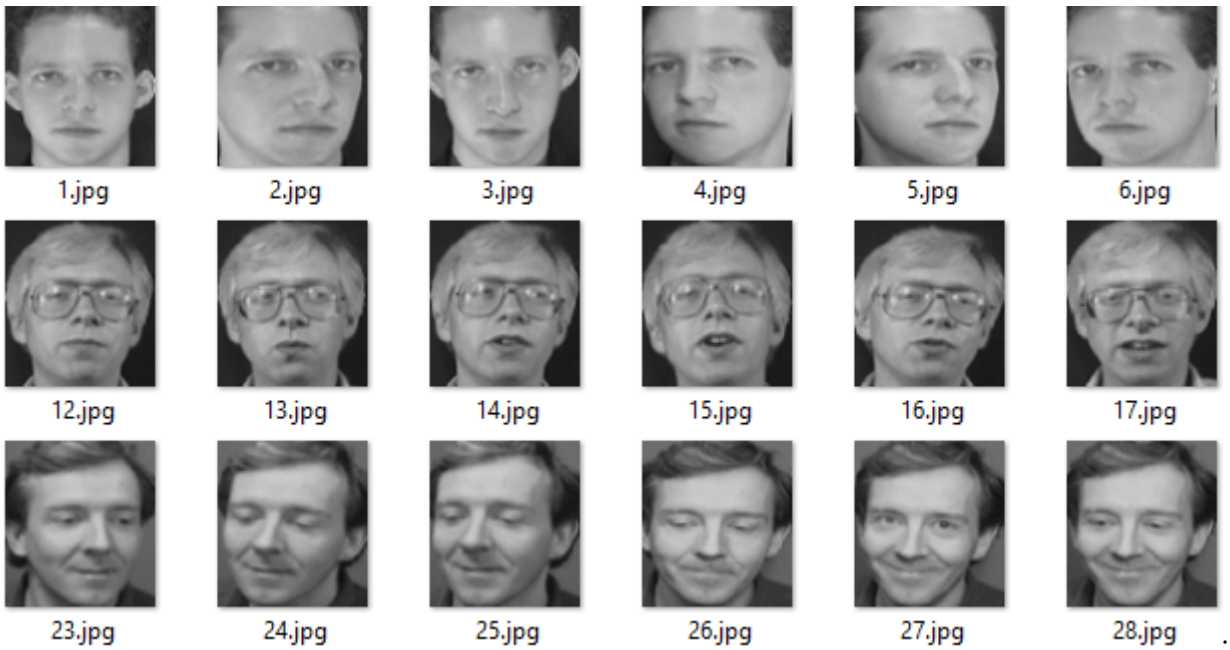
Step 1: Creating database:
Align a set of face images (the training set T1, T2, ... , TM)

Description: This function reshapes all 2D images of the training databaseinto 1D column vectors. Then, it puts these 1D column vectors in a row to construct 2D matrix 'T'. Each column of 'T' is a training image, which has been reshaped into a 1D vector.Also, P is the total number of MxN training images and C is the number ofclasses.

Argument: TrainDatabasePath - Path of the training database

Returns: T - A 2D matrix, containing all 1D image vectors.
The length of 1D column vectors is MN and 'T' will be a MNxP 2D matrix.

.
Step 2: Training the dataset:



:

Fig.2. Sample dataset of training database.

The images in the dataset are considered and their image gradients values are computed. These gradients show strong orientational power than its other counterparts.

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Step 3: Recognition phase:

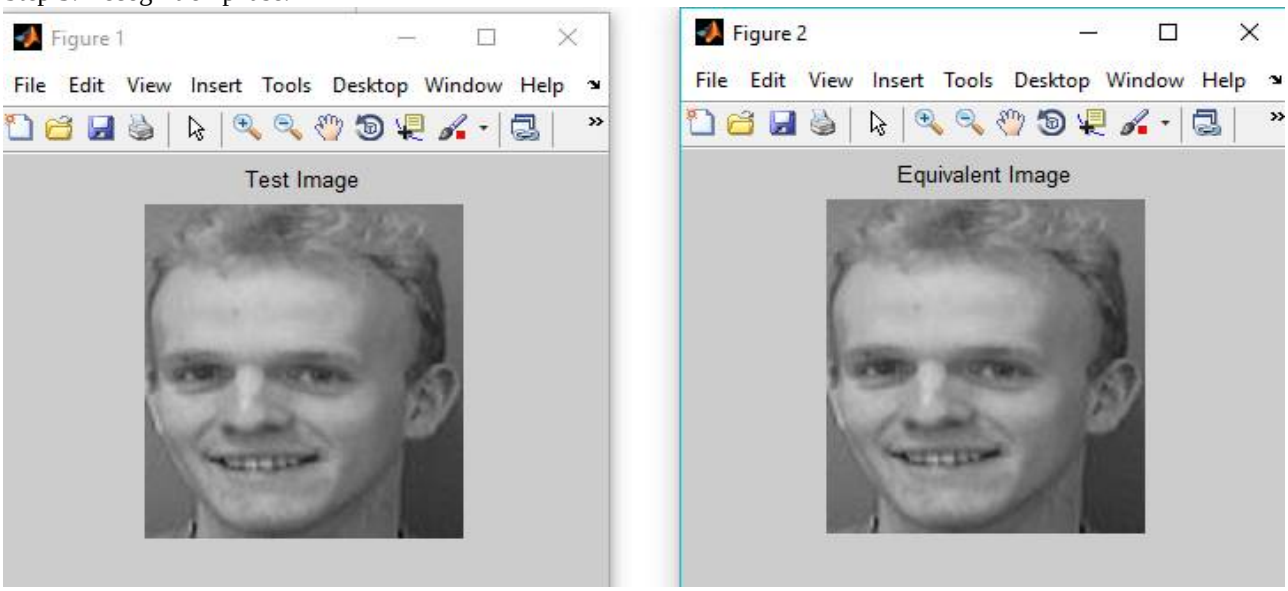

Fig.3. Face recognition using EGP.

Here, the code is written in matlab. We need to run the testing example function which is incorporated with functions of creating a database, Enhanced gradient pattern functions. After running the example function, one dialogue box opens up on which we select the train database and database. Then if you give you the number corresponding image, it will give image of the same person as shown above.Matlab code for training and testing are given below.

Code:

```
TrainDatabasePath = uigetdir(strcat(matlabroot,'\work'), 'Select training database path' );
TestDatabasePath = uigetdir(strcat(matlabroot,'\work'), 'Select test database path');
prompt = {'Enter test image name (a number between 1 to 24):'};
dlg_title = 'Input of the Face Recognition System';
num_lines= 1;
def = {'1'};
TestImage  = inputdlg(prompt,dlg_title,num_lines,def);
TestImage = strcat(TestDatabasePath,'\',char(TestImage),'.jpg');
im = imread(TestImage);
T = CreateDatabase(TrainDatabasePath);
[m,ProjectedImages] = Enhanced_Grtadient_Pattern(T);
OutputName = Recognition(TestImage, m, ProjectedImages);
SelectedImage = strcat(TrainDatabasePath,'\',OutputName);
SelectedImage = imread(SelectedImage);
imshow(im)
title('Test Image');
figure,imshow(SelectedImage);
title('Equivalent Image');
str = strcat('Matched image is :  ',OutputName);
disp(str)
```

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IV. PSEUDO CODE

Step 1: Create database of training images and testing images.
Step 2: Select training database path.
Step 3: Select test database path.
Step 4: CreateDatabase(TrainDatabasePath).
Step 5: Run 'EnhancedGradientPatterns' function to produce basis's of Gradient faces.
Step 6: Enter test image name, it will Run 'Recognition' function to get the equivalent image in training database.
Step 7: It will display equivalent matched image from trained image dataset.
Step 8: End.

V. SIMULATION RESULTS

Through this paper, I evaluated the performance of Enhanced Gradient Patterns based face recognition and its robustness against multiple variations in illumination, expression, occlusion and age.The Database used here is AT&T database, where it contains ten different images of each of 40 distinct subjects. For some subjects, the images were taken at different times, varying the lighting, facial expressions (open / closed eyes, smiling / not smiling) and facial details (glasses / no glasses). All the images were taken against a dark homogeneous background with the subjects in an upright, frontal position (with tolerance for some side movement). he database can be retrieved from http://www.cl.cam.ac.uk/Research/DTG/attarchive:pub/data/att_faces.tar.Z as a 4.5Mbyte compressed tar file or fromhttp://www.cl.cam.ac.uk/Research/DTG/attarchive:pub/data/att_faces.zip as a ZIP file of similar size.

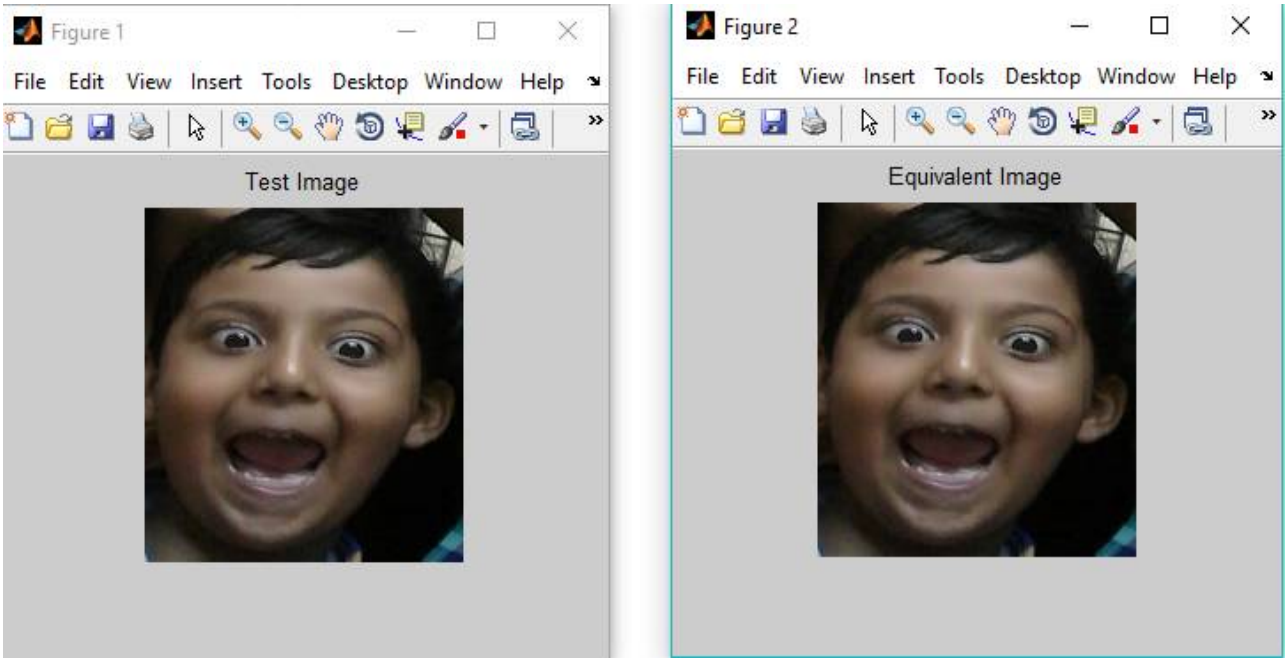

Fig.4. Robustness of EGP over different expression.

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The performance of EGP under illumination invariance was evaluated on the AT&T database as shown in the above process. This Enhanced Gradient patterns yielded better results when compared to its other counterparts such as Gabor wavelets, Eigenfaces, Fisherfaces etc., although some of the images considered here are under illumination, this method gave us better results by recognizing equivalent matching images from the training database.

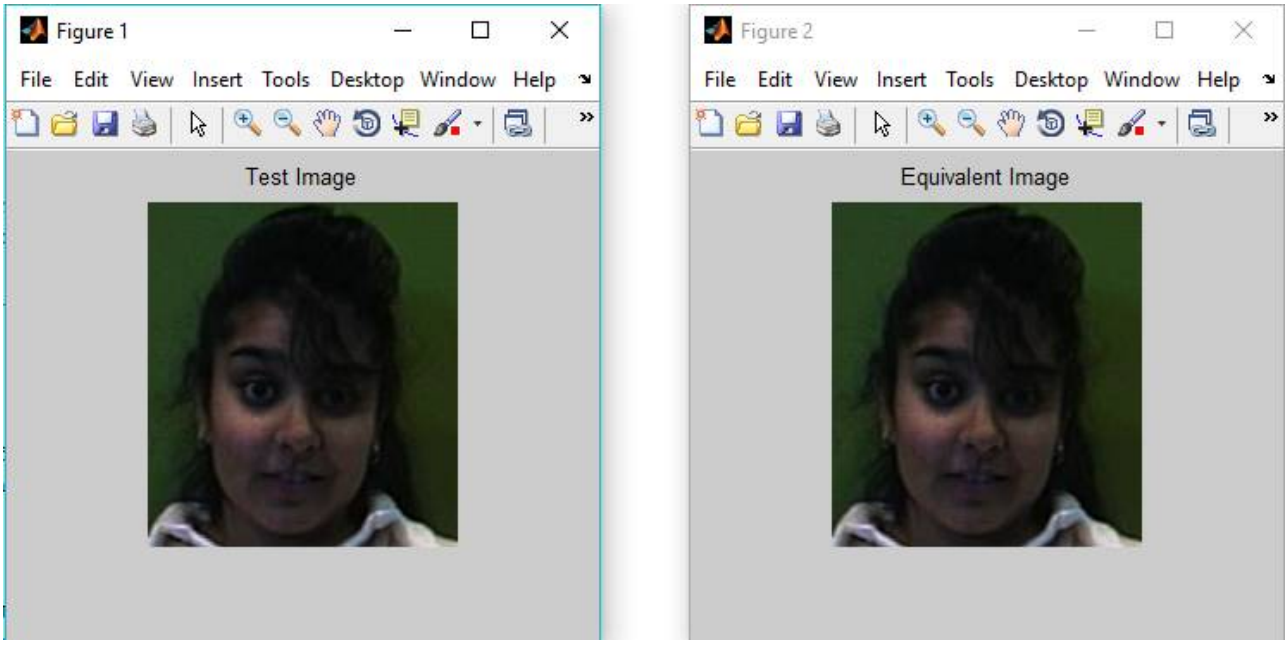

Fig.5. EGP recognizing matched images under low illumination.

VI. CONCLUSION AND FUTURE WORK

This system significantly improves over the existing face recognition systems and state-of-the-art methods in the terms of discrimination, robustness and complexity. This Enhanced Gradient Patterns achieve invariance against both illumination and local distortions. This is generic and suitable for building fusion models. This method has shown significant performance improvements in face recognition over the existing methods on a variety of robustness tests against variations in lighting, expression, occlusion and aging. This algorithm can be integrated with Deep learning mechanisms, which helps in building well defined, discriminative facial descriptors, which still plays a dominant role in face recognition applications.**My** Future work will look into how this Enhanced Gradient patterns and deep learned algorithms can work best in real applications.

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BIOGRAPHY

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