SFTA FEATURE DESCRIPTOR FOR MATCHING OPTICAL AND SKETCH PHOTO IMAGE

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Abstract- This paper presents a novel approach to address the representation issue and the matching issue in face recognition (verification). Face recognition has gained a widespread attention due to its potential application values as well as theoretical challenges compared with other biometrics. The major difficulty lies in face recognition is modality gap may occur, texture, and shape in the sketch face image and corresponding optical face images because they are different dimension, resolution, memory size, etc. In order to recognize face sketch through face photo database is a challenging task for many reaches because face photo image in training set and face sketch image in testing set have different modality, texture and shape is main difficulty for recognition. It may also deals with many crimes occur when none of such information is present, but instead an eye witness of the crime is available in such situation a forensic artist is found used to work with the witness or the victim in order to draw a sketch that depicts the facial appearance of the culprit according to the verbal description such as sketch drawn depending on the description given by an eye witness is called forensic sketch.

I. INTRODUCTION

Image Processing is a technique to enhance raw images received from cameras/sensors placed on satellites, space probes and aircrafts or pictures taken in normal day-today life for various applications. Most of the techniques are developed for enhancing images obtained from unmanned spacecrafts, space probes and military reconnaissance flights. Image Processing systems are becoming popular due to easy availability of powerful personnel computers, large size memory devices, graphics software's etc. The common steps in image processing are image scanning, storing, enhancing and interpretation. There are two methods available in Image Processing. They are Analog Image Processing and Digital Image Processing. Analog Image Processing refers to the alteration of image through electrical means. The most common example is the television image. The television signal is a voltage level which varies in amplitude to represent brightness through the image.

By electrically varying the signal, the displayed image appearance is altered. The brightness and contrast controls on a TV set serve to adjust the amplitude and reference of the video signal, resulting in the brightening, darkening and alteration of the brightness range of the displayed image. In this case, digital computers are used to process the image. The image will be converted to digital form using a scanner – digitizer and then process it. It is defined as the subjecting numerical representations of objects to a series of operations in order to obtain a desired result. It starts with one image and produces a modified version of the same. It is therefore a process that takes an image into another. The term digital image processing generally refers to processing of a two-dimensional picture by a digital computer. In a broader context, it implies digital processing of any two-dimensional data. A digital image is an array of real numbers represented by a finite number of bits. The principle advantage of Digital Image Processing methods is its versatility, repeatability and the preservation of original data precision.

There are several image processing techniques such as, Image representation, Image enhancement, Image restoration, Image analysis and reconstruction first, we see how to represent the image. An image defined in the "real world" is considered to be a function of two real variables, for example, f(x,y) with f as the amplitude (e.g. brightness) of the image at the real coordinate position (x,y). The 2D continuous image f(x,y) is divided into N rows and M columns. The intersection of a row and a column is called as pixel. The value assigned to the integer coordinates [m,n] with {m=0,1,2,...,M-1} and {n=0,1,2,...,N-1} is f[m,n]. In fact, in most cases f(x,y) which we might consider to be the physical signal that impinges on the face of a sensor. Typically an image file such as BMP, JPEG, TIFF etc., has some header and picture information. A header usually includes details like format identifier (typically first information), resolution, number of bits/pixel, compression type, etc. Now, we discuss about the Image Enhancement Techniques. Sometimes image obtained from satellite and conventional and digital cameras lack in contrast and brightness because of the limitations of imaging sub systems and illumination conditions while capturing image.

Images may have different types of noise. In image enhancement, the goal is to accentuate certain image features for subsequent analysis or for image display. Examples include contrast and edge enhancement, pseudo-coloring, noise filtering, sharpening, and magnifying. Image enhancement is useful in feature extraction, image analysis and an image display. The

enhancement process itself does not increase the inherent information content in the data. It simply emphasizes certain specified image characteristics. Enhancement algorithms are generally interactive and application dependent. Image analysis is concerned with making quantitative measurements from an image to produce a description of it. In the simplest form, this task could be reading a label on a grocery item, sorting different parts on an assembly line, or measuring the size and orientation of blood cells in a medical image.

More advanced image analysis systems measure quantitative information and use it to make a sophisticated decision, such as controlling the arm of a robot to move an object after identifying it or navigating an aircraft with the aid of images acquired along its trajectory. Image analysis techniques require extraction of certain features that aid in the identification of the object. Segmentation techniques are used to isolate the desired object from the scene so that measurements can be made on it subsequently. Quantitative measurements of object features allow classification and description of the image. Image restoration refers to removal or minimization of degradations in an image. This includes de-blurring of images degraded by the limitations of a sensor or its environment, noise filtering, and correction of geometric distortion or non-linearity due to sensors. Image is restored to its original quality by inverting the physical degradation phenomenon such as defocus, linear motion, atmospheric degradation and additive noise. Image reconstruction from projectionsis a special class of image restoration problems where a two (or higher) dimensional object is reconstructed from several one dimensional projections. Each projection is obtained by projecting a parallel X-ray beam through the object. Planar projections are thus obtained by viewing the object from many different angles. Reconstruction algorithms derive an image of a thin axial slice of the object, giving an inside view otherwise unobtainable without performing extensive surgery. Such techniques are important in medical imaging (CT scanners), astronomy, radar imaging, geological exploration, and nondestructive testing of assemblies. Compression is a very essential tool for archiving image data, image data transfer on the network etc. They are various techniques available for lossy and lossless compressions. One of most popular compression techniques, JPEG (Joint Photographic Experts Group) uses Discrete Cosine Transformation (DCT) based compression technique. Currently wavelet based compression techniques are used for higher compression ratios with minimal loss of data.

The applications of image processing are Remote Sensing, Medical Imaging, Non-destructive Evaluation, Forensic Studies, Textiles, Material Science, Military.

II. LITERATURE SURVEY

Face recognition system is a computer application for automatically identifying or verifying a person from optical image. One of the ways to do this is by comparing selected face feature from the image and a face database. It is typically used in security system and can be compare to other biometrics such as fingerprint, eye iris recognition system .Facial recognition can be a crime–fighting tool that law enforcement agencies can use to recognize people based on their eyes and face. In general Recognition algorithm can be divided into two main approaches,
Geometric, which looks at distinguishing features or
Photometric, which is a statistical approach that distills an image into values and compares the values with templates to eliminate variances. Popular recognition algorithm include principal component analysis using Eigen faces, linear discriminate analysis, elastic bunch graph matching using the fisherface algorithm, the hidden markov model, the multilinear subspace learning using tensor representation, and the neuronal motivated dynamic link matching.

Common Feature Discriminant Analysis(CFDA) here a new descriptor is used to learn a set of optimal hyperplanes quantize continuous vector space in to discrete partitions for common feature extraction and an effective Discriminant analysis. Here vector quantization technique is used. an image can be turned in to an encoded image by converting each pixel in to specific code using the vector quantization technique. Here we design a hyperplane based encoding method for effective feature representation for heterogeneous face images by using this descriptor we can obtain a high dimensional feature vector for each optical or infrared images in this method matching framework is based on LFDA method. The main motivation behind the undertaking of the paper is that there are a lot of problem in forensic sketch recognition compared to normal face recognition (in which both probe and gallery images are photographs). The texture of sketches whether they may be viewed or forensic are quite different from that of the gallery of photographs that were being matched against. Previous work in sketch matching is done only on viewed sketches even though most world scenarios involve forensic sketches only. Due to the petulant nature of the memory, the exact appearance of the criminal cannot be remembered by the witness. This leads to an incomplete and inaccurate depiction of the sketches which reduces the recognition performance substantially.

In biometric technology has provided criminal investigators additional tools to determine the criminal's identity. In additional to DNA and circumstantial evidence, if a dormant fingerprints is

found at the investigative sight or a surveillance camera captures an image of a suspect face, then these cues may be used to determine the identity of culprit using automated biometric identification. However many crimes occur when none of such information is present, but instead an eye-witness of the crime is available. In such situation a forensic artist is often used to work with the witness or the victim in order to draw a sketch that depicts the facial appearance of the culprit according to the verbal description, such sketch drawn depending on the description given by an eye witness is called forensic sketch To recognize a face sketch we have first tried to reduce the modality difference between face photo and face sketch which is the most important part in face sketch recognition system. Before extraction of the features from face photo and face sketch we have done some preprocessing task. In this step, photos are in color, first converted the RGB color to gray level and all the face photos and face sketches are resized with the dimension of 50 × 65 pixels. The drawback of this approach is that the local patches are synthesized independently at a fixed scale and face structures in large scale, especially the face shape, cannot be well learned. the drawback of this approach is that it requires a training set containing photo-sketch pairs. It proposed an example-based face cartoon generation system. It was also limited to the line drawings and required the perfect match between photos and line drawings in shape. The lack of technology to effectively capture the biometric data like finger prints within a short span after the scene of crime is a routine problem in remote areas. The Police department deploys a forensic artist to draw a sketch that depicts the facial appearance of the culprit. Two key difficulties highlighted in matching forensic sketches are: (1) Matching across image modalities, and (2) performing face recognition despite possibly inaccurate depictions of the face.

III. PROPOSED WORK

In general every face recognition system need to perform there subtasks, as face detection, feature extraction, and classification. For sketch recognition system need to perform four subtask as, face detection, modality reduction, feature extraction, and classification. In our system model we using feature descriptor as, segmentation based fractal texture analysis (SFTA). Recently various methods have been proposed to address the problem of face sketch recognition by matching optical image to sketch image. In this paper we propose a new descriptor as SFTA and Discrete wallet transform (DWT). In DWT we have many transform but in our system we propose Discrete haar transform is applied on face photo and face sketch at scale 3 than we consider only diagonal coefficient images. At last, to improve the result of modality reduction, an integer(I) is added to every sketch image. In 2d discrete haar transform initially decompose an image into four components: approximated image(LL), the horizontal image(HH), the vertical image (HL), and the diagonal details information(HH) System architecture consists of both optical image as well as sketch image based on DWT, learning based feature In DWT we have many transform but in our system we propose Discrete haar transform is applied on face photo and face sketch at scale 3 than we consider only diagonal coefficient images. At last, to improve the result of modality reduction, an integer (I) is added to every sketch image.

This paper is mainly used to correctly identify the face photo with the sketch photo. This paper consists of two phase namely training and testing. The general algorithm steps are as follow:

- Module 1: Detect the edges of the image using fuzzy logic.
- Module 2: Taking DWT of the face and sketch photo
- Module 3: Finding feature vector for each image using SFTA feature descriptor
- Module 4: Matching Sketch photo with Face photo

3.1 Image Acquisition:

In any image processing application, the first step is to read the image from the system. Here the objective of this project is to match the face photo with sketch photo. This project takes both the face photo and face sketch image from CUHK Database.

3.2 Edge Detection of face and sketch photo using Fuzzy logic

The first step is to detect the edges of both face photo and face sketch image. This project detected the edges in an image using a FIS, comparing the gradient of every pixel in the x and y directions. If the gradient for a pixel is not zero, then the pixel belongs to an edge (black). This project defined the gradient as zero using Gaussian membership functions for your FIS inputs.

Input: Face photo and Sketch photo

Output: Edge Detected Face and Sketch photo descriptor, hyperplane image of techniques are used. Training and testing dataset uses as input of the system, then rescaled for both dataset. To get crown region, the process of thresholding and filtering is used. The feature extraction consists of color and texture that are combined by collecting the digital information around the crown area. Color feature is one of important things to assess the diversity of colors at the same class. Each default image has same color space, i.e., RGB. RGB is non-uniform color that cannot be represented by human eye perception, SFTA applied multilevel Otsu thresholding to decompose segmented image in several parts. Two-Thresholding Binary Decomposition (TTBD) is computed for generating image in a couple. If the

default number of thresholds input is 8, there were obtained 16 images in each input image, in which each image has 3 vector features that represent boundaries of fractal dimension. The measurement of the fractal applied to describe the complexities of boundary and structures of segmented image, so the SFTA feature vector corresponds to the number of binary images obtained in TTBD phase. Three vector features extracted in each binary image are fractal dimension, mean gray level, and size of area image.

 Import the image into MATLAB.

 is a integer array. The three channels of (third array dimension) represent the red, green, and blue intensities of the image.

 Convert to grayscale so that it works with a 2-D array instead of a 3-D array. Use the standard NTSC conversion formula to calculate the effective luminance of each pixel. Alternatively, we can use the rgb2gray function in the Image Processing Toolbox software to convert to grayscale.

 The Fuzzy Logic Toolbox software operates on double-precision numbers only. So, convert a integer array, to a double array. Because integer values are in the [0 255] range, all elements of I are in that range too. Scale I so that its elements are in the [0 1] range. Alternatively, we can use the im2double function in the Image Processing Toolbox software to convert grayscale image to a scaled, double-precision image.

 The fuzzy logic edge-detection algorithm relies on the image gradient to locate breaks in uniform regions.

Calculate the image gradient along the x-axis and y-axis.

 and are simple gradient filters. Now convolute I with Gx, using the conv2 function, to obtain a matrix containing the x-axis gradients of I. The gradient values are in the [-1 1] range. Similarly, convolute I with Gy to obtain the y-axis gradients of I. Alternatively, if we have the Image Processing Toolbox software, you can use the imfilter, imgradientxy, or imgradient functions to obtain the image gradients.

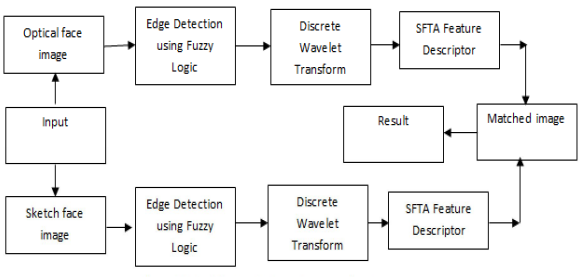


Figure 3.1 Architectural view of proposed system

3.2.1 Define Fuzzy Inference System (FIS) for Edge Detection

 Create a Fuzzy Inference System (FIS) for edge detection, edgeFIS.

 Specify the image gradients, and, as the inputs of edgeFIS.

 Specify a zero-mean Gaussian membership function for each input. If the gradient value for a pixel is 0, then it belongs to the zero membership function with a degree of 1.

 and specify the standard deviation for the zero membership function for the and inputs. We can change the values of and to adjust the edge detector performance. Increasing the values makes the algorithm less sensitive to the edges in the image and decreases the intensity of the detected edges.

 Specify the intensity of the edge-detected image as an output of edgeFIS.

 Specify the triangular membership functions, white and black, for .

 As we can with and , we can change the values of , , , , , and to adjust the edge detector performance. The triplets specify the start, peak, and end of the triangles of the membership functions. These parameters influence the intensity of the detected edges.

3.2.2 Specify FIS Rules

 Add rules to make a pixel white if it belongs to a uniform region.

 Otherwise, make the pixel black.

3.2.3 Evaluate FIS

 Evaluate the output of the edge detector for each row of pixels in using corresponding rows of and as inputs.

3.3Taking DWT of the face and sketch photo

Apply DWT of the images (both face and sketch photo) with decomposition level of using Haar Wavelet.

The two dimensional wavelet decomposition computes approximation coefficient matrix and detail coefficient matrix. The various detail coefficient matrix are horizontal, vertical and diagonal coefficient matrix. This project takes the diagonal coefficient matrix of both face and sketch image for the processing.

3.4 Finding feature vector for each image using SFTA feature descriptor

Convert image into 8 bit integer matrix. If the given image is RGB, then convert it into grayscale image. Then, we apply OTSU thresholding algorithm to the resultant image to create the threshold values through which we can create more number of thresholds. In computer vision and image processing, Otsu's method is used to automatically perform clustering-based image thresholding, or, the reduction of a gray level image to a binary image. The algorithm assumes that the image contains two classes of pixels following bi-modal histogram (foreground pixels and background pixels), it then calculates the optimum threshold separating the two classes so that their combined spread (intra-class variance) is minimal. The extension of the original method to multi-level

thresholding is referred to as the Multi Otsu method. Apply Two threshold decomposition algorithm to the DWT image. Then find the borders according to the various threshold values. Find the three features such as box counting, mean gray level and pixel count.

Input: DWT level 3 decomposition image and number of thresholds
Output: Feature Vector

- The set of thresholds is computed using the multi-level Otsu algorithm.
- All pairs of contiguous thresholds in T are added to T_A.
- The pairs of thresholds $\{t_i, n_l\}$, where $n_l$corresponds to the maximum gray level in $I(x;y)$, are added to T_B.
- Then it iterates over all pairs of thresholds in $T_A \cup T_B$.
- Each pair of thresholds is used to compute the two threshold segmentation as described in equation as follow:

$$I_b(x,y) = \begin{cases} 1, & if\ t_l < I(x,y) \le t_u \\ 0, & otherwise \end{cases}$$

- Then find the fractal dimension, mean gray level and region area.
- Fractal dimension can be efficiently computed in linear time by the box counting algorithm.

3.5 Matching face photo with sketch photo
The final step is to match the face photo with sketch photo. If both the face and sketch photo belongs to same person, then matching must be successful and if the face and sketch photo belongs to different person, then no matching will be done. If the matching process satisfies this condition, then these papers will 100% successful, or otherwise it will not be 100 % successful.

IV. RESULTS AND DISCUSSION

This section deals with the various results produced in these papers.

4.1 Image Acquisition:
Some of the images from CUHK face photo and sketch Database is shown in Figure 4.1 and 4.2 respectively.



Figure 4.1 Face Photo from CUHK Database

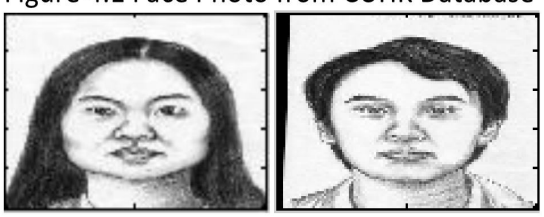


Figure 4.2 Face Sketch from CUHK Database

4.2 Edge Detection of face photos using Fuzzy logic
Figure 4.3 and 4.4 shows the edge detected image for the image shown in figure 4.1 and 4.2 respectively which is done by fuzzy logic system.

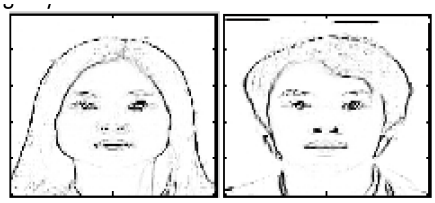


Figure 4.3 Edge detected image of face photos in figure 4.1



Figure 4.4 Edge detected image of face sketch in figure 4.2

4.3Taking DWT of the face and sketch photo
Figure 4.5 and 4.6 shows the some of the face and sketch photo from CUHK database and its corresponding
diagonal coefficient matrix respectively.

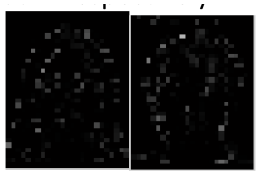


Figure 4.5 DWT of edge detected face photo

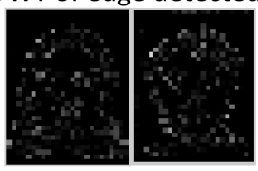


Figure 4.6 DWT of edge detected sketch photo

4.4 SFTA Feature Descriptor:
Figure 4.7 and 4.8 shows a feature vector for wavelet transformed edge detected face and sketch photo.

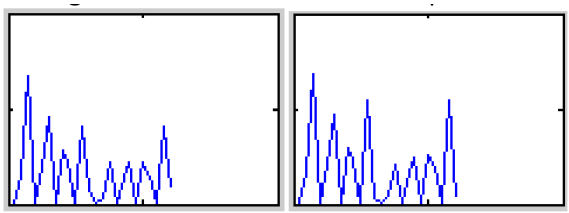


Figure 4.7 Feature Vector of face photo

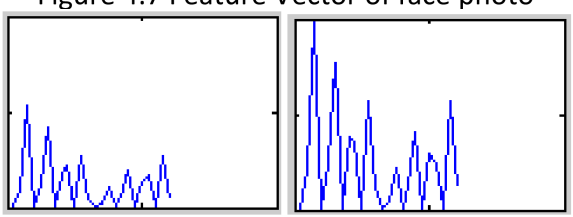


Figure 4.8 Feature Vector of face sketch

CONCLUSION AND FUTURE WORK

Thus, this paper completes three steps namely edge detection, wavelet decomposition, and feature descriptor of the complete face detection process. The edge detection is successfully done by fuzzy logic through which edges of the images only detected. After that, decompose the edge detected image into 4 components and successfully select the diagonal component of the face image.

Finally, this paper completes with feature descriptor which is done by SFTA method. Through this technique, it successfully extract the feature depends on area, mean and fractal dimension. In future, this paper will proceed to principal component analysis and finally to match the sketch image to optical image.

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