

New System of E-Voting Using Fingerprint

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Abstract— The problem of voting is still critical in terms of safety and security. This paper deals with the design and development of a web-based voting system using fingerprint in order to provide a high performance with high security to the voting system also we use web technology to make the voting system more practical. The new design is proposed an election for a university for selecting the president of the university. The proposed EVS allows the voters to scan their fingerprint, which is then matched with an already saved image within a database. The software is implemented completely as a .net managed code in C#. Upon completion of voter identification, voters are allowed to cast their vote using voting website. Casted vote will be updated immediately. The result shows that the proposed electronic voting system is fast, efficient and fraud-free.

Keywords— AFIS, biometric, e-voting, fingerprint, Minutiae.

I. INTRODUCTION

In the present day, democracy has become an important part of people's lives, and to achieve democracy must meet several conditions. The heart of democracy is voting. The heart of voting is trust that each vote is recorded and tallied with accuracy and impartiality. The accuracy and impartiality are tallied in high rate with biometric system. Among these biometric signs, fingerprint has been researched the longest period of time, and shows the most promising future in real-world applications. Because of their uniqueness and consistency over time, fingerprints have been used for identification over time.

Voting theory began formally in the 18th century and many proposals for voting systems have been made ever since. There have been several studies on using electronic technologies to improve elections. When designing an electronic voting system, it is essential to consider ways in which the voting tasks can be performed electronically without sacrificing voter privacy or introducing opportunities for fraud. An electronic voting system defines rules for valid voting and gives an efficient method of counting votes, which are aggregated to yield a final result.

Moreover, electronic voting systems can improve voter identification process by utilizing biometric recognition. Biometrics is becoming an essential component of personal identification solutions, since biometric identifiers cannot be shared or misplaced, and they represent any individual's identity. Biometric recognition refers to the use of iris, fingerprint, face palm and speech characteristics, called biometric identifiers. Fingerprint matching is a significant part of this process. It is an extremely difficult problem, due to variations in different impressions of the same finger. Fingerprints are unique to each individual and they do not change over time. Whereas different finger impressions of the same user look different [3].

Minutiae Based Matching is a technique in which minutiae are extracted from a fingerprint and stored as sets of points in a two-dimensional plane and then minutiae of the fingerprint to be recognized are extracted and matched with the stored points. Minutiae matching essentially consist of finding the alignment between the template and the input minutiae sets that result in the maximum number of minutiae pairings.

Automatic fingerprint identification is one of the most reliable biometric technologies. This is because of the well-known fingerprint distinctiveness, persistence, ease of acquisition and high matching accuracy rates.

Web-based Voting System makes the system more practical and help the voter to vote from anywhere, at any time this will solve many problems for voter. Internet use in the voting process is very important because it easier for people to participate without any hesitation or effort.

In this paper we describe design and implementation of an web based voting system based on fingerprint matching. Online matching is a new process introduced in Web-based voting system, it make the system more secure and practical. The paper contain many topics: in section II. we describe election type, section III. Describe fingerprint technique, section IV. Describe the proposed system.

II. ELECTION TYPES

In this section we explain the election or the voting types according to its development with the time.

A. Paper-Based Voting

Many people use the paper to choose their representatives through the traditional voting systems. This method has been used since long time especially before the advent of the internet. This method requires the presence of the person himself to the voting place and time specified and that stands in the booth and vote to choose one of the candidates in confidence and then put the paper in the ballot box. But this method have several disadvantage for example the voters must go to voting station and wait in a queue to cast his vote and in some cases, the voter is being subjected to harassment by some officials. also said this method easily susceptible to fraud and change the vote. Furthermore, it is very difficult to collect the ballot boxes and transported to the main center. and most importantly, the error that may happen during the counting of votes. in addition to the high cost of process and time spent. Well as in some countries, there are security problems may affect the functioning of the electoral process. For example, gets a threat to the polling stations and voters, which negatively affects co-extensive to the voters. All these reasons led to serious research to introduce e-voting to practical life.

B. E-voting

E-voting is complete the voting process electronically, without the use of paper and ballot boxes. The term electronic voting and also known as e-voting is a term inclusive of many systems and methods of voting, Voting mail includes stalls closed to vote equipped with electronic devices, software, peripherals, processing systems, equipment, tools and screens, networks and means of communication ... etc., and sometimes includes systems, smart cards "containing an electronic chip data by the voter," or biometric cognitive systems (a standard vital systems that rely on measuring the physical properties that are unique to each person is different from the other by such as fingerprint and retina and fingerprint DNA fingerprint).

C. Web-Based Voting

A lot of countries approved principle of voter voting from anywhere in the world with the Internet, and be either using a PIN code up to the voter by registered mail or using an identity card intelligent containing slice electronic data

with the rest of the voter, where their contents are read through card reader connected to your computer. Internet use in the voting process is very important because it easier for people to participate without any hesitation or effort. We can improve web-based voting by increase the security level of this system as we explain in the next section.

III. FINGERPRINT TECHNIQUES

Among all the biometric techniques, fingerprint-based identification is the oldest method which has been successfully used in numerous applications, because of their uniqueness and reliability. Usually, the fingerprint image data captured during enrolment is stored / transmitted for 1:1(verification) and 1: N (identification) in an e-Governance application life cycle.

Fingerprint recognition is really just a type of associative memory with similarity measure [20]. Probe fingerprint on input is compared with every candidate fingerprint stored in the associative memory, candidates are sorted by result of the similarity measure function, and the closest match is returned. Generic associative memory is parameterized by two fingerprint-specific functions: extraction and similarity measure. Extraction or abstraction improves signal-to-noise ratio in input fingerprint before storing its template in associative memory. Similarity measure function computes single value (similarity score) that represents degree of similarity between two templates. For efficiency reasons, probe template is first indexed into relatively large probe index containing multiple lookup tables for faster matching. Matcher then compares candidate templates against probe index instead of probe template itself. Extraction, indexing, and matching algorithms can be efficiently split into multi-stage pipeline to control algorithm complexity and allow easy extension. Template extraction algorithm constructs extraction models of the fingerprint by removing unimportant information thus improving signal-to-noise ratio.

A. AFIS

Automated fingerprint identification: is the process of automatically matching one or many unknown fingerprint against a database of known and unknown prints. Automated fingerprint identification systems are primarily used by law enforcement agencies for criminal identification initiatives, the most important of which include identifying a person suspected of committing a crime or linking a suspect to other unsolved crimes.

Automated fingerprint verification: is a closely related technique used in applications such as attendance and access control systems. On a technical level, verification systems verify a claimed identity (a user might claim to be John by presenting his PIN or ID card and verify his identity using his fingerprint), whereas identification systems determine identity based solely on fingerprints [1]. A large number of computer algorithms have been developed to automatically process digital fingerprint images. These algorithms have greatly improved the operational productivity. Minutiae filter and Gabor filter are a part of these algorithms; all these algorithms use the following steps in the figure below to do the automated fingerprint identification.

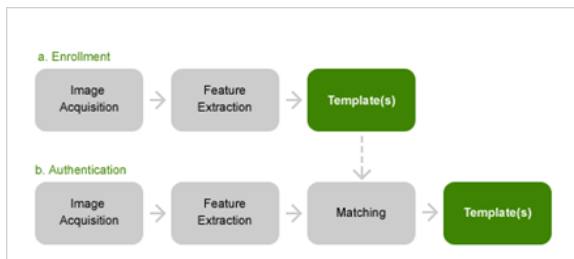


Figure 1. Fingerprint Identification Process

IV. PROPOSED DESIGN

The system that we design is suggest an election to choose the president of university, there are 4 candidate for this position, and there are 40 voter register in this election, the admin sponsors to register the voters, each voter can register after attending to the admin, give his name, ID, and scan his fingerprint, then the admin submit this information to store in database, or the admin can get all voter's information with their fingerprints from official office. On the day of election the voters can participate by open the website of election from anywhere and cast their votes. When the voter want to vote, he will asked by the website to identified himself by his fingerprint, he will scan his finger (the same finger who submit before) and submit it to the system, then the system will return the decision for allowed or not allowed him to vote, voter is allowed to vote only for one time, the system can compute and display the results of each candidate, also we add the pie chart in the results page to make the system more clear for user. The software is implemented completely as a .net managed code in C#.

In our project we use onlineAFIS.dll file which contains a single project online AFIS core SDK it basically handles the processing of fingerprint images and matching [20]. We design all *.aspx files for web application that required in e-voting system, these files have the code behind C# code. Figure 2 show how the system works in general.

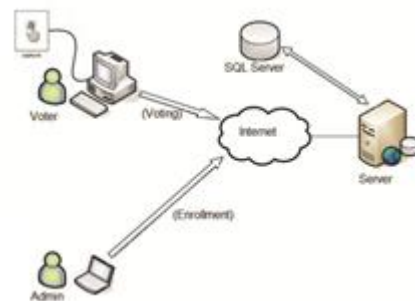
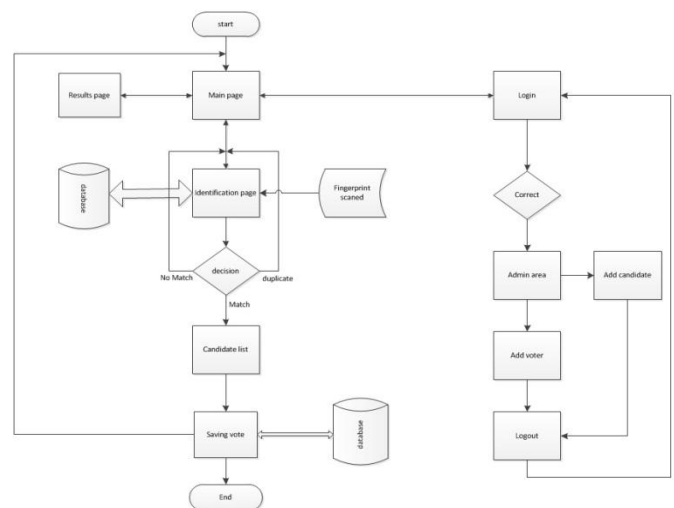


Figure 2

We use SQL server to create the evoting_db database the database we create have three tables: the candi- table for candidate information, voter-table for voter information with their fingerprint, votes-table for count the votes. In voter table the fingerprint image features will store in byteIsoTamplate field, the system will used this features to do the matching process. In votes table the system will store the voter Id and candidate Id which he selected, the system can compute the results from this table by count the candidate Ids.



Flow chart for proposed design

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The above chart show the work flow of the system, we can see that the voter in identification page have three cases: No Match, duplicate and Match. If Matching then he has the permission to cast his vote.

To get access to the home page of the Voting Web site, just enter in our favorite Web browser the URL: <http://localhost:4710>. the home page are appeared as shown in the figure (3), the voter can participate in election after he register in the system, he can register by contact the admin of the system we will explain the registration later. After we click the green button to cast our vote, the authentication page are appeared as shown in figure (4) in this page the voter must submit his fingerprint image

through click browse button and choose his fingerprint image that already taken by fingerprint scanner. The source code of this page (authentication.aspx) is written behind (authentication.cs) in C# which contains the source for calling onlineAFIS.dll this page will upload the image to server side for doing the authentication, the process happened as follows:

1. on the server side onlineAFIS.dll is called, and the image is passed to onlineAFIS library.
2. onlineAFIS have many*.cs classes represent the core onlineAFIS sdk these classes contains source code for fingerprint processing and matching.

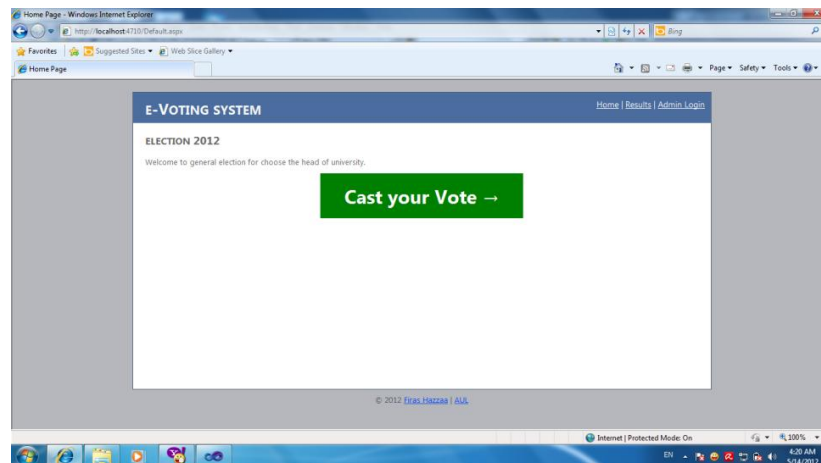


Figure 3 Main page

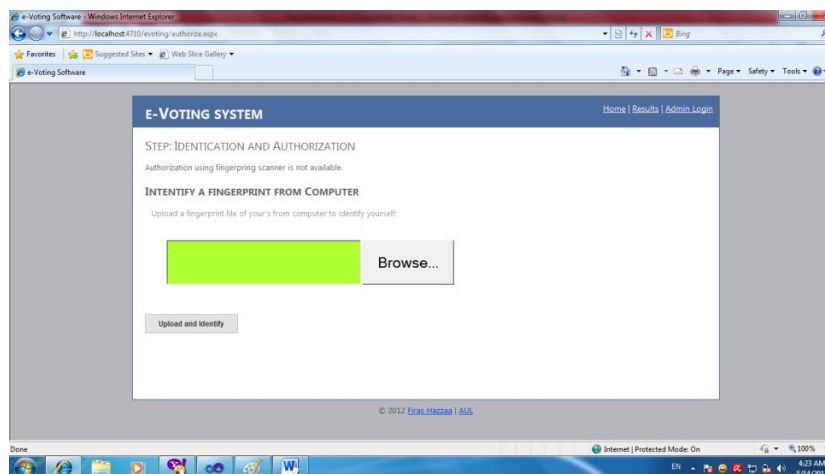


Figure 4 Identification page

. Calls afis engine class and create new object, then create fingerprint object [6], and wrap it in person object:

```
Fingerprint fp1 = new Fingerprint();
fp1.AsBitmapSource = new
Bitmap(Bitmap.FromFile(pathToImage));
Person person = new Person();
person.Fingerprints.Add(fp);
```

4. Extracts minutiae from the fingerprint image and stores them in fingerprint template:

```
Afis.Extract(person);
```

5. Calls afisengine.identify to matching the fingerprint image with all images in database:

```
Person matchingCandidate = Afis.Identify(probePerson,
allCandidates);
```

The fingerprint will captured by the fingerprint scanner (zk5000) and saved on computer as shown in figure (5) then the voter select the fingerprint image from its location on the computer, After that he submit his fingerprint image to the system, the system will check if he register or not, through check the fingerprint images in database, if it match and the voter not participate before, that means the voter can participate, and welcome message will appeared as shown in figure (6). We can see that the system bring the name and the Id of voter from database depend on his fingerprint. Now the voter identified himself and he is authorized to vote.

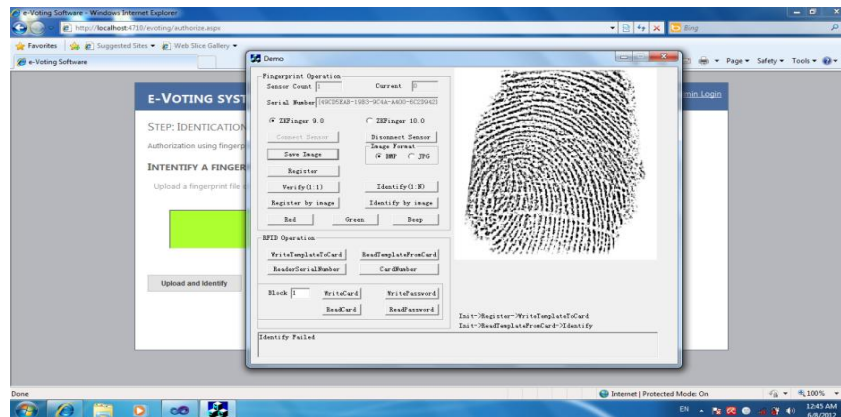


Figure 5 scan fingerprint

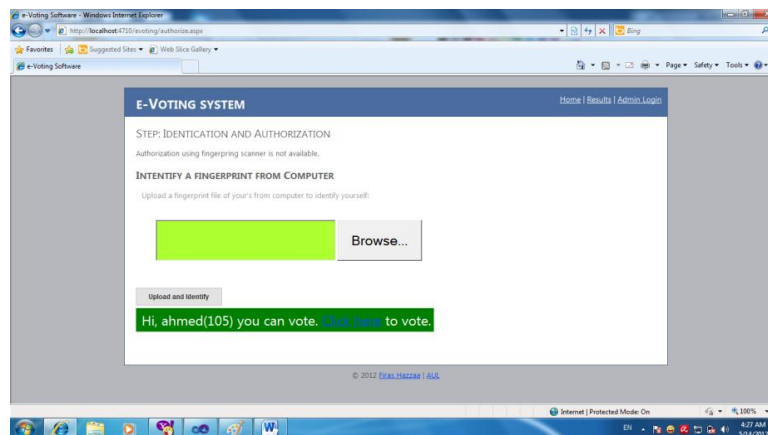


Figure 6

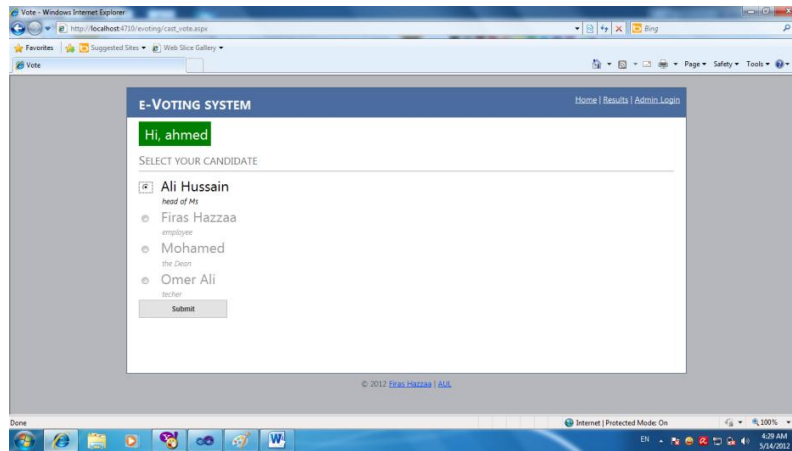


Figure 7 candidate page

The voter must click on link inside the msg, after he doing that, list of candidate will appear as shown in figure (7) in this page we see that the voter can select just one candidate, then the voter click submit to cast his vote and after that the system displays thanks message for voter. If the voter tries to enter the voting system for second time, the system will prevent him and will display sorry msg as shown in figure (8). If someone wants to enter the voting system and he don't register in the database, the system will prevent him

and displays not match msg as shown in figure (9). The tools we are used in this project on the server side are:

Microsoft visual studio 2010, IIS server and SQL server.

On client side: fingerprint scanner (zk5000 used in our project) and internet explorer 5+.

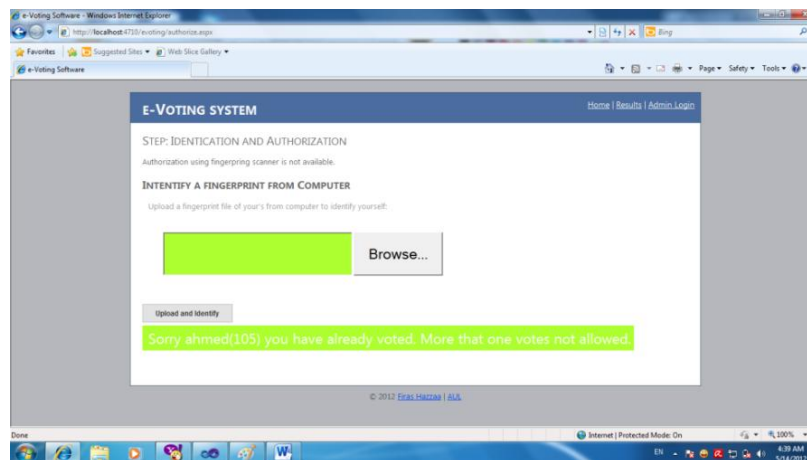


Figure 8 duplicate

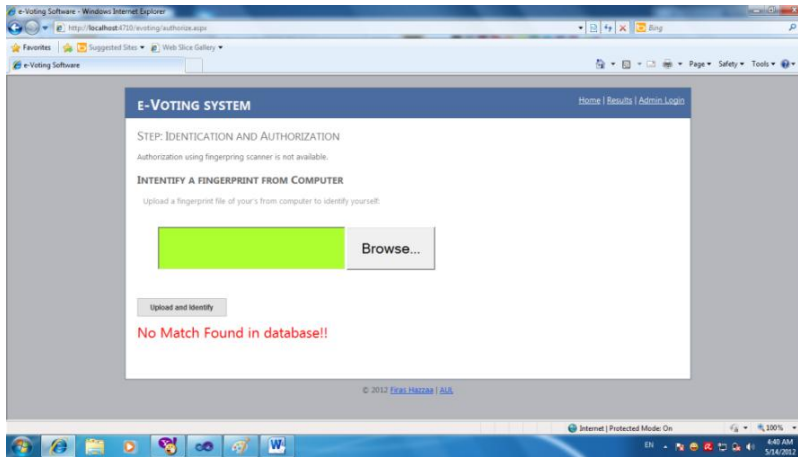


Figure 9 error page

The result can be displays as shown in the figure (10) the result contains a list of the name of candidate, his Id, ratio of the number of votes, and the number of votes obtained for each candidate. You can see the pie chart appeared in this page. The administrator can login to the system by using his account as shown in figure (11) He can add a new voter and add a new candidate by use menu as illustrate in the same figure then when the admin register a new voter to

system he must write the name and the Id of voter and upload voter's fingerprint image taken by scanner and when the admin add new candidate, everyone must have unique Id. After adding him the new mgs appeared tell us that the candidate added successfully.

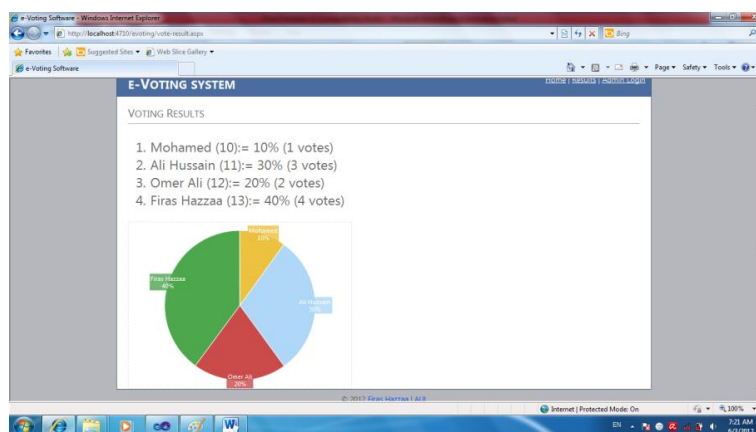


Figure 9 Results page

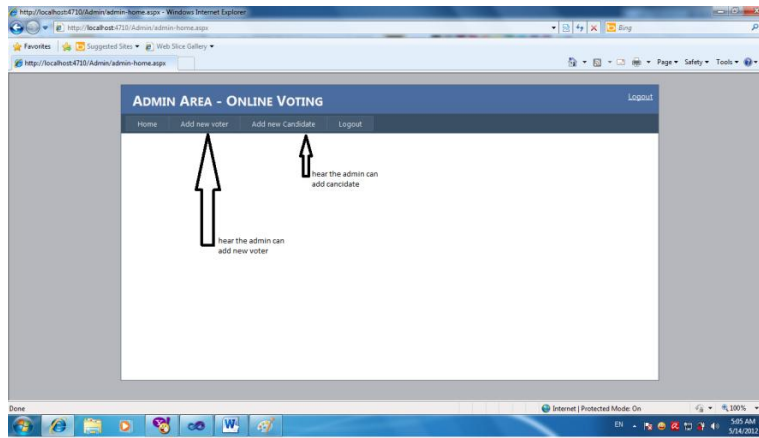


Figure 10 Admin page

V. CONCLUSION AND FUTURE WORK

In our test, 60 people are participating in the election to vote for their candidate to choose the president of university. 40 people are register in the system by submit their fingerprint to the system, 20 people are not register in the system. All 40 people were able to indicate their votes using their fingerprint without any error. Another 20 people couldn't cast their votes and the system prevent them to enter the voting system because of lack of match their fingerprints with fingerprints that exist in database. The system could calculate the voting result immediately, table (I) show the results of our test.

We have developed Web-based Voting System using Fingerprint Recognition. This system has provided an efficient way to cast votes, free of fraud, and make the system more trustable, economic and fast. We have used Minutiae-based fingerprint identification and matching with high accuracy. The image size of 150 Kb are used. We tested our system with a database of 40 enrolled users on a Pentium 4 with 2.2 GHz Processor. Feature extraction stage takes approximately 130ms and it was found that on the average, the matching process is completed in 1ms. Success Rate of our system is 100% and 0% error rate. The overall cost of this system is only 700\$. Finally the correct use of the fingerprint reader is very important, because it Affects fingerprint image resolution, which affects functioning of the system.

TABLE I
VOTING RESULTS

Candid. Id	Name	Rate %	votes
10	Mohamed	45%	18
11	Ali Hussain	30%	12
12	Omer Ali	15%	6
13	Firas Hazzaa	10%	4
Total		100%	40

VI. FUTURE WORK

1. Protect all the system by provide secure channel, encrypt data, protect servers Prevent hackers and threads, will make the system more efficient and practical. Also we can increase security levels of admin login process by adding second level of security.
2. Using twin driver for fingerprint scanner will allow the web application to read fingerprint data through finger scanner directly, and send to web service for verification.
3. For big database we can use verification instead of identification in AFIS to reduce the matching time.

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