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Finger Vein Pattern Based Authentication (Some Investigations)

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Abstract –
The ability to identify the individuals uniquely will be crucial for security reasons. In the recent days identification based on biometric features is widely used for authentication purposes. Finger vein is one of the biometric feature which is unique even to the identical twins. An investigation on Finger vein pattern authentication system is presented in this paper. The proposed system is accurate, well suited for identification and can be used for a number of applications.
Keywords :Finger vein pattern, Biometrics, MATLAB

I. INTRODUCTION

The person identification systems are improved in the recent times due to advancement in technology with improved accuracy and reduced the error rate. The Biometric features are unique for every individual and any authentication system based on biometric features are expected to yield better results [1-4]. Finger vein are the most secured and convenient biometric pattern that can be used for identification of person[5] since vein features are not same even for identical twins. As the vein patterns are located beneath the skin surface and invisible to human eyes it is difficult to forge or steal. Thus Finger vein patterns can be considered to be best suitable for authentication purposes[6]. A scheme of authentication using finger vein pattern is discussed in this paper and its performance metrics are evaluated.

II. SYSTEM IMPLEMENTATION

The block diagram of the proposed system is shown below.

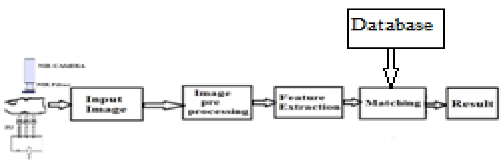

Fig 1: Block diagram

The test image in color is converted into gray image by using BT601 standard [7]

$$Y=R*0.299+G*0.587B*0.114$$

where R, G and B denote the decimal values of the red, green and blue color components . The Region of Interest ROI is obtained by filtering unwanted black background. The size of the ROI is different from image to image due to personal factors such as different finger size and changing location. Therefore it is necessary to normalize the ROI region to the same size before feature extraction. Then the Histogram Equalization is applied to enhance the contrast in an image , in order to stretch out the intensity range. After preprocessing the image the Vein features are extracted using LDC descriptor. [8]Where the difference of the neighbors of the pixel V_h and V_v are used as the two components of the local direction. The gradient orientation θ is computed along the horizontal and vertical directions. For simplicity the θ is further quantized into T dominant orientations as θ' which ranges from 0 to 2π. Then the code function is followed as mod([θ'/(2π/T)]+1/2, T) here we set T=8.

In the present work the proposed scheme is simulated using MATLAB and data base from SDUMLA-HMT Database[9]. The proposed scheme is implemented and tested taking the finger vein images of five persons(P1 to P5) from SDUMLA-HMT database. From each person six samples are taken under various conditions and they are represented as (P11 to P16) for the first person (P21 to P26) for second person and so on, resulting in a total of 5*6=30 samples . The samples taken are processed, features are extracted as discussed above and stored in memory. The input image taken is processed as mentioned above and the compared with featured templates stored in the database.

	P11	P12	P13	P14	P15	P16
P11	1.000	0.8227	0.7969	0.8103	0.8092	0.8172
P12	0.8227	1.000	0.8024	0.8107	0.8082	0.8116
P13	0.7969	0.8024	1.000	0.7767	0.8062	0.7856
P14	0.8103	0.8107	0.7767	1.000	0.7899	0.8054
P15	0.8092	0.8082	0.8062	0.7899	1.000	0.8027
P16	0.8172	0.8116	0.8056	0.8054	0.8027	1.000
P21	0.7731	0.7900	0.7662	0.7627	0.7689	0.7682
P22	0.7735	0.7905	0.7661	0.7667	0.7686	0.7706
P23	0.7712	0.7878	0.7583	0.7658	0.7623	0.7641
P24	0.7635	0.7741	0.7488	0.7548	0.7520	0.7538
P25	0.7634	0.7751	0.7462	0.7566	0.7540	0.7560
P26	0.7963	0.7762	0.7513	0.7581	0.7576	0.7574
P31	0.777	0.7894	0.7733	0.7719	0.7712	0.7709
P32	0.7518	0.7943	0.7687	0.7746	0.7708	0.7716
P33	0.7419	0.7512	0.7363	0.7341	0.7350	0.7323
P34	0.7501	0.7636	0.7403	0.7439	0.7424	0.7419
P35	0.8158	0.8352	0.7938	0.7991	0.8021	0.8007
P36	0.8145	0.8321	0.7951	0.7999	0.7998	0.8004
P41	0.7690	0.7798	0.7470	0.7575	0.7515	0.7616
P42	0.7740	0.7838	0.7570	0.7575	0.7515	0.7616
P43	0.7690	0.7767	0.7455	0.7565	0.7498	0.7527
P44	0.7627	0.7743	0.7458	0.7503	0.7538	0.7541
P45	0.7638	0.7738	0.7455	0.7503	0.7549	0.7510
P46	0.7626	0.7738	0.7484	0.7476	0.7556	0.7528
P51	0.8103	0.8171	0.7820	0.7994	0.7924	0.7898
P52	0.8054	0.8114	0.7779	0.7966	0.7864	0.7787
P53	0.7921	0.7956	0.7756	0.7743	0.7736	0.7507
P54	0.7932	0.7965	0.7709	0.7770	0.7740	0.7885
P55	0.7858	0.7997	0.7726	0.7771	0.7770	0.7749
P56	0.7847	0.7919	0.7630	0.7722	0.7660	0.7693

Table 1 is shown below where matching scores obtained.

The matching scores are calculated as

$$\text{Matching score}=\frac{Mt(i,j)}{code\ \ num}$$

$$\text{Where } Mt(i,j)=\begin{cases}1\ if\ A(i,j)=B(i,j)\\0\ else\ where\end{cases}$$

code num is the total number of pixels of matching area, the matching scores ranges from 0 to 1.

III. RESULTS

The results obtained are given in figure2 below.

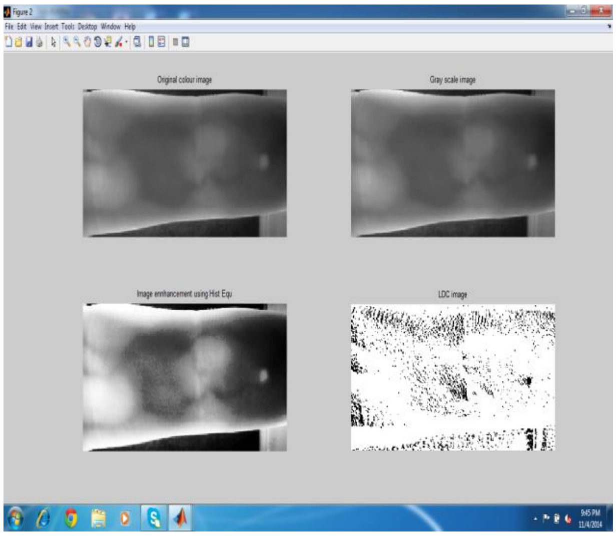

Fig 2. Finger vein pattern

Calculations are made based on normalized matching score obtained from comparison of 256x256 equal size test image and data base image using the BT601 RGB to GRAY conversion standards equation.

The results obtained by using BT601 standard equation from RGB2Gray conversion for sample data of 180 comparisons for person 1are tabulated in table 1.

In order to determine the accuracy of any biometric system , we have to measure the error rates There are two key error rates in biometrics, False acceptance rate(FAR) and False rejection rate(FRR).

FAR is the measurement of how many imposter users are falsely accepted into the systems as "genuine" users.

FRR is the measurement of how many genuine users are falsely rejected by the system. From the experiments performance metrics like FAR (false acceptance ratio) and FRR (false rejection ratio) are calculated. The results are tabulated in table 2.

Samples of P1				
Threshold	0.75	0.79	0.8	0.85
BT601	FAR= 72.2%	FAR= 14.44%	FAR= 6.11%	FAR= 0%
	FRR= 0%	FRR= 13.88%	FRR= 19.44%	FRR= 83.33%

Table 2. The performance metrics calculations.

From the above table 2 for sample P1 it is observed that at a threshold of 0.75 the FRR is zero but the FAR is very high and at a threshold of 0.85 the FAR is zero but FRR is very high. At the threshold of 0.79 FAR and FRR are nearly equal to 14% with BT601.

The optimum threshold value chosen from the performance metrics is 0.79 that is the condition of equal error rate.

IV. CONCLUSION

In this paper, a finger vein based authentication system is investigated. The performance metrics like FAR and FRR are also calculated and tested. The identification systems based on finger vein patterns can be further integrated with ATMs(automatic teller machines) and other applications which require high security.

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