Network Authentication Protocol Based on Secure Biometric NIDN

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Abstract

In this paper an authentication based finger print biometric system is proposed with personal identity information of name and birthday. A generation of National Identification Number (NIDN) is proposed in merging of finger print features and the personal identity information to generate the Quick Response code (QR) image that used in access system. In this paper two approaches are dependent, traditional authentication and strong identification with QR and NIDN information. The system shows accuracy of 96.153% with threshold value of 50. The accuracy reaches to 100% when the threshold value goes under 50.

Keywords: Automatic Fingerprint Identification System, Fingerprint verification, QR, National Identification Number, Secure Socket Layer

Introduction:

The growth in the natural of applications especially in as e-government and e-business requires a new secured controlled authentication methods. The automatic identification of individuals plays an essential role in applications of that type where the identity of the person comes from his/her biometric and sometimes other personal information. User identification is known also as authentication or individual recognition in form of one – to – one verification. Authentication can be Token-based and/or Knowledge-based. The use of the term “something you have” is centered in the Token-based methods while the use of the term “something you know” is centered in the Knowledge-based methods. Both of these methods types suffer drawbacks of lost, forgetting, stolen, guessing by others and bad-using that makes the biometric technology takes an important range in applications. “Biometrics” is the term that overcomes the limitations mentioned above by using the individual properties both in physical and behavior form to identify persons. Biometrics can be finger print, Iris, face, palm, voice, handwriting, gait [1, 2].

Finger print (FP) biometric is considered the more reliable and useable that it is easy to capture, store and processed to generate a unique personal identification [3,4].

Section two expressed the architecture of the system where how the test of the system is done is expressed in section three. Section four gives the experiments results and tests. Conclusions are stated in section five. Finally, the references are listed as section six

System Architecture:

The framework system architecture that is suggested in this paper is illustrated in figure 1. It is depending on dividing the work into client/server sides. It is based on interaction system of client/server in Secure Socket Layer (SSL) protocol [5]. The client side afford complete interface helping user with totally system jobs, fingerprint scanner is accompanying in the client computer to capture the fingerprint image, and the QR code is generated and decoded. The server side affords services facilities for users of the system like registration procedure, and the generation of NIDN with the registration and

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authentication facilities for the user that needed from the users in both authentication types of normal such as normal and strong. Data transmission in both directions is traveling over SSL protocol module. The complete system structure and functions is expressed in figure 1 and the details of its functions are illustrated as follows:

1. **Graphical User Interface (GUI):** this component represents the front end interface for the system. The GUI interface is simple, clear and easy to be used by the user providing guiding in each step. It is implementing using C# language compiler

2. **FP capturing:** to capture the fingerprint image, ZK 4500 FP optical scanner is used providing the system with a real time fingerprint image. In this module the fingerprint scanner will be compatible with the client program.

3. **QR Generation:** in this segment the QR image is produced for the produced NIDN. It is printed in a card that makes it available to use later in the accessing system [5].

4. **QR Decoding:** in this segment the web camera of the laptop is used to read the QR image, so it will work as a QR reader. Then it will recover the involved NIDN to be used later.

5. **NIDN generation:** this unit is work in the enrollment process to register a new user. Integration of the fingerprint feature and the personal identity user information like mane and birthday is used to generate the unique NIDN number. Flowchart of this process Figure 2 displays the

![Figure1](image.png)

**Figure1**-The proposed system architecture
The steps of generating the unique NIDN that are related with fingerprint and the personal information of the users are completed with hashing function to produce 128-bit hash value as an output, the steps are as follows:

**a. FP pre-processing:** to enhance the fingerprint image time domain Gabor filter is used, and as another preprocessing steps binarization and thinning are accomplished. The processes in this stage are useful to develop and enhance the feature extraction process.

**b. FP minutiae features extraction:** Crossing Number (CN) algorithm is used in this stage to extract the minutiae fingerprint features as in equation (1) below:

\[ CN = \sum_{i=1}^{8} |N_{i+1} - N_i|, N_9, ..., N_{16} \tag{1} \]

Where \( CN \) is the crossing number, \( N_i \) is neighborhood pixels.

The value of \( CN \) is representing the minutiae type; that the value of (1) means that minutiae is in edge termination while the value of (3) means that it is in bifurcation.

**c. Combining minutiae features with personal information:** to avoid any conflict may be happened in minutiae feature extraction and to strength the system authentication, an integration with the personal identity information is done in this step.

**d. Apply MD5:** the integrated information in the previous sub-step will be the input to a one way hashing function that generate the NIDN which it is in a fixed 128-bit length.

At this point we get NIDN, to complete registration process a new user will be added to the dataset and production QR card that contain the NIDN to be used as token card in the access system.

**6. DB registration:** this component is clarified for registration procedure that comprises the computed NIDN and the other information of the user to the dataset of the system.

**7. Normal Authentication:** this part runs the traditional kind of authentication service that supplied by the system to guard the simple data that is public. In normal authentication the token QR card for individuals is only used in accessing the system as illustrated in the block diagram of Figure-3.
Figure 3-The basic block diagram for the normal authentication

A normal authentication gets QR card as input then matches it with the saved NIDN in the dataset. As a final point, the judgement is based on comparison to decide access or denied to the public application.

8. **Strong authentication:** it is another authentication service that the system is provided. By this service the safeguard to a sensitive data is applied. The data may be for banking application. In strong authentication QR card and real time fingerprint is required to access the system. Figure 4 illustrates the flowchart of this strong authentication service.

Figure 4-“Strong authentication flowchart”
“In strong authentication; user identification has been accomplished by examining the user NIDN with the total NIDNs in the saved dataset”. The dependence of user verification in FP one-to-one is based on the comparison between saved FP image of data set and real time captured image [9]. “Automatic Fingerprint Identification System (AFIS) algorithm, called (AFIS engine) is used to implement the verification” [7], which is a robust matching algorithm that can solve some of the complications connected with fingerprint images such as “rotation and shifting. The difference between two fingerprint images defines the user’s receipt by the system”.

Testing ways of System:
“The system has been weighed using the following methodologies”:

1. **FP matching system testing**: this check demonstrates the trustworthiness of AFIS engine” with some changing of impressions circumstances of fingerprint images. Figure 5 shows the fingerprint shifting conditions to test the system. “Table-1 shows the results matching score values results for these conditions”.

![Figure 5](image)

Figure 5- (a) Fingerprint backward shifting, (b) Fingerprint forward shifting, (c) Fingerprint clock-wise rotation and (d) Fingerprint anti-clock-wise shifting.

| FP Impression                          | Matching Score |
|----------------------------------------|----------------|
| Backward shifting                      | 55.95922       |
| Forward shifting                       | 65.58824       |
| Clock-wise rotation 45°                | 42.90625       |
| anti-clock-wise rotation 45°           | 67.27821       |

1. **Traffic analysis**: this check confirms the reliability of Secure Sockets Layer to prevent sniffing attack for the transmitted data. This testing is achieved by the wire shark which is a software tool developed with the system to deal with the traffic sniffing. With Secure Sockets Layer the users can get encrypted data that is useless and unmeaning when the secret keys are unknown.

Experiments and Results:
This section demonstrates the effects and outcomes of implementing the system, demonstrations the features in stages of processing fingerprint images, normalization of the fingerprint images, the
minutiae feature extraction, and for each user generating NIDN to be used in strong authentication access to the system, then the precision rate for the system is computed depending on some real and faked users. Figure 6 displays the steps and results of fingerprint processing on a sample image.

![Figure 6 - Steps of fingerprint processing](image)

Table 2 expresses for number users of the system their NIDN. Table 3 displays or number of both authenticated and unauthenticated users of the system their matching scores value in the strong authentication service.

To conclude results, the precision matching of system is calculated with different thresholding values. The following formula outlines the computing of percentage precision.

**Precision rate (%)** = \( \frac{TM}{TN} \times 100\% \)

Where

- **TM**: True Matching trails.
- **TN**: Total Number of trails.

The results of computing the accuracy for different threshold values is shown in Table 4.

**Table 2 - The generated NIDN**

| User Name    | NIDN                                      | Birthday      |
|--------------|-------------------------------------------|---------------|
| Ali Kadom    | ed507237030ee067e935ef23c086bae5         | 26/2/1976     |
| Muntaser Saleem | b73a482561c9e96f1830986354037a2          | 20/5/1990     |
| Abdalhameed Mondel | 20710b300645592ae356285aab1addf         | 3/5/1996      |
| Sana Kamal   | cb5c361cbe7754235eb54b469191cb8ca6      | 11/4/1990     |
| Hussan Kamal | e932792e98d4bf45c062654897e12df        | 30/7/1991     |
| Thulera Jaber | 37f5a08612a802a540399282461f760d        | 4/11/1970     |
| Hurna Kadom  | b5f2f4285f451c6d5b8f386767f9e           | 14/17/1992    |
| Rafe Saleem  | 0e612da014a144a100eadd17e6d5e66         | 1/8/1938      |
| Mohammad Saleem | 7f8b6313db63c076082974794e3332285        | 18/6/1982     |
| Sabah Fatch  | 3bd27e91eece2697d1bb10f48f4711f5        | 7/7/1989      |
Table 3 - matching fingerprint scores for both real and faked cases

| User Name   | User NIDN                                                                 | True Matching Score | Fake Matching Score |
|------------|---------------------------------------------------------------------------|---------------------|---------------------|
| Mutasar Saleem | 075a492561c9e96fd1d33 d883450337a2                                           | 93.22698            | 0                   |
| Mustafa Taher   | 35bdf7d7f0df77f8b3f07b5b6ea08d834f769                                    | 77.22011            | 0                   |
| Rafel Saleem    | da612da1cc144b410334add7b6da6b6                                    | 72.1989             | 0                   |
| Mustafa Ali     | 922fca9107f92500f109b6b4c54                                              | 40.95295            | 0                   |
| Samer Falah     | 35bdf7d7f0df77f8b3f07b5b6ea08d834f769                                    | 75.94591            | 0                   |
| Mahdi Satar     | 131d019b05547d094d631b88df                                             | 58.06331            | 0                   |
| Mokhaled Saleem | ff1b296ebc6ad89243bbdf5ef18df                                              | 99.31831            | 0                   |
| Mustafa Haji    | 5800c73a1c0c0c2725ca3c1e442842ed5                                     | 70.96764            | 0                   |
| Dhia Raad       | e5d8555ef91d5443686800d8acbad17                                         | 99.56341            | 0                   |
| Foad Emad       | 95fa0b6620ba7539bea130460f63b49                                            | 54.16734            | 0                   |
| Hasanen Ibrahim | b261323fa6562ab402d64f77340f                                             | 55.6778             | 0                   |
| Sabah Falah     | 3bd2f1e96e6ed2697d1b1b10843b04711f5                                     | 50.86031            | 0                   |
| Zia Raad        | 593b4a2420ee240ff8053001cd7100ea1                                         | 76.24079            | 0                   |

Table 4 - Accuracy rate

| Threshold value | Accuracy rate (%) |
|-----------------|-------------------|
| 0               | 100%              |
| 10              | 100%              |
| 20              | 100%              |
| 30              | 100%              |
| 40              | 100%              |
| 50              | 96.153%           |

Conclusions

Over and done with the stages of designing and implementing the system, some points are concluded; they are seen in the natural of the system flow work like the trade of strong authentication service method for protection the privacy of the application including sensitive data from unauthorized access. Also the time cost of extra computations is considered. And for less sensitive applications including e-libraries a less weight computation authentication which is considered normal authentication method is proposed. Combining NIDN with QR image can be secure and quick properly. It is planned to capture the QR image by the device in accessing time in and compare it with the plain NIDN. For transmission data, SSL protocol is used. Gabor filter is used to enhanced the performance of fingerprint with the minutiae feature extraction technique.

The future work is to implement the developed the biometric recognition system in a reconfigurable hardware (10-16).
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