3D to 2D: Conversion for Latent Fingerprint

Vaibhav Jain[1] , Ajay Kumar Singh[2]

[1]M. Tech. Student in Computer Science and Engineering at Meerut Institute of Engineering and Technology, Meerut, U.P, India

[2]Pofessor in Computer Science and Engineering at Meerut Institute of Engineering and Technology, Meerut, U.P, India

Abstract

To overcome the problem associated with 2D fingerprints such as skin deformation we use the concept of 3D fingerprint scanning. Fingerprints are the combination of ridge and furrows pattern. Fingerprints are taken by putting on the hard surface of the sensor like prism, silicon, polymer, index card. To remove the drawback of traditional 2D fingerprint a new technology has been introduced called 3D fingerprint. Human finger is just like 3D object. More fingerprint features and more real fingerprints will be provided if 3D fingerprints features. This paper explores 3D fingerprints features and their application for personal identification.

Index Terms: 2D fingerprint, 3D fingerprint, Data Acquisition, Latent fingerprint.

1.INTRODUCTION

Today fingerprint recognization system is mostly used in the forensics labs, police and civilization. We used the fingerprints recognize in many fields such as whether the person is criminal or not, the person who access the information is authentic or not. Fingerprints are the right choice because no two people have same fingerprints even the twins has different fingerprints [1]. In legacy system the fingerprint scans require placing and pressing of fingers against the hard surface and which results in partial or degraded quality images. We can raise the latent fingerprints of the last person who has put his finger on a sensor are sometimes visible on the surface on the sensor. And it could be raised through simply breathy on the sensor. So it is vulnerable. 2D fingerprint does not give such better result [2]. 3D fingerprints have both depth and texture information of the fingerprint while the 2D has only texture information. The 3D fingerprint is free from distortion as compared to the 2D fingerprints because in these fingerprints it is free from low pressure and distortion. Three dimensional systems however, are usually based on more complex and expensive acquisition setups [3].

2.PREVIOUS WORK

The term biometrics has taken the very wide area in the field of security. Recognition of fingerprints is considered to be the most powerful technique for security and authentication. For identifying the fingerprints we need the better quality of images. Many times fingerprints found at crime place are not good and we are working on that. First we eliminate the different type of noise present in it. We eliminate it by different type of proposed algorithm. [4] introduce Directional Weighted Median Filter (DWMF) to remove the background noise. [5] introduce Short Time Fourier Transform (STFT). This technique estimates all the intrinsic properties of the fingerprints.

3.POOR WAY OF PLACING THE FINGERPRINT

In the 2D fingerprint system we see that there are many types of errors while placing the fingerprints on the sensor [6]. In 3D system these errors are eliminated and the resulting image is good as compared to 2D fingerprint system which is shown in figure 1.

Why do we get poor images?
a. Too little pressure:
b. Too much pressure
c. Wet or sweaty
d. Swiped at angle
e. Poor Placement

Fig.1 a.   b.   c.

d.   e.
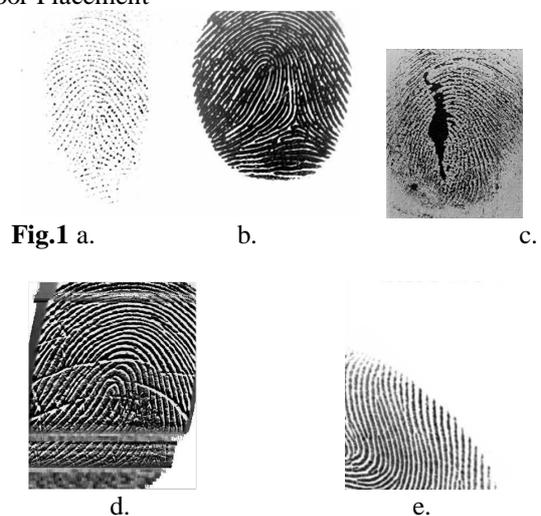
But in the 3D fingerprint we do not face these types of errors, because it gives the depth and texture information both as shown in figure 2.

Fig. 2 Good Image

International Journal of Emerging Trends & Technology in Computer Science (IJETTCS)
Web Site: www.ijettcs.org Email: editor@ijettcs.org
Volume 4, Issue 5(2), September - October 2015   ISSN 2278-6856

3. DATA ACQUISITION

Data Acquisition is the way of measuring physical or electrical phenomenon like voltage, current, temperate, pressure etc. It consists of sensor for measuring the data from these physical devices. It may be used to convert physical perimeter to electrical signals. Analog signals may be converted digital signal by well known instrument called A to D converter. 3D data acquisition and object reconstruction can be performed by stereo image pair. Stereo photogrammetery is based on block overlapping. Software which could do this is known as Vexcel FOTO G. Fingerprint can be approximated by cylinders [7]. It is difficult to capture size variability in vertical and horizontal direction by best fit cylinder model. So we do not use parametric method to fit the cylinder to 3D space. Following step may be involved in 3D acquisition. First, capture p phase shifted sine wave pattern, capturing can be done by with the help of projector and camera then calculate the wrapped phase for the targeted area then go for segmentation of background with the help of mask. Use of wrapped phase algorithm for 3D depth matrix use pre_computed calibration, to remove noise use filter to obtain 2D equivalent fingerprint. One can use filtering and fusion. And finally evaluate performance matrix from 2D fingerprint achieved in the above steps which is shown in figure 3. 2D fingerprint may be distorted if a person's fingerprint is dirty or his finger is twisted during the process. 3D fingerprint provide more information as compared to 2D. 3D is more robust then 2D. 3D can also be used for ear recognition.
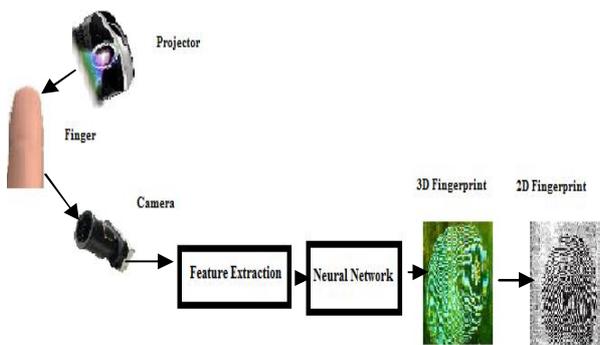

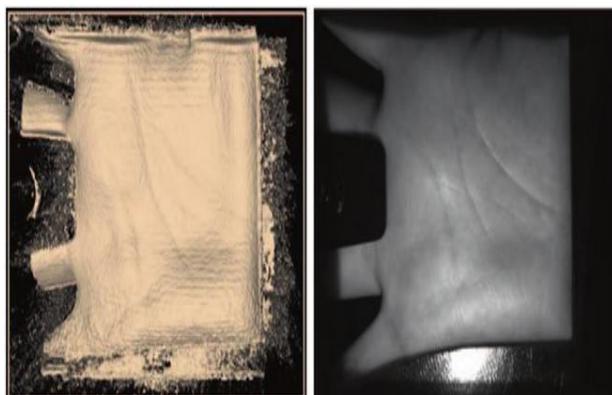**Fig. 3** Process of changing to 3D to 2D fingerprint

Fig.4 3D Palm to 2D Palm

Note only fingerprint but also palm can be taken for more security aspects as shown in figure 4 [7].

4. FEATURE OF 2D AND 3D FINGERPRINT

Traditional fingerprint recognition system uses touch pad sensor on the other hand 3D uses touchless system. 2D uses touch based device such as optical and solid state sensor. Touch based techniques suffer from the following problem: a). Local Region (ROI) [8] b). Dryness of the skin c). Sweat d). Dirt e). Humidity in the air. These are lacuna in 2D [9]. More than one 2D image can be formed in 3D image. Systems which use multiple view techniques can only obtain samples that have finger volume with super imposed image which represent ridge pattern. Structured light technique and photometric stereo are also used to identify 3D models of valley and ridge. Non parametric unrolling algorithm preserves the Geodesic or Euclidean distance between points. We can denote a 3D fingerprint in set form such as:

$$F=\{(x_i, y_i, z_i, f_i)\} \text{ where } i= 1.......N$$

Where (x_i, y_i, z_i) are the co-ordinates of the ith point of the fingerprint, f_i is the intensity and N is the total number of points.

5. SIMULATION WORK IN MATLAB

We have made software which matches two images as shown in figure 5 and 6. Images are taken from the hard disk which is stored in the format of .jpeg [10, 11]. Here we are taking 2 same images which show that 100% matching is done after executing the source code which is made in MATLAB. The core part of the source code is given below.

```
function flag = check_condition( path , end_list , branch_list )
[len ,ddummy] = size(path);
curr_x = path(len,1);
curr_y = path(len,2);
flag = 0 ;
 if is_a_branch_point(curr_x,curr_y,branch_list) == 1
flag = 1;
elseif is_a_end_point(curr_x,curr_y,end_list) == 1
 flag =1;
 elseif curr_x == 0 & curr_y == 0
 flag = 1;
end;
```
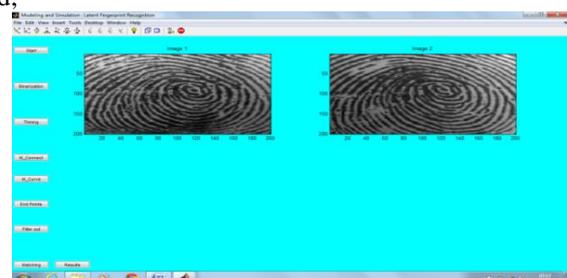

Fig. 5 Two same images are taken for matching

International Journal of Emerging Trends & Technology in Computer Science (IJETTCS)
Web Site: www.ijettcs.org Email: editor@ijettcs.org
Volume 4, Issue 5(2), September - October 2015   **ISSN 2278-6856**
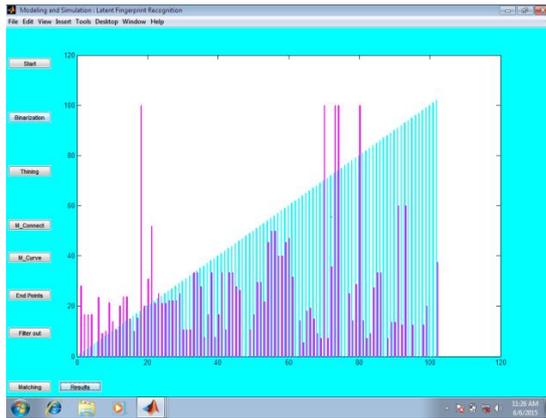
Fig. 6 Result of above matching

6.CONCLUSION

It is quite helpful for us to convert 3D to 2D fingerprint because in many cases of latent fingerprint 2D database is there but 3D database is not yet maintained for checking criminal activities. By using 3D touchless technique we can produce many 2D images which can assures us that matching can be done by any angle. 3D is the latest technology which is yet to be used and improved by forensics science department for latent fingerprint database.

References
[1]. Ruggero Donida Labati, Angelo Genovese, Vincenzo Piuri and Fabio Scotti, "Touchless Fingerprint Biometrics: A Survey on 2D and 3D Technologies", Journal of Internet Technology, Volume 15, No.3, 2014.
[2]. Romulo Ferrer L. Carneiro and Jessyca Almeida Bessa, "Techniques of Binarization, Thinning and Feature Extraction Applied to a Fingerprint System", International Journal of Computer Applications Volume 103 - No. 10, p. 4, October 2014.
[3]. Massimo Tistarelli, Stan Z. Li and Rama Chellappa, "Handbook of Remote Biometrics for Surveillance and Security", ISBN 978-1-84882-385-3, DOI 10.1007/978-1-84882-385-3, Publisher Springer, 2009
[4]. Lin Hong, Yifei Wan and Anil Jain, "Fingerprint Image Enhancement: Algorithm and Performance Evaluation" IEEE Transactions on Pattern Analysis and Machine Intelligence, Volume. 20, pp. 8, August 1998
[5]. Yiqiu Dong and Shufang Xu., "A New Directional Weighted Median Filter for Removal of Random", Valued Impulse Noise. Volume 5(9), pp. 2-4, April 2001.
[6]. Yongchang Wang, Laurence G. Hassebrook and Daniel L. Lau, "Data Acquisition and Processing of 3-D Fingerprints", IEEE Transactions on Information Forensics and Security, Volume 5, No. 4, pp. 750-760, 2010.
[7]. Bee Yan Hiew, Andrew Beng Jin Teoh and Ooi Shih Yin, "A Secure Digital Camera Based Fingerprint Verification System", Journal of Visual Communication and Image Representation, Volume 21, No. 3, pp. 219-231, 2010.
[8]. Anju Mohan and Prof. Shilpa P. Kodgire, "Touchless Fingerprint recognition using MATLAB", International Journal of Innovation and Scientific Research, ISSN 2351-8014, Volume 10 No. 2, pp. 458-465, October 2014.
[9]. Feng Liu and David Zhang, "3D Fingerprint Reconstruction System Using Feature Correspondences and Prior Estimated Finger Model", Volume 47, No.1, Publisher Springer, pp.178-193, 2014.
[10]. Saurabh Yadav and Ajay Kumar Singh, "A Biometric Traits Based Authentication System for Indian Voting System," International Journal of Computer Application (IJCA), ISSN: 0975-8887, doi: 10.5120/11002-6185, Volume. 65, No.15, pp. 159-162, March 2013.
[11]. Vaibhav Jain and Ajay Kumar Singh, "An approach for Minutia Extraction in Latent Fingerprint Matching," International Journal, ISSN: 2319 – 1058, Volume 6, No. 1 , pp. 51-58, October 2015.

AUTHOR

Prof. (Dr.) Ajay Kumar Singh: Born in 1974 at Dhanbad (Jharkhand). He had done B.E (Computer Science & Engg.) from Kumaon Engineering College, M. Tech (I.T) Allahabad, Ph. D (Computer Science & Engg.) Jaypee University of Information Technology. Work Experience: He had been in different institution / university like Radha Govind Engineering College, Meerut, (U.P), Sir Padampat Singhania University, Bhatewar, Udaipur, Rajasthan, Jaypee University of Information Technology, Waknaghat, Solan (H.P), Mody College of Engineering and Technology, Lakshmangarh, Sikar, Rajasthan, Regional Engineering College (Now N.I.T.) Kurukshetra (Haryana), Software Solution Integrated Ltd. (Delhi), Now he is working with MIET, Meerut, U.P. He has published several papers in international Journals like PIER, Asia Magazine EFY, Elsevier. He has more than 17 years of experience.

Vaibhav Jain: M. Tech student of Meerut Institute of Engineering and Technology, U.P, India. Born in 1991 at Shamli. He had done B.Tech (Computer Science & Engg.) from Mangalayatan University Aligarh. His hobby is searching new things.