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A Survey Paper on Finger Knuckle Print Recognition Algorithm

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ABSTRACT

Now a days various biometric techniques have been explored by the researcher for identification and recognition of the person. Being more reliable than the traditional method of recognition, bi metrics traits are becoming mor and more popular for identification of the person. Characteristics of the biometrics decide the performance of such system. Fingerprint, iris, face palm veins are some of the common biometrics which are being used for person identification. Finger knuckle print is also one of the biometrics traits which has attracted many researcher for person identification. Finger knuckle carry some important and unique texture or lines of the skin which can be utilized for the person recognition and identification. This paper present a survey work on the finger knuckle print recognition methods.

KEYWORDS *: knuckle print, Biometrics, finger features, recognition system.*

I. INTRODUCTION

Biometric highlights have been generally utilized as a part of individual verification framework since it is more solid when contrasted with traditional strategies like information based techniques e.g. secret word, PIN number and token based strategies eg. visas, ID cards. Diverse physical or behavioral qualities like unique mark, face, iris, palmprint, hand geometry, voice, walk, signature and so forth., have been generally utilized as a part of biometric frameworks. Among these characteristics hand based biometrics, for example, palmprint, unique finger impression and hand geometry are extremely well known in view of their high client acknowledgment. As of late it has been found that picture examples of skin overlap and wrinkles, the external finger knuckle surface is very novel and this can serve as unmistakable biometric identifier [19]. It has got more points of interest when contrasted with fingerprints. Initially it is not effortlessly harmed subsequent to just the internal surface of the hand is utilized broadly as a part of holding of items.. Furthermore it is not connected with any criminal exercises and henceforth it has higher client acknowledgment [17]. Third it can't be manufactured effortlessly since individuals don't leave the hints of the knuckle surface on the articles touched/took care of. Additionally the FKP is rich in composition and has a potential as a biometric identifier. Whatever remains of this paper is sorted out as takes after: Section 2 talks about the different strategies utilized for catching finger knuckle print (FKP), segment 3 condenses the different method utilized for individual distinguishing proof framework in light of FKP and segment 4 the closing comments

II. FINGER KNUCKLE PRINT ACQUISITION

Woodward and Flynn are the principal researchers who made utilization of the finger knuckle surface in their work. They set up a 3D finger back surface database with the Minolta 900/910 sensor. This sensor catches both a 640x 480 territory picture and an enlisted 640x480 24 bit shading force picture about at the same time. The sensor measurements are 213mm x 413mm x 271mm and it weighs around 11 kg. The sensor cost, size and weight, restrains the utilization of this sensor in a business biometric framework. Amid information gathering, the sensor is

situated roughly 1.3 m from a level divider which has been secured with a dark bit of material. Dark material was picked as the foundation to disentangle the hand information division undertaking. Before information gathering, the subject was told to evacuate all gems. The nearness of gems amid reach picture catch causes the discharged light from the sensor to disperse when contact is made with its intelligent surface. The outcome is absent or off base extent picture information close and at that area. The subject was told to place his or her right hand level against the divider with the fingers normally spread as the picture is caught. Between picture catches, the subject is told to expel his or her hand from the divider and after that arrival it to around the same position.

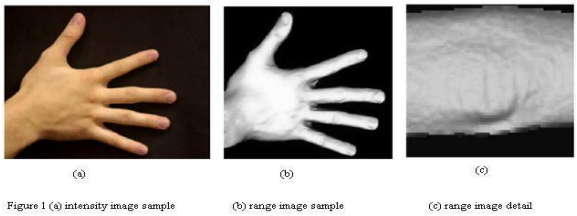

Figure 1 (a) intensity image sample (b) range image sample (c) range image detail

Figure1 (a) demonstrates a specimen 640x480 shading picture of a hand. Figure 1(b)is a pseudo power of the same hand rendered utilizing the 640x480 territory picture as a polygonal cross section. Figure1(c) delineates the surface point of interest distinguished close to a knuckle. The main necessity for hand arrangement is that the fingers are set such that there is space between two contiguous fingers. No limitations like pegs were utilized for securing the pictures. In the wake of preprocessing and fragmenting the fingers they utilized the 3D territory picture of the hand to ascertain the ebb and flow surface representation of the record, center and ring fingers. Standardized connection coefficient was utilized for similitude comparison.[18]

C.Ravikanth et al.[19] built up a framework for getting the finger back surface pictures. This imaging framework utilizes an advanced camera centered against a white foundation under uniform enlightenment. The camera has been set and altered at a separation of 20 cm from the imaging surface. Non-uniform brightening cast shadows and reflections at the hand limits which altogether diminishes the execution. In this manner, the picture obtaining is consistently lit up by a settled light source over the hand. The determination of the procured picture is 1600 x 1200 pixels. Every subject is asked for to put the hand on the backing with their back hand confronting the sensor. The subject can picture the situation of their hand from the live-criticism on little plasma show. The procurement of an example picture is appeared in figure 2(b).

Figure 2 (a) acquistion of finger back image (b) acquired image

Lin Zhang et al. [1] did some advancement in a framework for FKP acquisition. This comprises of four parts FKP picture acquisition, ROI (region of interest) extraction, extraction of the feature and matching of the features. The figure 3(a) demonstrates the FKP recognition framework, Figure 3(b) demonstrates the acquired picture and figure 3(c) the separated ROI which is currently freely accessible in the PolyU database. The FKP pictures were taken utilizing this gadget as a part of figure from 165 persons. The general population who gave the

database were in age bunch from20-50 years.

The examples were gathered in two distinct sessions and the time interim between these two sessions was around 25 days. Six specimens was gathered from left index, left middle, right index and right middle fingers of every individual and in this way an aggregate of 48 tests was accessible. The database hence comprises of 7920 pictures from 660 fingers.

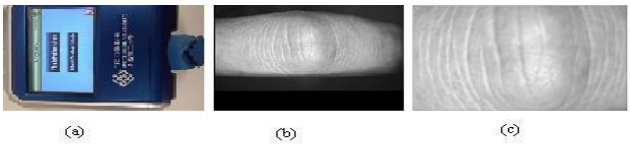

Figure 3 (a) FKP recognition System (b) Captured image (c) extratcted ROI

III. RECOGNITION ALGORITHMS

A bio metric system can recognize a person based on the algorithm built in to the system. These recognition algorithms are generally of two types1) Identification algorithm which computes the template of the user and compares it with the templates stored in the database. It is also referred to as one to many matching.

A bio metric framework can identify an individual in view of the algorithm fed into the framework. These identification algorithm are by and large of two types-

i. Identification methods which calculate the template of the used and use this template to compare the thetenplate already in the database. This step is also known as the one to many matching method.

ii. The algorithm for verification require identity like ID card, smart card, ID number etc. the template of the user is then matched with the Master template of the database for recognition. This is called one to one matching. It is very important that the recognition as well as the identification procedure must be very fast and accurate. The performance of the recognition system can be carried out by computing the error rate. There are two types of error rate in the literature i.e. False Acceptance Rate(FAR), False Rejection Rate (FRR).

$$FAR = \frac{Numberof Falseattemptaccepted}{TotalNumberof falseattempt}$$

$$FRR = \frac{Numberof\ Trueattemptrejected}{TotalNumberofTrueattempt}$$

Threshold value for which FAR and FRR are equal is called the equal error rate (ERR). Accuracy of the biometrics system can be computed by the following formula

Accuracy = max (100 -FRR+FAR)/2)

This formula is used in [26].

In this paper, various biometrics algorithm for the finger knuckle print recognition can be describe by dividing it in to the following category-

i. Sub space based Method.
ii. Coding Method.

iii. Other Method.
iv. Fusion Method.

A. Subspace Based Method

Subspace techniques are used to produce the spatially localized features [2,3,14,27]. This method is attracting the attention of the many researchers. This technique is supposed to be more resistant to the occlusion because the localized features helped to carry out the region based identification [19]. PCA (principal component analysis), LDA(Linear discriminate Analysis) and ICA(Independent Component analysis). The coefficients are used in this method as a features and store in a feature vector. For matching purpose, distance measure or classifier is used. PCA, LDA and IDA are also used for the dimensionality reduction.

Jun et al.[14] proposed another linear feature extraction algorithm called Weighted Linear Embedding(WLE).It joins Fisher standard with complex learning paradigm like neighborhood discriminant inserting investigation. From the complex learning hypothesis it is comprehended that nearby data is more imperative than non neighborhood data and consequently both these elements are extricated. Gaussian weighting is used to consolidate nearby and non neighborhoodinformation.WLE plans to discover a mapping vector such that the proportion between weighted class disperse to the weighted inside class disseminate is boosted. The grouping depends on the closest neighbor classifier. The creators have likewise tried the same calculation on palmprint and have made a near investigation of PCA, LDA, LDE and WLE .The WLE is connected on right pointer of 1000 persons and an recognition rate of 78.2%is accomplished.

Yang et al. [2] motivated by the work that Gabor wavelets have been utilized effectively in image processing and pattern recognition task, utilized it for feature representation as a part of FKP. PCA was utilized to change Gabor features into low dimensional space. Further orthogonal linear discriminant examination (OLDA) change in PCA subspace is done and ordered utilizing closest neighbor classifier and effectiveness as high as 98% was gotten. This paper thinks about the execution of the individual fingers and demonstrates that the left forefinger gives better execution.

Jing et al.[3] utilized the distance and angle between inage data vector to find out the similarities. In order to highlight the difference between angles of two different data and highlight the complimentary information of the angles as compared to the distance. He proposed a new type of image angle measurement in a shifted image space which is kept centered at the data mean. Both angle and distance features are fused using the parallel fusion techniques. This techniques effectively extract out the low dimensional features which preserve the actual structure of the data set. For removing the redundant information, they have used OCLLP(Orthogonal Complex locality preserving Projections). During the training phase, four images have been randomly selected and the recognition rate of 88% have been achieve for l;eft index finger. A comparison process is carried out with some other subspace methods such as PCA, LPP, CLPP, CPCA and OCLPP.

B. Coding Methods

In the past various methods of coding are proposed in the literature [5, 13, 15, 17]. Iris code has been considered as the foundation for the development of the coding based method. Earlier coding alogorithm have been widely used in Palm print Recognition task[21,22,23,24,25,29] and achieved a very good recognition results. There are so many lines and creases in the finger knuckle surfaces. These lines and creases are very unique for each individuals. Ajay

Kumar[17] utilized this local information instead of the global information for achieving improved performance. Texture features are accentuated in the preprocessing steps helps to fight the variation in the illumination. In order to avoid wrap around produced due to the inherent modulo operation of finite redon transform(FRT), he proposed the modified redon transform(MFRT) for making the orientation of the knuckle lines and creases certain around the local neighborhood region. At every pixel, the dominant direction is coded using the binary bit. The combination of theses bits are called the knuckle code. In this work, normalized hamming code was used for similarity measurement. The project is claiming to be provided an accuracy of 98.6%.

Lin et al.[13] developed a system which capture the FKP images and suggested a method to FKP images with the other already stored images by constructing the local co-ordinate system locally. The bottom part of the FKP image is kept fixed by suitable acquisition. This is used as the X-axis. A convexity magnitude is computed by establishing the curve model of the FKP. Minimum of this is used to set the Y-axis. Once this coordinate system is fixed then ROI sub image of the dimension 110x220 is extracted out. Gabor filter is then used to extract the orientation information from the image and represented as the competitive code. Angular distance is applied for the matching purpose.

In the paper[1], author , designed and developed the improved competitive and magnitude code by extracting the magnitude and orientation information from the FKP ROI image by applying the gabor filter.
Lin et. al. [15] suggested a monogenetic code which was based on the monogenetic signal theory and used it for FKP recognition. Monogenetic signal can be computed by combining the two dimensional signal f(x) and its ritz transform. In this method each code is represented by 3 bit which is extracted by sign of the three component of the monogenetic signal. It gives the phase and orientation information of the pixel. The accuracy achieved in this method is very close to the ideal one.
Lin Zhang et al. [5] also suggested a coding method for recognition of the FKP. High accuracy, compactness, robustness and high matching speed are some advantages of the coding method. In this method , second order ritz transform is used to encode the local patches of the FKP image. This method shown the accuracy which is highest at that time.

C. Other Methods

In the literature[7, 8, 11, 16] different image processing systems are utilized either autonomously or joined to remove the feature,local, global or line features from the finger knuckle print. The neighborhood and worldwide data have been joined [8.11] to give more data and better acknowledgment results. To investigate FKP acknowledgment innovation Zhu Lei Quing [9] proposed a FKP feature presentation and coordinating technique taking into account Speeded-Up Robust Features (SURF). It is a change on scale invariant component change. Initial a direction framework is characterized in light of the neighborhood arched course guide of FKP to adjust the pictures and a ROI is trimmed for feature extraction. Also the key focuses are extricated utilizing Fast Hessian indicator. This technique is invariant to rotation, scale and view point changes which demonstrates its robusticity. The technique gives an exactness of 90.63% to check and 96.91% for recognizable proof.

Lin et al. [11] in light of the consequences of psychophysics and neurophysiology concentrates on which demonstrate that both global and nearby components are significant for image discernment, proposed, the Local Global Information Combination (LGIC) method. For neighborhood highlight extraction, the introduction data

separated from Gabor channels utilizing four scales and six introductions is coded utilizing the aggressive coding plan. This technique is appropriate for pictures containing bounteous line like structures and has the favorable circumstances like high exactness, power to brightening varieties, and quick coordinating. Next the size of the Gabor channel is expanded to interminability by which the Fourier change of the FKP picture is gotten. The Fourier coefficients of the picture are taken as the worldwide component. For coordinating two aggressive code maps, rakish separation in view of standardized Hamming separation is utilized. Band Limited Phase Only Correlation (BLPOC) is utilized to gauge the closeness between Fourier changes (Global Information) of the pictures. In this way the neighborhood and worldwide components are coordinated independently and two separations, d1 and d2 is accomplished which are intertwined by Matcher Weighting (MW) principle separation. An Equal Error Rate (EER) as low as 0.402 is accomplished utilizing this procedure.

Rui Zhao et al.[16] proposed a novel methodology utilizing a solitary knuckle print just, for individual recognizable proof. This strategy diminishes the weight of an extensive information base to prepare the classifier. The edges of a picture are described by discontinuities in the dim levels. Along these lines the primary lines in a finger knuckle print are the aftereffect of dim level intermittence. Subsequently to dispose of the clamor and to remove the fundamental lines a self characterized convolution layout of 3x5 is in the spatial area is utilized as a slope administrator for edge location and separating the line feature. Further he utilized a technique to diminish the likelihood of wrong choice that might be brought on by the variety in the exact area of the securing gadget of the distinctive standing stance of the client amid the accumulation of pictures. Eight diverse pictures were gotten by interpretation operation and this alongside the first picture totaling to nine was utilized for affirming the client's personality by most extreme of cross connection coefficient. The tests checked that the knuckle print is solid as one of the biometric characteristics and gave an accuracy rate of 95.68% at 30 limit esteem.

Z.S.ShariatMadar and KarimFaez [7] in their work utilized a bank of Gabor channels to extricate the orientation information from the FKP pictures. Five diverse scales and eight distinct orientations were chosen keeping the remaining parameters steady Next PCA is connected for dimensionality decrease. Since a mix of PCA and LDA gives great impact on features choice LDA is connected on PCA weights. Euclidean distance is utilized for matching .The proposed calculation was tried on every one of the four fingers and it is observed that right center finger furnishes better execution with an accuracy rate of 75.25%.Feature level data combination was done for various finger mixes and a most extreme accuracy rate of 98.79% was acquired for each of the four fingers.

D. Fusion Method

Fusion is a promising procedure that is utilized to expand the precision of the biometric frameworks [20]. Diverse biometric qualities are joined utilizing distinctive combination methods[2,4,6,8.27] These incorporate (i) Sensor level Fusion (ii) Feature level Fusion (iii) Rank level Fusion (iv) Sore level Fusion. In finger knuckle print recognition score level combination has been utilized widely. Z.S.Shariat Madar and KarimFaez [8] proposed a productive technique for FKP acknowledgment by utilizing data combination at various levels. For every picture two component vectors were extricated. The ROI picture was separated into twenty two sections of 1100 pixels each and Average Absolute Deviation (AAD) was figured in individual portions.

Next for the same ROI, Log Gabor transform of five scales and ten orientations is obtained and for each of these fifty images, the AAD is computed. By this process 1100 features were obtained. For dimensionality reduction, a

combination of PCA and LDA algorithm was applied and 164 most important features were selected. The two feature vectors were combined and minimum Euclidean distance was used for comparing. Two experiments were conducted in which each finger was evaluated separately and then different combinations of the fingers were used to get the best recognition result. Left index finger gave an accuracy of 89.9% and the fusion of all four fingers provided 96.56% using feature level fusion.

Abadallah Meraoumia et al.[4] have planned a biometric acknowledgment framework in view of the combination of FKP and palmprint modalities. This plan utilizes Phase Correlation Function (PCF) for matching. Two dimensional DFT of the palm-print picture to be checked and enlisted are gotten. The cross connection of the two dimensional opposite DFT of the phase parts is obtained. This is known as PCF. The PCF has an unmistakable motivation which is utilized for matching. At the point when two pictures are comparative, the PCF gives an unmistakable sharp crest and when they are diverse the top drops essentially. Investigation is accomplished for particular fingers and the right pointer is appeared to have better execution. The two modalities are joined and combination at matching score level is obtained.

L.Shen et al.[2] in his work expects to enhance the exactness of the individual distinguishing proof when just a solitary specimen is enrolled as a layout by coordinating various hand based biometrics i.e. the Palm-print and FKP. To concentrate Gabor features for the palm-print, the picture is convolved with an arrangement of wavelets of various frequencies, introductions and scales. A two bit code is designed for representing the local feature information of a pixel . The same procedure is applied to the FKP pictures and a combination code is acquired. At that point the scores are consolidated at decision level fusion algorithm and Hamming separation measure is utilized to ascertain the similitude between two subjects.

Y.Zhang et al.[6] presents a novel methodology by intertwining two sorts of biometrics i.e. palm-print and center internal surface of the finger. Discriminant features are gotten by joining the measurable data and auxiliary data of every methodology which are separated utilizing locality preserving Projections (LPP) taking into account wavelet change to diminish the impact of relative change, mean filtering is utilized to upgrade the strength of the basic data with a specific end goal to enhance the discriminant capacity of the high recurrence sub groups in the palm-print. The two sorts of elements are melded at score level for the last hand based single specimen bio metric recognition. An recognition productivity of 99.56% is gotten.

IV. CONCLUSION

Finger knuckle print is a new biometric attribute that has entered the biometric family a couple of years back. It contains bended line like structures and is rich in texture. Diverse picture handling strategies that were utilized as a part of individual recognizable proof biometric frameworks have been employed to finger knuckle print and shows promising results. From the above dialogs it might be seen that combination strategies results in high acknowledgment rates. Just a not very many works has been accounted for around there and it has scope for development

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