TEXTURE AND COLOR INTENSIVE BIOMETRIC MULTIMODAL SECURITY USING HAND GEOMETRY AND PALM PRINT

A. Kirthika[1] and S. Arumugam[2]
[1] A/P Dept. of CSE & [2] Chief Executive Officer,
Affiliated to Anna University, Nandha College of Technology, Perundurai, Erode

ABSTRACT

Hand geometry based verification systems are amongst the utmost in terms of user satisfactoriness for biometric qualities. This is obvious from their extensive profitable deployments around the world. Regardless of the profitable achievement, a number of issues remain to be addressed to formulate these systems more comprehensible. Shape features (hand/finger geometry) obtained from the hand carry restricted inequitable information and, thus, they are not recognized to be extremely distinctive. This paper presents a new technique for hand matching using texture and color intensive biometric (TCIB) for multimodal security that achieves considerable performance even for the large pose variations with diverse angles. The proposed TCIB for hand geometry and palm print uses both 2D and 3D hand images, to attain an intensity and range images of the user's hand offered to the system in a random pose. The approach involves Dynamic feature level combination to develop the performance of identifying similarity of the multimodal features. Multimodal palm print and hand geometry textures are concurrently mined from the user's facade standardized textured 3-D hand, for identifying the similarity between the hand posture. Individual matching scores are united using a new combined value approach. An experimental results on the datasets with seven sample images in a considerable pose variations deferred better results compared to an existing Contact less and Pose Invariant Biometric Identification Using Hand Surface (CPBI). A reliable (across various hand features considered) performance improvement attained with the pose correction reveals the usefulness of the proposed TCIB approach for hand based biometric systems. The experimental results also suggest that the dynamic feature level approach presented in this work helps to attain performance enhancement of 60% (in terms of EER) over the case when matching scores are shared using the pixel rate.

KEYWORDS: *Palm print, Hand Geometry, Texture, Color Intensive approach, Dynamic feature.*

I. INTRODUCTION

For biometric traits, hand based biometric systems, particularly hand/finger geometry supported verification systems are among the main in terms of user adequacy [4]. This is obvious from their extensive profitable deployments around the world. In spite of the profitable success, numerous concerns stay to be addressed in order to build these systems more user-friendly. The main problems comprise, troubles based by the inhibited imaging set up, particularly to elderly and people suffering from limited dexterity due to the position of the hand on the imaging platform. Furthermore, shape features (hand/finger geometry or silhouette) mined from the hand hold partial biased information and, consequently, are not known to be extremely distinctive. Normally, hand identification strategies are divided in to three categories based upon the personality of image attainment.

1) *Constrained and contact based*: These approaches use pegs or pins to restrict the situation and position of hand.

2) *Unconstrained and contact based*: Hand images are attained in an unrestrained behavior, often involving the users to put their hand on flat surface.

3) *Unconstrained and contact-free*: This approach use pegs or platform through hand figure acquirement. It is supposed to be more user-friendly.

An existing Contact less and Pose Invariant Biometric Identification Using Hand Surface (CPBI) described the process of palm print and hand geometry features [1] using dynamic fusion features. It first localizes the hand posture in the obtained hand images. These acquired images are stored, because the intensity and range images of the hand are obtained concurrently. These binary images are promoted by morphological operators, which eliminate inaccessible noisy regions [4]. At last, the chief connected constituent in the resulting binary image is measured to be the set of pixels corresponding to the hand. Center of the palm is then positioned at a rigid distance along a line that is perpendicular to the line joining the two finger valley points. It extracts the features and used dynamic fusion approach to identify the palm print and hand geometry. After combining the palm print and hand geometry feature data sets, the posture hand images are matched with the training data sets and formed the similarity of the hand posture images [7].

The main contribution of the proposed TCIB approach is to improve the performance of multimodal biometric security using texture and color intensive strategy. Using training and test sample sets, the proposed TCIB approach are evaluated.

The paper is organized as follows. Section 2 presents Literature Review, Section 3 presents the methodology of TCIB For Multimodal Biometric Security Using Hand Geometry And Palm Print. In Section 4 shows the experimental evaluation for proposed technique TCIB. In section 5 the results and discussion of the proposed technique for hand geometry system is presented. Finally, conclusions are provided in Section 6.

II. LITERATURE REVIEW

Over the period of years, researchers have presented different strategies to tackle the problem caused by the constrained imaging set up. A numerous researches have been developed to concurrently attain and join hand shape and palm print features and thus realizing considerable performance improvement. Furthermore, researchers have listened on removing the use of pegs for directing the placement of the hand. Recent progresses in hand biometrics literature is towards increasing systems [1] that obtain hand images in a contact free manner.

The unconstrained and contact based images with Hand postures are obtained in an unrestrained method, often involving the users to put their hand on flat surface, [7] or a digital scanner. The unconstrained and contact free approach presented the requirement for any pegs through hand image achievement. This form of image attainment is supposed to be more user-friendly and have newly established increased awareness from biometric researchers.

A few researchers have developed hand based biometric systems that obtain images in an unrestrained and contract free manner. Though, none of these approaches openly achieve 3-D pose normalization nor do they pull out any pose invariant features. The work presented in [7] is based upon the arrangement of a pair of intensity hand images using the homographic transformation between them. The crisis of 3-D pose variation has been well addressed in the framework of 3-D face [2] and 3-D ear recognition. On the other hand, minute work has been done in the area for 3-D hand detection, even with it being one of the very acceptable biometric traits.

The work in [4] suggested identification-verification biometric system based on the combination of geometrical and palm-print hand features. Emerging technology has introduced [5] potential biometric such as hand geometry, palm print, lips, teeth and vein. However, most of this biometric requires a special device to capture it. Innovative contactless palm print and knuckle print recognition system is presented in [6]. Robust directional coding technique encoded [8] the palm print feature in bit string representation. Approach for personal identification using hand geometrical features, in which the infrared illumination device is employed to improve the usability of this hand recognition system.

Invalid sample detection module based on geometric constraints is presented in [9]. The work in [11] investigated deformation simulation of hand-object interaction for the virtual rehabilitation system of hand. The deformation along the contact normal on hand and object is investigated. The biometric template data [12] guarantee its revocability, security and diversity among different biometric systems.

To make the multimodal biometric security approach as a reliable one, this work presented a texture and color intensive approach for multimodal biometric security using hand geometry and palm print features.

III. TCIB FOR MULTIMODAL BIOMETRIC SECURITY USING HAND GEOMETRY AND PALM PRINT

The proposed TCIB approach is designed to improve the performance of biometric security for hand geometry and palm print hand images with different angles. The proposed TCIB comprises of three different operations for palm print and hand geometry features and with combine approach to compare the values obtained through texture and color intensive approaches. The architecture diagram (Fig 3.1) describes the process of the proposed TCIB approach for posture hand image matching.

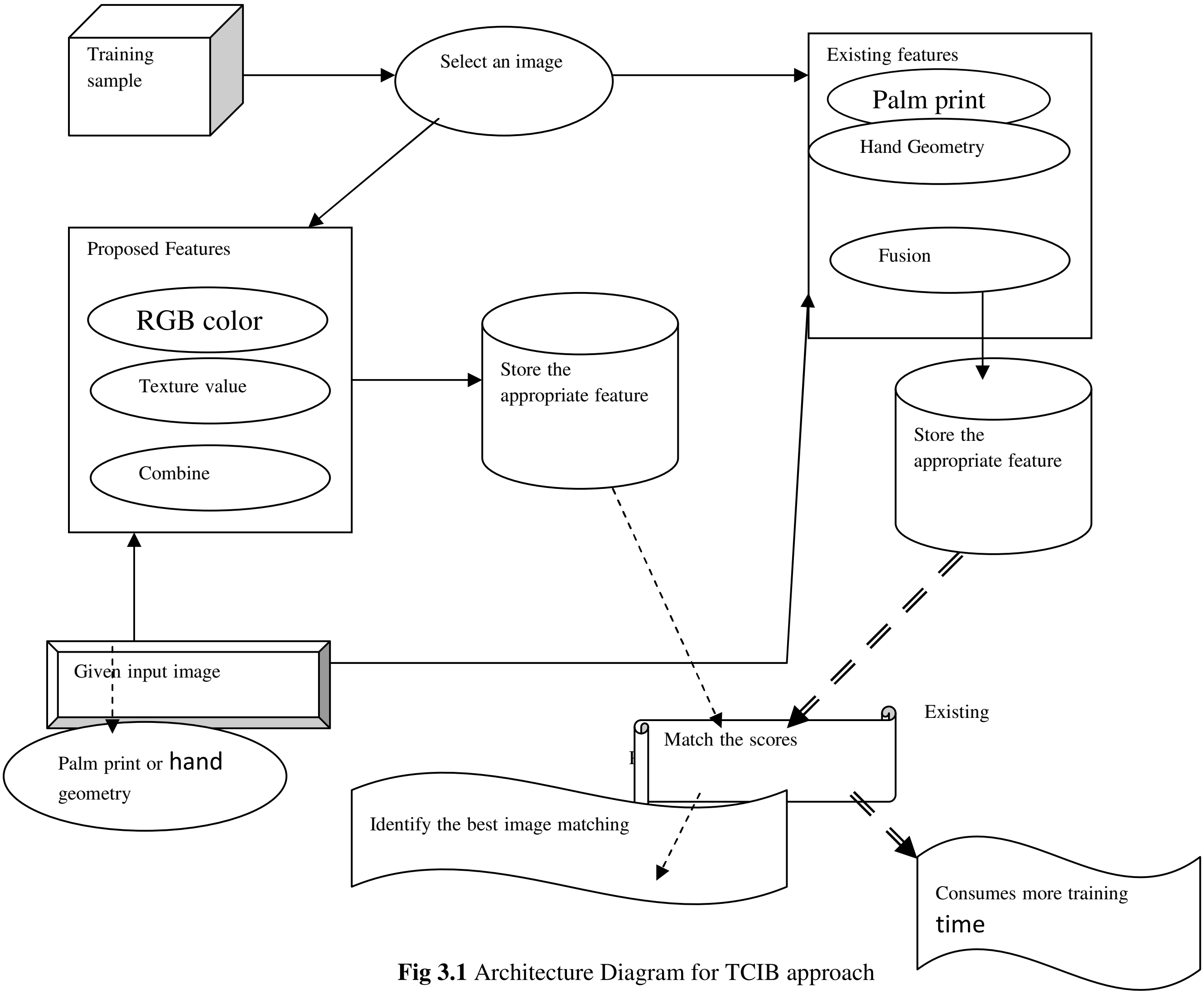

Fig 3.1 Architecture Diagram for TCIB approach

3.1 Proposed TCIB approach

The proposed TCIB approach initiated with the training sample sets. From the training sample sets, select the image for multimodal biometric security process. Compute the RGB color value, texture value and combine value for the given training samples. The same process is being handled over the given input image. After identifying the color texture values for the given image, the scores are matched with the selected training image set. Find the error rate values and identify the best image. The pseudo code for the proposed TCIB approach is described below:

Step1: Input: Training sample sets

Step 2: Existing CPBI features

Step 2.1: Find the hand geometry and stored

Step 2.2: Find the palm print value and stored

Step 2.3: Find the fusion values

Step 3: Proposed TCIB features

Step 3.1: Generate the RGB value and stored

Step 3.2: Generate the texture value and stored

Step 3.3: Compute the combined value

Step 4: Match the template with,

Step 4.1: Existing CPBI

Step 4.2: Proposed TCIB

Step 5: Match the individual scores

Step 6: Identify the best image

Step 7: Input: test samples (Hand geometry/ palm print)

Step 8: Repeat the step 2 to 6

Step 9: Output: Best similar image

3.1.1 Generate RGB Values:

For the given hand images either hand geometry or palm print, it is necessary to compute the RGB values in the proposed TCIB approach. The RGB values are evaluated by the given image pixel size. The pseudo code for generating the RGB values for the proposed TCIB approach is as follows:

```
Step 1: Input: Sample image (Hand geometry/ palm print)
Step 2: Get the pixel size
Step 3: If pixel size > 16
                Assign the value into red
        Else if pixel size > 8
                Assign the value into green
        Else
                Assign the value into blue
End If
End If
Step 4: Generate the value and stored
Step 5: end
```

3.1.2 Generate Texture Values:

For the given hand images either hand geometry or palm print, it is necessary to compute the texture values in the proposed TCIB approach. The texture values are evaluated by the given image pixel size. The pseudo code for generating the texture values for the proposed TCIB approach is as follows:

Step 1: Input: Sample image (Hand geometry/ palm print)

Step 2: Find the height and width of the image

Step 3: generate the texture value

If image pixel > 24

Step 4: End

After identifying the RGB and texture values, combine both the approaches and match the scores to identify the error rate occurred during the process. Compare the values to estimate the performance of the proposed TCIB approach.

3.2 Template Matching

After identifying the RGB and texture values, the image matching process is taken place. The pseudo code below described the process:

Step 1: For RGB value, compute the error rate

Step 2: For texture value, compute the error rate

Step 3: For combine value, compute the error rate

Step 4: Match the scores with an existing CPBI

IV. EXPERIMENTAL EVALUATION

The proposed TCIB for hand geometry and palm print is implemented by using the Java platform. The experiments were run on an Intel P-IV machine with 2 GB memory and 3 GHz dual processor CPU. The experiments are carried over with seven sets of sample images. In order to prove the performance of the proposed TCIB for hand geometry and palm print, the proposed features are applied to those sample sets of images with combined value approach [9]. Based on pixel size, the RGB color values [6] are generated and the texture values are generated and both these values are stored in a secure manner. Using both these approaches, the combined value is evaluated. Then it would match the template values and efficiently identify the given image similarity. The proposed TCIB for hand geometry and palm print is efficiently designed for identifying the similarity of image (hand geometry/palm print) and improved the multimodal biometric security. The performance of the proposed TCIB for hand geometry and palm print for multimodal biometric security is measured in terms of

i) Genuine Acceptance rate

ii)False Acceptance rate

iii)Error rate

V. RESULTS AND DISCUSSION

In this work, we have seen how the palm print/hand geometry image similarity are identified with the proposed TCIB for hand geometry and palm print for multimodal biometric security with an existing CPIB approach [1] written in mainstream languages such as Java. I used seven sample test images with diverse postures. The comparison results have shown that the proposed TCIB approach for multimodal biometric security using hand geometry and palm print.

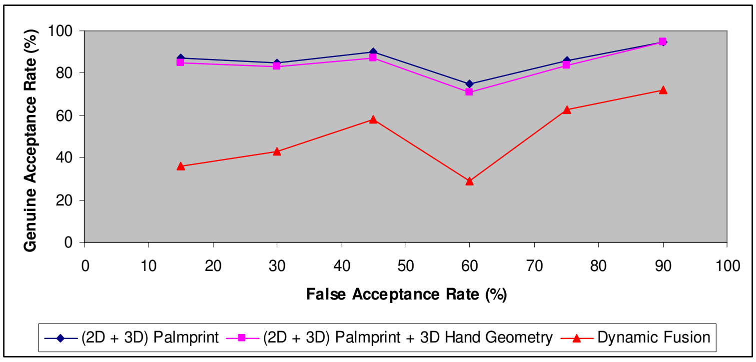

Fig 5.1 False Acceptance Rate vs Genuine Acceptance rate

From the fig 5.1, we observed that in an existing CPIB approach, a simple weighted combination of (2D + 3D)palm print and (2-D + 3-D) hand geometry fails to achieve the desired results. But the grouping performs subsidiary enhancement in EER described, when only 2-D and 3-D palm print matching scores are combined. When the features are combined with weighted sum rule, the dynamic combination approach performs better in terms of EER. The dynamic fusion approach decrease the influence of the poor hand geometry match scores to improve the verification accuracy. The below screen shots will describe about the process of an existing CPIB features with TCIB features.

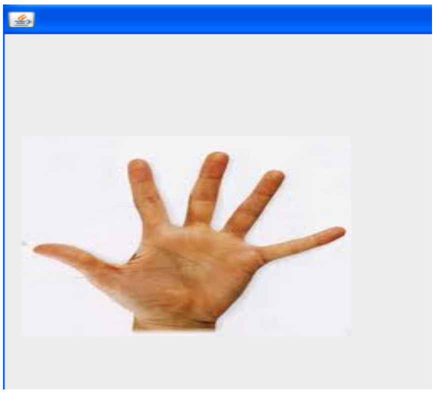

Fig 5.2 Input image

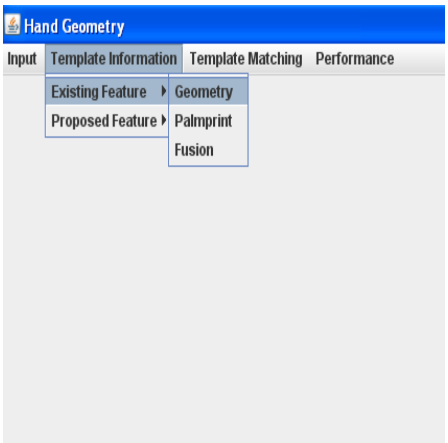

Fig 5.3 Existing i) Hand Geometry ii)Palm print iii)Fusion

For a given training set image, we first apply an exisiting features to generate the values and stored. In fig 5.3 and 5.4, the hand geometry feature is selected and value is computed for that particular geometric feature and stored. Fig 5.5 described the proposed features for a given training set image.

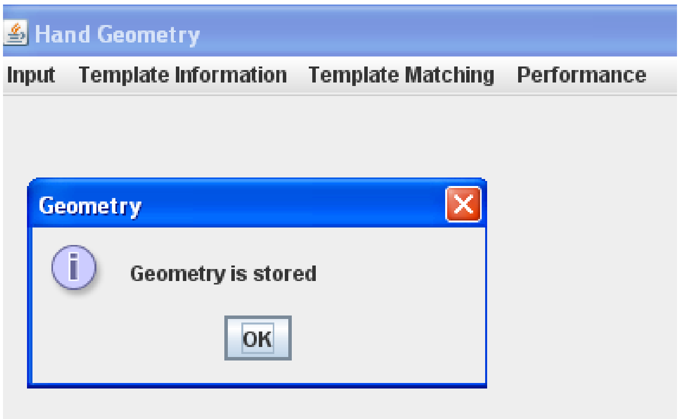

Fig 5.4 Geometry values stored for i/p image

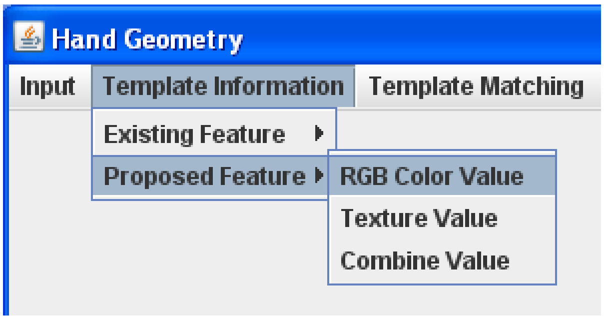

Fig 5.5 Proposed Features i)RGB ii)texture iii) Combined approach

For the proposed feature, RGB value is generated and stored. Then for a sample test, a test image is given in fig 5.7.

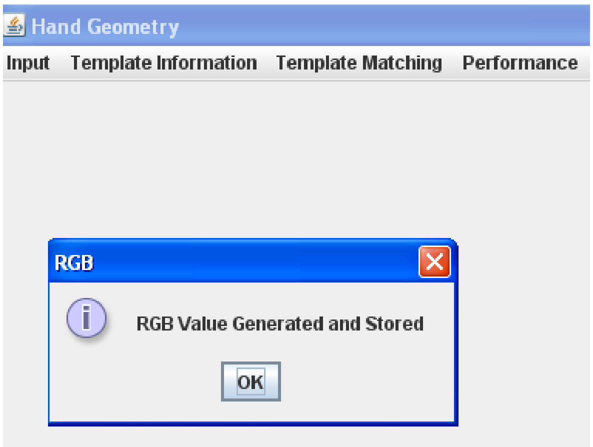

Fig 5.6 RGB value for given input image stored

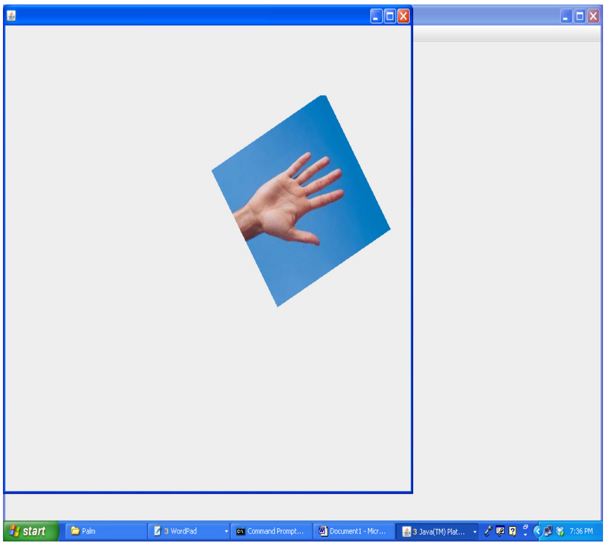

Fig 5.7 Input image to match

Then we have to match the given input image with the test image to identify the similarity. The error rate is calculated to identify the similarity of the hand input image. Compared to an exisiting CPIB feature, the proposed TCIBs' error rate is less in value.

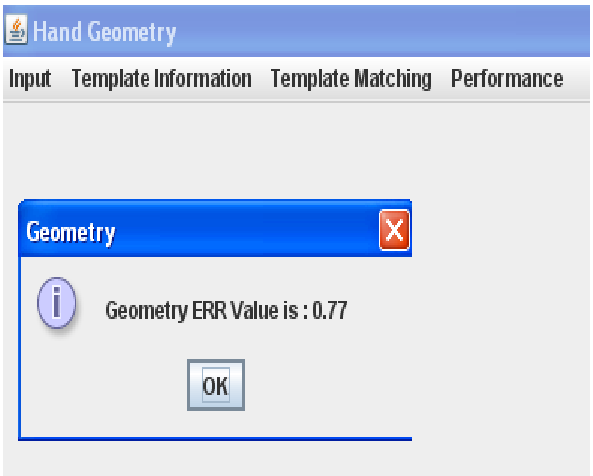

Fig 5.8 Geometry error rate: 0.77

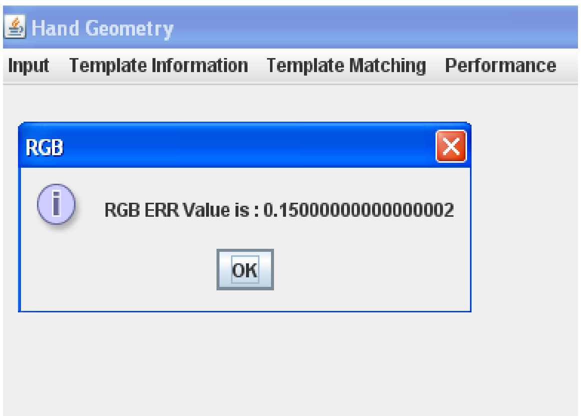

Fig 5.9 RGB error rate: 0.15

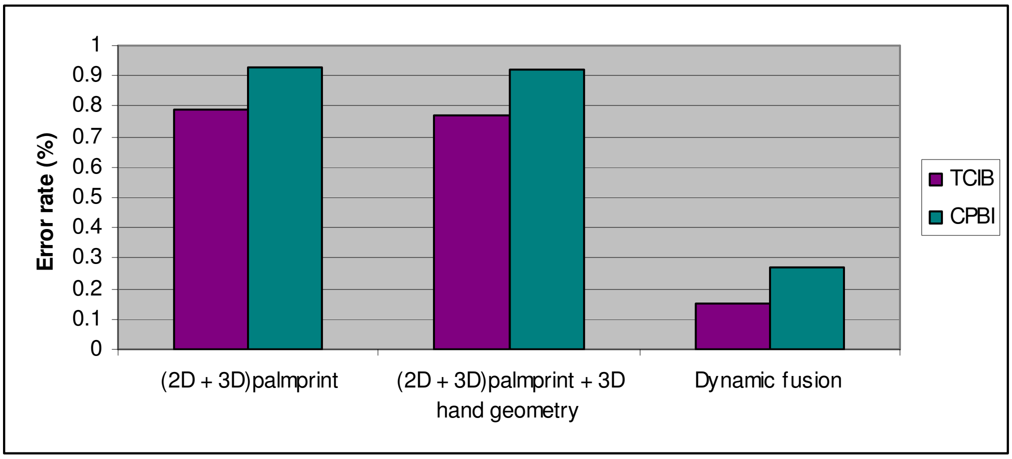

Fig 5.10 Error Rate (%)

Fig 5.10 Demonstrates the equal error rates from our experiments for the combination of palm print and hand geometry matching scores concurrently generated from contactless 2-D and 3-D imaging using TCIB and CPBI [1]. In the case of hand geometry features, 3-D features make somewhat better than 2-D features. Finally, we evaluate the performance from the combination of palm print and hand geometry features proposed dynamic fusion method which constantly outperforms the simple combination of match scores. From the above figure, it is obvious that proposed TCIB achieves best result.

Finally, it is concluded that the proposed TCIB approach is the best suited approach for multimodal biometric security using hand geometry and palm print. The error rate of the proposed TCIB approach is also being low when compared to an exisitng CPIB approach [1] and it automatically improved the performance of the secure approach.

VI. CONCLUSION

This paper has presented a TCIB approach to attain pose invariant biometric identification using palm print/hand geometry images acquired through a combined value imaging set up. The proposed TCIB approach used the acquired 3-D hand to estimate the direction of the hand. The estimated 3-D direction information is then utilized to right pose of the obtained 3-D as well as 2-D hand. I also developed a combined approach to proficiently combine the extracted hand features together. Dynamic feature level combination has identified similarity of the multimodal features. Individual matching scores has united using a new combined value approach. This approach combines palm print and hand geometry features, by ignoring some of the poor hand geometry features. It efficiently matched scores with an existing CPIB feature sets. The experimental results demonstrated that the proposed TCIB approach appreciably enhanced the identification accuracy and shows the performance improvement of 60% in terms of EER over the case when matching scores are shared using the pixel rate.

ACKNOWLEDGMENT

I would like to thank my outstanding research supervisor & advisor, Dr. S. Arumugam, for his advice, support and encouragement throughout the research work. I would like to thank my Parents, Sister, Son, and my dear S. Rajakumar for giving me moral support throughout my life. Thank you to everybody whoever taking part in my life and carrier.Finally I express my love to GOD who is driving my life successfully.

REFERENCES

[1] Vivek Kanhangad, Ajay Kumar et.al., "Contactless and Pose Invariant Biometric Identification Using Hand Surface", *IEEE Transactions On Image Processing*, Vol. 20, No. 5, May 2011

[2] D. Zhang, V. Kanhangad, L. Nan, and A. Kumar, "Robust palmprint verification using 2-D and 3-D features," *Pattern Recognit.*, vol. 43, no. 1, pp. 358–368, Jan. 2010.

[3] V. Kanhangad, A. Kumar, and D. Zhang, "Combining 2-D and 3-D hand geometry features for biometric verification," in *Proc. IEEE Workshop Biometrics*, Miami, FL, Jun. 2009, pp. 39–44.
[4] Fuertes, J.J.; Travieso, C.M.; Ferrer, M.A.; Alonso, J.B., "Intra-modal biometric system using hand-geometry and palmprint texture Security Technology (ICCST), 2010 IEEE International Carnahan Conference, Page(s): 318- 322, 2010.
[5] Kurniawan, F.; Shafry, M.; Rahim, M., "A review on 2D ear recognition", Signal Processing and its Applications (CSPA), IEEE 8th International Colloquium, Page(s): 204 -209, 2012.
[6] Michael, G.K.O.; Connie, T.; Jin, A.T.B., "Robust palm print and knuckle print recognition system using a contactless approach", Industrial Electronics and Applications (ICIEA), 5th IEEE Conference, Page(s): 323 - 329, 2010.
[7] C. Methani and A. M. Namboodiri, "Pose invariant palmprint recognition," in *Proc. ICB*, Jun. 2009, pp. 577–586.
[8] Jing-Ming Guo; Yun-Fu Liu; Mei-Hui Chu; Chia-Chu Wu; Thanh-Nam Le, "Contact-free hand geometry identification system", Image Processing (ICIP), IEEE International Conference, Page(s): 3185 – 3188, 2011.
[9] Burgues, J.; Fierrez, J.; Ramos, D.; Puertas, M.; Ortega-Garcia, J., "Detecting Invalid Samples in Hand Geometry Verification through Geometric Measurements", Emerging Techniques and Challenges for Hand-Based Biometrics (ETCHB), Page(s): 1- 6, 2010.
[10] Lategahn, H.; Gross, S.; et. Al., "Texture Classification by Modeling Joint Distributions of Local Patterns With Gaussian Mixtures", Image processing,IEEE transaction on june 2010
[11] Miao Feng; Jiting Li, "Real-time deformation simulation of hand-object interaction" Robotics, Automation and Mechatronics (RAM), IEEE Conference, Page(s): 154 – 157, 2011.
[12] Ramalho, M.B.; Correia, P.L.; Soares, L.D., "Hand-based multimodal identification system with secure biometric template storage" Computer Vision, IET, Volume:6 , No. 3, Page(s): 165- 173, 2012

Authors Biography

A. KIRTHIKA was born and brought up at Erode, TamilNadu, India and working as the Assistant Professor in the Department of Computer Science & Engineering, Affiliated to Anna University of Technology, Chennai, Tamilnadu, India.. She obtained her Bachelor and Master Degree in Computer Science and Engineering from Anna University, Chennai in the year 2005and 2007 respectively. She has pursuing the Ph.D., Programme at Anna University of Technology, Coimbatore. She has 4 years of Teaching Experience and au thored 4 research papers in National Journals and Conferences. Her current area of research includes Biometrics. She is a member of various professional societies like ISTE.

S. ARUMUGAM, received the PhD., Degree in Computer Science and Engineering from Anna University, Chennai in 1990. He also obtained his B.E(Electrical and Electronics Engg.) and M.Sc. (Engg) (Applied Electronics)Degrees from P.S.G College of Technology, Coimbatore, University of Madras in 1971 and 1973 respectively. He worked in the Directorate of Technical Education, Government of Tamil Nadu from 1974 at various positions from Associate Lecturer, Lecturer, Assistant Professor, Professor, Principal, and Additional Director of Technical Education. He has guided 4 Ph.D .,scholars and guiding 10 PhD., scholars. He has published 70 technical papers in International and National journals and conferences. His area of interest includes network security, Biome trics and neural networks. Presently he is working as Chief Executive Officer, Nandha College of Technology, Erode.