International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2015): 6.391

HCI Authentication Technique based on Chaos Neural Network and PCA

Haider K. Hoomod Ahmed A. Ali

AL-Mustansyriah University- Education College- computer science Dept

Abstract: ***Mobile devices have become the most used and advanced technology .Providing increased computing and storage capabilities .Due to the importance of these devices it is necessary to develop appropriate and powerful protection methods .In this paper was propose a new authentication technique that includes the face recognition using modify Cellular Neural Networks with chaos and hashing password .The images obtained in real time for 10 persons each person has 10 to 15 different shot face images, were the results for (FAR =0), (FRR =6.6), (FER =3.3) and accuracy =90%, detection time is (710Milliseconds).***

Keywords: HCI, HCI authentication, PCA, Cellular neural network, chaos

1. Introduction

Human Computer Interaction focuses on the interactions between persons and computer systems, inclusive the user interface and the main processes which produce the interactions ,With mobile devices constantly taking a bigger section in our everyday life, the suitability of accessing a bank account, paying for any services or even examination medical journals independently of present place and time is bring more and more feasible. Having in mind that these types of services request access to user's personal information, the logical major requirement is high security and strong user authentication methods.there are many threat of mobile , Like viruses and spyware that can infect your PC, there are a variety of security threats that can affect mobile devices. We divide these mobile threats into several categories: application-based threats(Malware ,Spyware ,Privacy Threats), web-based threats(Phishing Scams, Drive-By Downloads), network-based threats(Network exploits, Wi-Fi Sniffing) and physical threats. Some of the previous work in mobile authentication : face and eye detection for person authentication in mobile phones. Hadid, J. Y and the result was Detected is(117) False positives is (12) Speed(8)[1] .and "Mobile Authentication using Keystroke Dynamics ", by SudhirDhage and etal was results false accept rate =(1.612) and false reject rate =(0)[2].

2. Secure Hash Algorithm (SHA-1)

It developed by the National Institute of Standards and Technology (NIST) the flowing steps of (SHA-1).

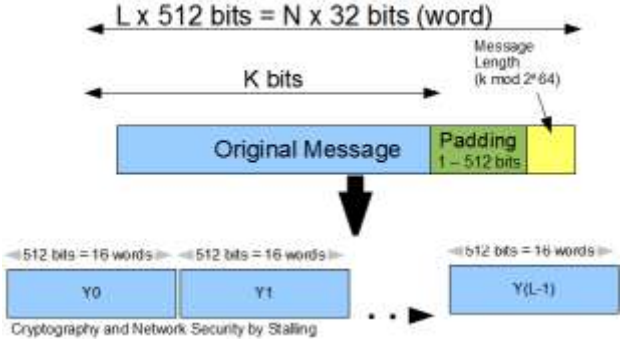


Figure 1: (SHA-1)

1) Pad message so its length is 448 mod 512
2) Append a 64-bit length value to message
3) initialize5-word(160-bit)buffer(A,B,C,D,E)to (67452301,efcdab89,98badcfe,10325476,c3d2e1f0)
4) operation message in 16-word (512-bit) chunks: •
   - Extend 16 words into 80 words by mixing and shifting
   - Utilize four tours of 20 bit processes on message block and buffer •
   - Collect output to input to compose new buffer value
5) Output hash value is the final buffer value all round has 20 steps which substitute the 5 buffer words so .

$$(A,B,C,D,E) \leftarrow (E+f(t,B,C,D)+(A<<5)+W_t+K_t),A,(B<<30),C,D) \quad \text{.....(1)}$$

Where a, b, c, d refer to the 4 words of the buffer, t is the step number ,$f(t, B, C, D)$ is nonlinear function for tour ,Wt is derived from the message block ,$K\ t$ is a fixed value derived from sin [3].

3. Chaos

The Henon map is a prototypical 2-D invertible iterated map with chaotic solutions proposed by the French astronomer Michel Henon .

$$x_{n+1} = 1 + ax_n^2 + by_n \quad .. \quad (2)$$

$$y_{n+1} = x_n \quad \text{.....(3)}$$

The map depends on two parameters, a and b, which for the classical Hénon map have values of a = 1.4 and b = 0.3. For the classical [4].

4. Principal Component Analysis (PCA)

Principal component analysis (PCA) was invented in 1901 by Karl Pearson. PCA is a variable decrease execution and decrease when gained data have some redundancy. This will result into reduction of variables into lower number of variable that can be explained in these steps:

Step1: convert image$(n * m)$ to vector

$$\mathbf{S= \{}L_1 \mathbf{,}L_2 \mathbf{,}L_3 \mathbf{.....}L_m\mathbf{\}}$$

Step 3: compute the average face vector

$$\Psi = \frac{1}{M}\sum_{n=1}^{M} \Gamma_n \quad \text{..... (4)}$$

Step 4: Subtract the average face vector

$$\Phi_i = \Gamma_i - \Psi \quad \text{…. (5)}$$

Step 5: Calculate the covariance matrix

$$C = \frac{1}{M}\sum_{n=1}^{M} \Phi_n \Phi_n^T \quad \text{……..(6)}$$

Step 6: Calculate the eigenvectors and eigenvalues of thecovariance matrix[5]

5. Cellular Neural Network Background

Standard CNN, known as Chua Yang model consists of arectangular MxN array of identical cells, described by thefollowing state and output equations

$$\frac{dx_{ij}}{dt} = -x_{ij} + \sum_{(k,l)\in N(i,j)} A(i,j;k,l)y_{kl} + \sum_{(k,l)\in(i,j)} B(i,j;k,l)u_{kl} \quad \text{…. (7)}$$

Where,$xij \in Rykl \in$ R, $ukl \in$ R and $Zij \in$ R are called state, output, input and threshold of cell $C(i,j)$ respectively.) $A\ i,(\ j;\ k,l\ )\ B\ i,(\ j;\ k,l\ )$are called the feedback.[6]

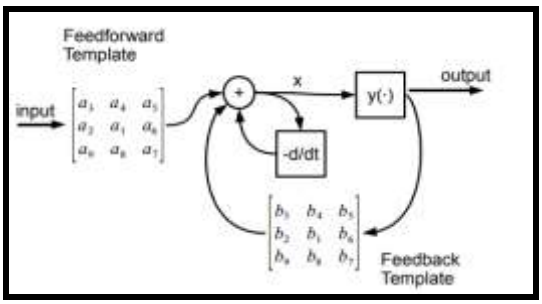


Figure 2: standards (CNN)

6. Face Recognition

The ability to recognize people by their facial characteristics

- **Preprocessing**
- **Face detection**Face detection is the process of automatically determination human faces in visual media (digital images or video). A face that is reveal is reported at a situation with a connected size and trend.
- **Features extraction** Facial feature extraction is the process of extracting face component features like eyes, nose, mouth, etc. from human face image.
- **Matching or classification**[7]

7. Modify (CNN) with chaos

In this stage, the Modified Chaotic CNN was used to find optimal face recognition between face features in database and current entered face features. The proposed modifications are in two locations in CNN, the first modification in the outputs of CNN by adding Henon results to (CNN) for improving the making a decision. Second modification was used Henon chaos system in the learning feeding of the CNN in order to increase the learning speed and get acceptable results in stable case by avoiding angle deviation of face image. Also, to optimization the speeding of the learning and detection of case to find the optimal matching for two images face in face recognition system.

Figure 2 shows the modification of CNN cells by adding Henon chaos system. The proposed modified CNN equation will be

$$\frac{dx_{ij}}{dt} = -x_{ij} + \sum_{(k,l)\in N(i,j)} A(i,j;k,l) + \text{ch}.\ y_{kl} + \text{ch} + \sum_{(k,l)\in N(i,j)} B(i,j;k,l)u_{kl} \quad \text{…. (8)}$$

Where the chaos is ch and:

$$ch = xn + 1 = 1 + axn2 + byn \text{……..(9)}$$

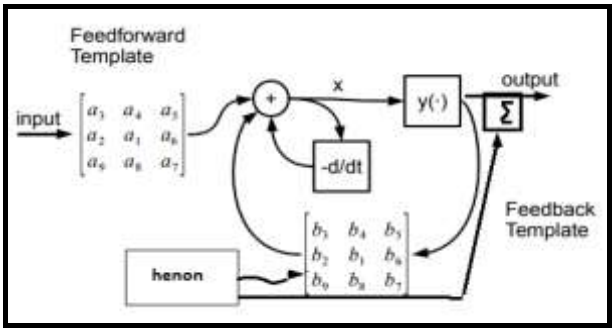


Figure 3: Modify (CNN) with chaos

8. Process of Fuzzy Control

The most widespread use of fuzzy logic today is in fuzzy control Applications.

1) Fuzzification The fuzzification is defined as a mapping from a real-word point to a fuzzy set using a specific membership function
2) Fuzzy Rule-Base : fuzzy rule-base consists of a set of fuzzy IF-THEN rules. The control rules are defined as fuzzy conditional statements of this type.
3) Defuzzification:Thedefuzzification represents the last step in building a fuzzy logic process. Defuzzification can be defined as a mapping from a fuzzy values that results from the previous stages into a real-word value.[8]

9. Propose System

The main aim of the proposed system is to design the authentication system for(HCI),to get high-level identity management processes and a system that is easy and safe to use. The user can be authorize or rejected within a few seconds. The propose authentication system is consists three main stages. First is stage hash password . the second stage face recognition using (PCA) and face recognition using Henon Cellular Neural Network(HCNN)and third stage fuzzy control rules .Through the interface, the user enters the password that is converted to Hash and is compared with the Hash in the database .If the password correctly opens the camera to capture the face image and if the user is not rejected and displayed the error message . face recognition : using two method first "PCA" that consist from steps face detection ,features extraction ,matching or recognition . The input images obtained from image acquisition devices e.g. Using a camera 2-megapixel and image size (256 * 256) Might not be suitable for recognition due to noise or illumination conditions. first step preprocessing to remove noise and fix the illumination, in this stage using Canny edge detection, Canny edge was a multi-stage algorithm that

can discover edges with noise at the same time .The two steps preprocessor and the edge detection were merged into one stage when using canny. features extraction- includes obtaining important face features from the data. These features are face areas, difference, corner or measurement, (e.g. eyes spacing, Size and shape of nose and mouth). The next is to classify and match features compared with stored face features in database.the modified cellular neural network by using chaos for face recognition. This modification (as shown in Figure.2) to the CNN is to increase the learning speed and accuracy of the recognition operation. These two steps of face recognition using (HCNN) and (PCA) are worked parallel on the image of the face, the results goes to the fuzzy rules control and calculated the process where (HCNN) accelerate and corresponding improvement in decision-making. The following rules are applied to calculate the decision ratio.

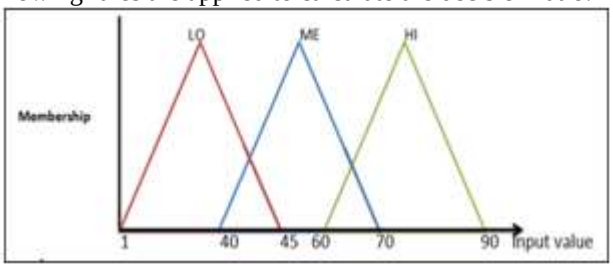


Figure 4: illustrates membership function.

Table 1: illustrates fuzzy rules

FEPCA \ HCCN	LO	ME	HI
LO	0	0	0
ME	0	1	1
HI	1	1	1

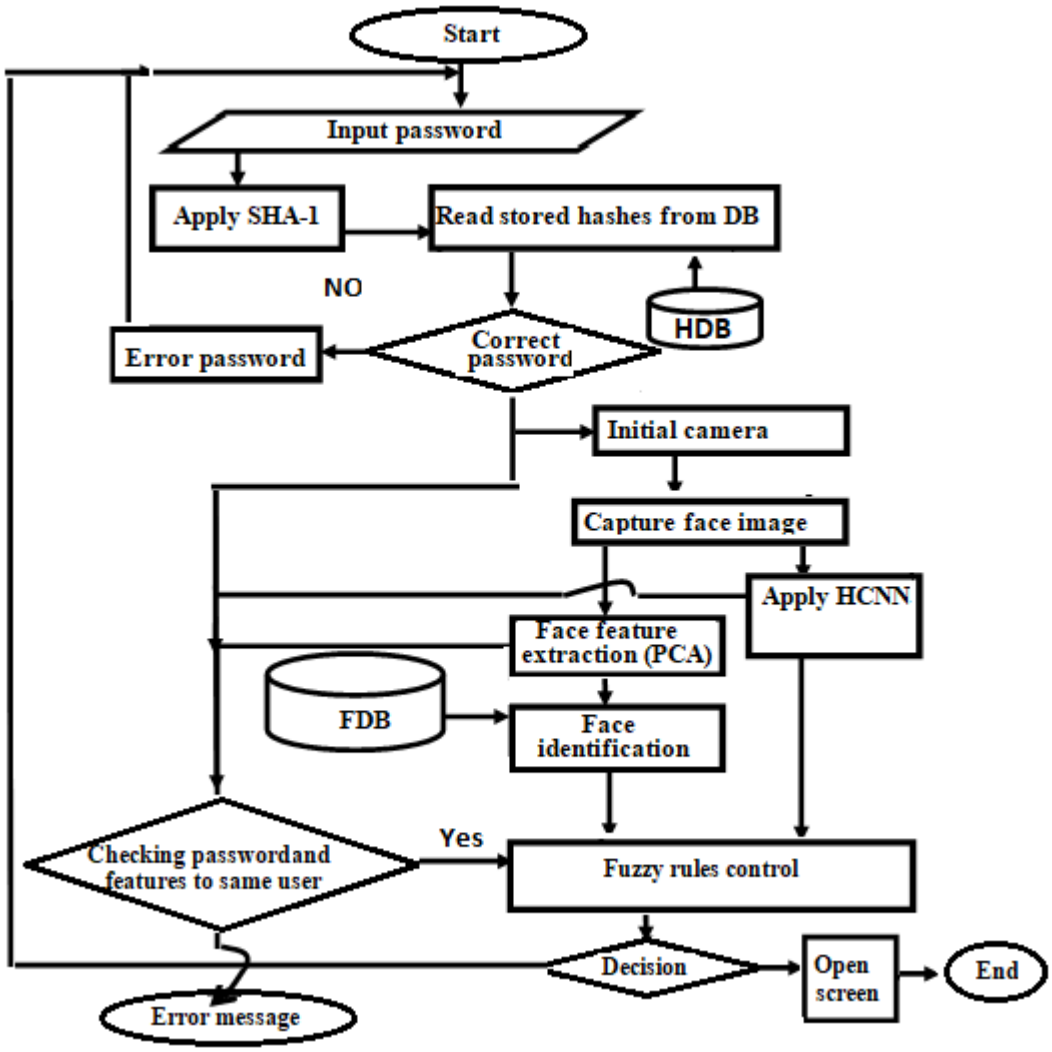
Fuzzy Rule

If HCNN= LO and FEPCA=LO then flags=0
If HCNN=LO and FEPCA= ME then flags=0
If HCNN=LO and FEPCA=HI then flags=1
If HCNN=MEand FEPCA=LO then flags=0
If HCNN=ME and FEPCA=ME then flags=1
If HCNN= ME FEPCA=HI then flags=1
If HCNN=HI and FEPCA=LO then flags=1
If HCNN=HI and FEPCA= ME then flags=1
If HCNN=HI and FEPCA=HI then flags=1

The calculation defuzzification is convert truth values into output from the following equation (3.1)The figure (3.7) shows fuzzycontrol and algorithm (3.10) shows steps of fuzzy control

$$u = \frac{\sum_{n=1}^{N} ui\, fi}{\sum_{n=1}^{N} fi} \quad \ldots\ldots(10)$$

Finally check the password you are returning to the same person, if the face image and password is correct and the same person, system authorize to person opens the façade and provides the services .



10. Conclusion

The proposed HCI Secure Authentication Technique that was developed to protected the users from threats and concerns related to the safety of their personal information. From the results, we obtained Note that the proposed system is very fast in the process of detecting and face recognition. Also according to the results obtained through the implementation of the system on 10 people and each person (15 to 20) different situations, we note that the high speed of recognition with good performance. Where oneimagewere rejected out of 10 images due to high deviation of the image of the face. The use of the CNN of recognition led increasing speed of recognition of the system and according to the results in the tables we notice the matching speed of 140 to 310 millisecond and the speed of detection was 500 to 900 milliseconds (Depending on lighting conditions and angle of face) less than one second. By integrating CNN with Henon and running in parallel with PCA we notice an increased speed learning algorithm and gave it the best results. The use of fuzzy control rule increases the accuracy of the results in proposed system The use of hash function on the password gave more security

11. Experimental Results

At this stage we used smartphones such as galaxy s5 and we applied ten images persons .For compute the accuracy of proposed authentication system, error rates have to be determined and must using various execution valuation parameters. Execution parameters FAR (False Acceptance Rate) Is the percentage of the system error that accepts the number of people who are not authorized as authorized persons ,FRR (False Rejection Rate) Is the percentage of the system error that accepts the number of persons unauthorized as authorized persons,(Failure to Enroll Rate) FER the Failure to Enroll Rate is the number of persons who failure in try at registration and (recognition rate) RR or accuracy is The recognition rate .And measuring the time registration ,time detection and Hash values for each password.

Table: 2 illustrates result for proposed system

	Face image	*password*	*Time execution for has*	*Time detection (Milliseconds)*	*SHA-1*	*Time recognition (Milliseconds)*
1.		74714503454564	4ms	798	425b105510ecfe5c68f579ed665349eb88f579ed	244
2.		9081570266766	1ms	682	65349eb810ecfe5c685510ecfe5c68f579ed6653	301
3.		6913608200090	3ms	603	038d64d965349eb810e8f579ed6653cf29d8749e	278
4.		1111114567789	1 ms	690	6534510ecfe5c68f579ed669eb810ecfe5c68500	101
5.		547488590700	1 ms	721	510ecfe5c68f579ed6600ecfe5c68f579ed669e9	180
6.		3565678990078	3 ms	681	05510ecfe5c6866e0ecfe5c68f579ed669eb810ecf	200
7.		93456782345	2 ms	570	e69eb810eeb810e8f579ed665cfec68679f67	223
8.		23455676879	1 ms	651	fb810ecfe5c685510ecfe5c68455700e4558890	233
9.		233546576890	3 ms	900	ed665349eb8eb105510ecfe5c68f579ed6653478	250
10.		9876453423456	1 ms	690	5510ecfe5c68f579ed665349eed665349eb8e899	101

Table: 3 illustrates result of (FRR, FER, FAR and RR)

	FRR	FER	FAR	RR
	6.666666666666667	3.333333333333333	0	90%

References

[1] Hadid, A., Heikkila, J. Y., Silvén, O., &Pietikainen, M. (2007, September). Face and eye detection for person authentication in mobile phones. In Distributed Smart Cameras, 2007. ICDSC'07. First ACM/IEEE International Conference on (pp. 101-108). IEEE.
[2] Dhage, S., Kundra, P., Kanchan, A., &Kap, P. (2015, January). Mobile authentication using keystroke dynamics. In Communication, Information & Computing Technology (ICCICT), 2015 International Conference on (pp. 1-5). IEEE.
[3] Grah, J. S. (2008). Hash functions in cryptography (Master's thesis, The University of Bergen).
[4] Knauf, A., & Sinai, Y. G. (2012). Classical nonintegrability, quantum chaos (Vol. 27). Birkhäuser.
[5] Liu, C., Zhang, T., Ding, D., &Lv, C. (2016, July). Design and application of Compound Kernel-PCA algorithm in face recognition. In Control Conference (CCC), 2016 35th Chinese (pp. 4122-4126). IEEE
[6] Wu, C. Y., & Cheng, C. H. (2000). The design of cellular neural network with ratio memory for pattern learning and recognition. In Cellular Neural Networks and Their Applications, 2000.(CNNA 2000). Proceedings of the 2000 6th IEEE International Workshop on (pp. 301-307). IEEE
[7] Haji, S., &Varol, A. (2016, April). Real time face recognition system (RTFRS). In Digital Forensic and Security (ISDFS), 2016 4th International Symposium on (pp. 107-111). IEEE.
[8] Bai, Y., & Wang, D. (2006). Fundamentals of fuzzy logic control—fuzzy sets, fuzzy rules and defuzzifications. In Advanced Fuzzy Logic Technologies in Industrial Applications (pp. 17-36). Springer, London.