ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 2, Issue 2, pp: (278-282), Month: April-June 2014, Available at: www.researchpublish.com

AN IMPLEMENTATION OF FEATURE-LEVEL FUSION OF FACIAL AND THUMB PRINT IMAGES

L Logeswari[1] and Dr.R.Indra Gandhi[2]

[1]Research Scholar, Dept of Computer Applications, GKM College of Engineering and Technology, Chennai-63
[2]Professor, Dept of Computer Applications, GKM College of Engineering and Technology, Chennai-63

Abstract: **The increasing applications of Face recognition system in various fields are the motivating factor for me to propose new methods to improve the recognizing rate of the face images. The aim of this paper is to develop a robust method for face recognition and classification of persons in-order to increase the recognition rate by improving the efficiency of the system and reducing its complexity. I desired to develop this project to automate the entire process of face recognition given a set of facial database and to improve the performance of the face recognition system. The proposed approach is based on the fusion of face and fingerprint traits at feature extraction level. Here the independent features of the two modalities are extracted and then fused together for further recognition and classification. Two different algorithms are used in extracting the features of face and fingerprint traits. I have applied SIFT algorithm for extracting the facial features and Minutiae algorithm for extracting the features of fingerprint. Later, the features are combined together and the Euclidean distance metrics is used for recognition and the classification of persons is done using the labels. The proposed system has been proved to be efficient and the accuracy of recognition has been improved.**

Keywords: **SIFT Algorithm, Minutiae Algorithm, Euclidean distance, Feature extraction, Classifiers.**

I. INTRODUCTION

Face recognition is an important research problem spanning numerous fields and disciplines. This is because face recognition, in addition to numerous practical applications such as access control, security monitoring, bankcard identification, mug-shots searching, and surveillance system, is a fundamental human behaviour that is essential for effective communications and interaction among the people. Face recognition presents a challenging problem in the field of image analysis and computer vision, and as such has received a great deal of attention over the last few years because of its many applications in various domains. The face recognition problem can be formulated as follows: Given an input face image and a database of face images of known individuals, should be capable of verifying or determining the identity of the person in the input image. Several algorithms and methods are in existence for face recognition, but still researches are carried out in this field to improve the efficiency of the system. A multi-modal biometric system is a form of computer application that combines more than one form of traits such as face and fingerprint for recognition and automatically identifying or verifying a person. One of the ways to do this is by comparing selected facial features from the image and a facial database. Some facial recognition algorithms identify facial features by extracting landmarks, or features, from an image of the subject's face. For example, an algorithm may analyze the relative position, size, and/or shape of the eyes, nose, cheekbones, and jaw. These features are then used to search for other images with matching features. Other algorithms normalize a gallery of face images and then compress the face data, only saving the data in the image that is useful for face recognition. A probe image is then compared with the face data.

This paper focuses on obtaining a multi-modal biometric system that makes use of the face and the fingerprint traits for recognition and classification. The features of the two modalities are extracted separately using two different algorithms and then they are fused together at the feature extraction level itself. A biometric system that integrates information at an earlier stage of processing is expected to provide more accurate results than the systems that integrate information at a later stage, because of the availability of more richer information. Since the feature set contains much richer information on the source data than the matching score or the output decision of a matcher, fusion at the feature level is expected to provide better recognition performances.

II. LITERATURE REVIEW

In our electronically inter-connected society, reliable and user-friendly recognition and verification system is essential in many sectors of our life. The person's physiological or behavioural characteristics, known as biometrics, are important and vital methods that can be used for identification and verification. Face and Fingerprint recognition are the most popular biometric techniques used in automatic personal identification and verification. In Zhan-Li Sun et al has developed a new method for correcting a gradient field of a face. First, a height map is generated with a global maximum located at a critical point located at the tip of the nose. Second, the recovered surface is forced to be convex in accordance with evidence provided by local shape indicators. It has been proved that the simple idea of modifying the surface normal directions so as to restore the convexity of imploded features using the constraints derived from the location of a point of global maximum height seems to work well with the recovery of face surfaces. After integration, the recovered shape preserves most of the salient facial features, including the nose lips and eye-sockets. As the accuracy of the reconstruction will depend on the gradient data, pre-processing steps for correcting intensities would probably improve the quality of the results, if a more accurate height map is required.

M. D. Levine and Y. F. Yu, in combine deformable 3 D models with a computer graphics simulation of projection and illumination. Given a single 2D image of a person, the algorithm automatically estimates 3D shape, texture, and all relevant 3D scene parameters. In this framework, rotations in depth or changes of illumination are very simple operations, and all poses and illuminations are covered by a single model. Illumination is not restricted to Lambertian reflection, but takes into account specular reflections and cast shadows, which have considerable influence on the appearance of human skin. This approach is based on a morphable model of 3D faces that captures the class-specific properties of faces. These properties are learned automatically from a data set of 3D scans. The morphable model represents shapes and textures of faces as vectors in a high-dimensional face space, and involves a probability density function of natural faces within face space. The algorithm presented here estimates all 3D scene parameters automatically, including head position and orientation, focal length of the camera, and illumination direction. This is achieved by a new initialization procedure that also increases robustness and reliability of the system considerably. The new initialization uses image coordinates of between six and eight feature points.

Vaikol et al., presented a reliable method of computation for minutiae feature extraction from fingerprint images. The scheme relies on describing the orientation field of the fingerprint pattern with respect to each minutia detail. A fingerprint image is treated as a textured image, where an orientation flow field of the ridges is computed. To accurately locate ridges, a ridge orientation based computation method is used. After ridge segmentation, smoothing is done using morphological operators. In Choi et al., introduced a novel fingerprint matching algorithm using both ridge features and the conventional minutiae features to increase the recognition performance against nonlinear deformation in fingerprints. The proposed ridge features are composed of four elements: ridge count, ridge length, ridge curvature direction, and ridge type. These ridge features have some advantages in that they can represent the topology information in entire ridge patterns that exist between two minutiae and are not changed by non-linear deformation of the finger. For extracting ridge features, they have also defined the ridge-based coordinate system in a skeletonized image. With the proposed ridge features and conventional minutiae features (minutiae type, orientation, and position), they have proposed a novel matching scheme using a breadth first search to detect the matched minutiae pairs incrementally.

III. PROPOSED SYSTEM

All face recognition algorithms consist of two major parts: face detection and normalization and face identification. Algorithms that consist of both parts are referred to as fully automatic algorithms and those that consist of only the second part are called partially automatic algorithms. Partially automatic algorithms are given a facial image and the coordinates of the centre of the eyes. Fully automatic algorithms are only given facial images. Face recognition research still face challenge in some specific domains such as pose and illumination changes. Although numerous methods have been proposed to solve such problems and have demonstrated significant promise, the difficulties still remain. For these reasons, the matching performance in current automatic face recognition is relatively poor compared to that achieved in fingerprint and iris matching. The proposed system works in such a way that the multiple face images and finger print images from different subjects were collected. The face images in different poses and illumination variation and background changes are trained by extracting the feature values from all the images. The test face image and finger print is first pre-processed using Gaussian filter to remove noise from the image, then the SIFT algorithm is used to extract features from face image and the minutiae algorithm is used for extracting fingerprint features. Later, the fingerprint feature values and the face feature values are integrated together and the Euclidean distance metrics is applied for recognition of the face image from the training database. If the face image and the finger print image is of the same person then the person is authenticated. The identity of the person is obtained by means of the classification methods using the true labels.

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 2, Issue 2, pp: (278-282), Month: April-June 2014, Available at: www.researchpublish.com

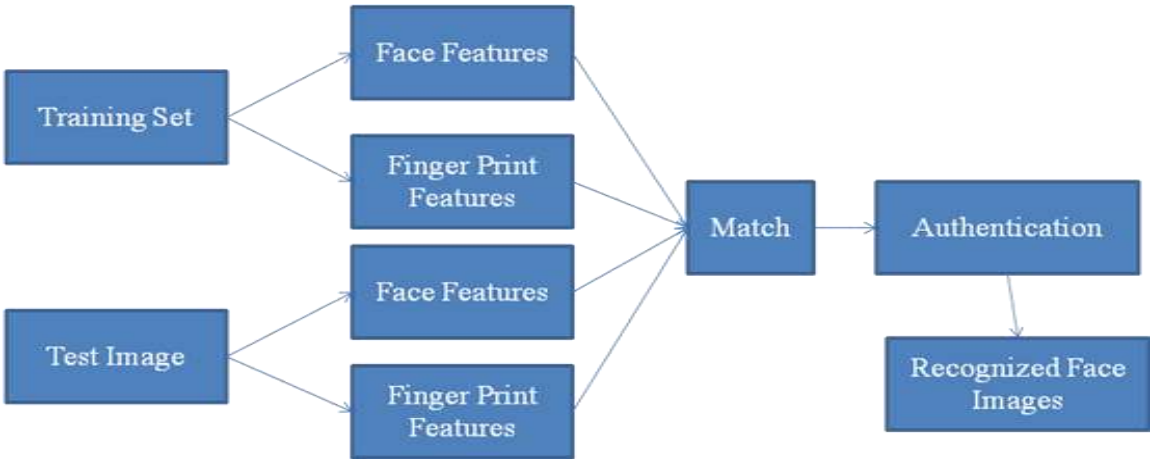


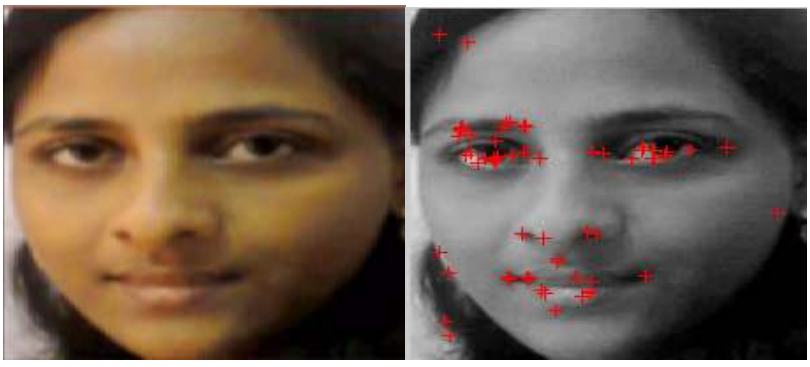
Fig 1: Architecture of System

Since the proposed method makes use of the SIFT algorithm for face recognition, the changes in illumination, background and poses are easily adorable, and also feature level fusion of the face and fingerprint traits provides the system with increased performance and accuracy in recognition rate.

IV. FACE AND FINGERPRINT FEATURE EXTRACTION

4.1 Face Recognition based on Scale Invariant Feature Transform (SIFT)

In Feature extraction stage, the features of images that are important for classifying them at the recognition stage are extracted. Here, each image is represented as a feature vector, which becomes its identity. This is one of the most important stage because its effective functioning improves the recognition rate and reduces the misclassification. In this project, I have used the SIFT Algorithm for face feature extraction. SIFT algorithm is used to extract the feature values from the image. It is an algorithm in computer vision to detect and describe local features in images. For any object in an image, interesting points on the object can be extracted to provide a "feature description" of the object [7]. This description, extracted from a training image, can then be used to identify the object when attempting to locate the object in a test image containing many other objects.



(a) (b)

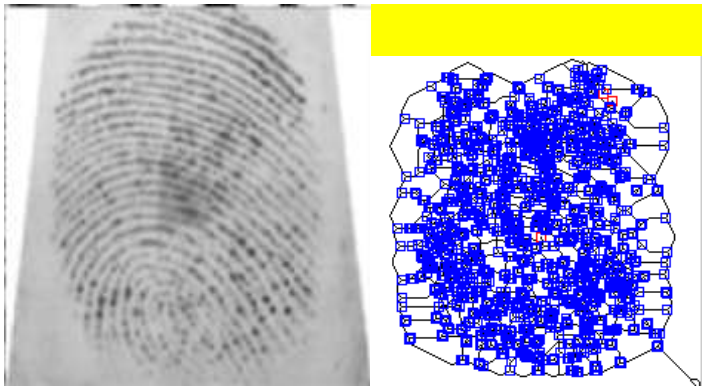
Fig 2: (a) Test Image, **(b)** SIFT Features

The SIFT features represent a compact representation of the local gray level structure, invariant to image scaling, translation, and rotation, and partially invariant to illumination changes and affine or 3D projections. Thus the input to this process is a test image and the output is the set of extracted SIFT features.

ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 2, Issue 2, pp: (278-282), Month: April-June 2014, Available at: www.researchpublish.com

4.2 Fingerprint verification based on Minutiae algorithm

A fingerprint is the pattern of ridges and valleys on the surface of a fingertip. Each individual has unique fingerprints. The two most prominent local ridge characteristics are: 1) ridge ending and, 2) ridge bifurcation. A ridge ending is defined as the point where a ridge ends abruptly. A ridge bifurcation is defined as the point where a ridge forks or diverges into branch ridges. In this paper I have used the Minutiae algorithm for fingerprint feature extraction.



(a) **(b)**

Fig 3: (a) Test Image, **(b)** Minutiae Features

There has been proposed many methods for the minutiae extraction, the traditional method consist of the following steps. Binarization, thinning and minutiae detection:

Binarization- This process consist in converting the gray scale image in binary image, i.e, the intensity of the image has only two value: black, representing the ridges, and white, representing the valleys and the background. A simple method to binarize is to use a global threshold value, however, it is not well suited for noisy images, a more robust method consist of using some rectangular mask, rotate according the orientation of the ridges.

Thinning- The objective of thinning is to find the ridges of one pixel width. The process consist in performing successive erosions until a set of connected lines of unit-width is reached. This lines are also called skeletons. An important property of thinning is the preservation of the connectivity and topology which however can lead to generation of small bifurcation artifacts and consequently to detection of false minutiae. Therefore some procedure aiming the elimination of these artifacts must be performed after the thinning.

Minutiae detection- From the binary thinned image, the minutia are detected by using 3x3 pattern masks. Samples of masks used for identifying the ridge ending and bifurcations point are shown in the figure below. Although the process seems to be simple, it is necessary to consider the elimination of false detected minutiae.

V. RECOGNITION USING EUCLIDEAN METRICS

The recognition of face images is obtained by calculating the distance between the feature values that are measured by using the Euclidean distance. The Euclidean distance or Euclidean metric is the ordinary distance between two points that one would measure with a ruler, and is given by the Pythagorean formula. By using this formula as distance, Euclidean space becomes a metric space. The associated norm is called the Euclidean norm.

It is measured using the following formula.

$$\delta_1(\mathbf{x},\mathbf{y}) = \|\mathbf{x}-\mathbf{y}\|_2 = \sqrt{\sum_{j=1}^{d}(x_j - y_j)^2}$$

This is used to find the similarity between the test image that is given and the training images in the dataset.

VI. CONCLUSION AND FUTURE ENHANCEMENTS

A Multimodal biometric authentication system based on the integration of face and the fingerprint traits at feature extraction level has been presented in this paper. Generally the face and the fingerprint traits are the most widely used in most biometric applications. In this project, initially the face images and the fingerprint images are pre-processed to remove the noises, then the features are extracted from the images. For face image SIFT algorithm is applied to extract features and for fingerprint image Minutiae algorithm is applied for extracting the features. Later, the extracted features for the face and the fingerprint images are integrated together. Finally the Euclidean distance metrics is applied to recognize the most similar face from the training database. Here, I have used the CALTECH dataset and some of the real-time images in-order to identify the probability of a true match. These images are exposed to illumination, pose, and background changes. The accuracy of the recognized image is increased depending upon the number of training samples available. The proposed system is proved to have increased performance by means of recognizing images with a higher rate of accuracy.

This project provides a higher rate of accuracy in recognizing face images and identifies a person by means of classification using labels, but one of the most important issue that has not been encountered and resolved in this paper is that the case of an imposter(most likely a previously unseen person), which is of utmost importance for authentication. In-order to further improve the recognition rate of this system, algorithms that could obtain features of the most influencing facial regions such as the eyes, nose and lips can be integrated with this. Clustering these features into different groups and then applying the distance metrics could also improve the rate of recognition.

REFERENCES

[1] Zhan-Li Sun, Kin-Man Lam, and Qing-Wei Gao, “Depth Estimation of Face Images Using the Nonlinear Least-Squares Model.” In IEEE Transactions On Image Processing, vol. 22, no. 1, Jan. 2013.

[2] Ce Liu, Jenny Yuen and Antonio Torralba, “SIFT Flow: Dense Correspondence across scenes and its applications.” In IEEE Transactions on Pattern analysis and Machine Intelligence, 2011.

[3] Wu Zhen, Xu Zhe, Zhang Rui-nian and Li Shao-Mei, “SIFT Feature Extraction Algorithm for Image in DCT Domain.” In International Symposium on Computer, Communication, Control and Automation (ISCCCA-13), Apr. 2013.

[4] Zheng Yongbin, Huang Xinsheng, Feng Songjiang, “An Image Matching Algorithm Based on Combination of SIFT and the Rotation Invariant LBP [J].” In Journal of Computer-aided design and Computer Graphics, vol.22, no. 2, pp.286-291, 2010.

[5] D. Zhang, F. Liu, Q. Zhao, G. Lu, N. Luo, “Selecting a Reference High Resolution for Fingerprint Recognition Using Minutiae and Pores.” In IEEE Transactions On Instrumentation And Measurement, vol. 60 no. 3 pp.863-871 , Mar. 2011.

[6] J. Feng, A. K. Jain, “Fingerprint Reconstruction: From Minutiae to Phase.” In IEEE Transactions On Pattern Analysis And Machine Intelligence, vol. 33, no. 2, pp.209-223, Feb. 2011.

[7] D. Lowe, “Distinctive image features from scale invariant keypoints.” In International Journal of Computer Vision, vol. 60, no. 2, pp.91–110, 2004.

[8] Dakshina R. Kisku, Massimo Tistarelli, Jamuna Kanta Sing, Phalguni Gupta, “Face Recognition by Fusion of Local and Global Matching Scores using DS.” In IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 27, no. 3, pp.450-455, 2007.

[9] Shekhar Karanwal, Davendra Kumar, Rohit Maurya, “Fusion of Fingerprint and Face by using DWT and SIFT.” In International Journal of Computer Applications, vol. 2, No.5, June 2010.

[10] M. D. Levine and Y. F. Yu, “State-of-the-art of 3D facial reconstruction methods for face recognition based on a single 2D training image per person,” In Pattern Recognit. Lett., vol. 30, no. 10, pp.908–913, Jul. 2009.

[11] S. Vaikol, S. D. Sawarkar, S. Hivrale, T. Sharma, “Minutiae Feature Extraction From Fingerprint Images.” In IEEE International Conference on Advance Computing, Mar.2009.

[12] H. Choi, K. Choi, J. Kim, “Fingerprint Matching Incorporating Ridge Features with Minutiae.” In Prodeedings of the IEEE, 2010.