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Fingerprint based Electronic Voting Machine with Inbuilt Identification and Verification System

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Abstract

Voting is one of the important tasks in electing a government for any democratic country. Biometric identification system is secure, reliable and privacy protected for the purpose of electronic voting machine. This paper provides the design of fingerprint based electronic voting machine.The developed system verifies the voter identity and also check whether the voter is authentic or not during election process. This work is targeted to replace the manual verification system with biometric verification system. The developed system also examines carefully whether the voter has voted once or more. This system does not require any third party service for its operation. It is a low cost system, flexible and easy to operate. Different components of the developed system have been tested under various operating conditions.

Keywords: *Fingerprint, Templates, Voting system, Biometric, Verification, Authentication.*

INTRODUCTION

In the recent times of modernization, privacy is an important issue all over the world. In majority of democratic countries, government is elected through the process of voting. The existing system is not very efficient and reliable and also manual approaches are required for verification, which consumes more time. At present, balloting unit and control unit are used to conduct the voting. Balloting unit is used by the voter to choose the candidates while control unit is used by the Polling officer to allow the user for voting. But in the existing system, illegal voting is possible by the invalid voter, which is sensitive to security attack, which results that some people loses their voting right in selecting the government.

Fingerprint recognition technique is most popular technique among all other technique of biometric. Every human has different fingerprint except handicapped person, who has disability related to hand. Every person has a unique fingerprint pattern and also never changes all over the life. Fingerprint recognition is a very complex process; hence it is necessary to build a system easily that automatically recognises the fingerprint with low computational cost and high level of accuracy. Fingerprint matching is based on the information contained on fingerprint image namely, minutia, delta, shape, core, pores etc. Minutia primarily based matching algorithm is useful in many programs and usually carry out with high accuracy. However its overall performance additionally depends upon many factors namely, variety of minutia factors, satisfactory of picture, alignment of fingerprint and so forth.

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LITERATURE SURVEY

Before start to work on project, it is necessary to have the complete understanding of the target and knowledge about the possible ways to reach that target. This content describes the previous work which has been done so far in the area of fingerprint matching. Some research papers has been done, which incorporates some very useful fingerprint matching algorithm. Before start the matching process three fingerprint matching techniques are compared to select appropriate method. These matching techniques are Direct matching, Minutia based matching and Ratio of relational distance matching. Direct matching technique is the simplest way of matching. In this technique, pixels of base fingerprint template are compare with the pixel of input fingerprint template.This type of matching includes different attributes such as location, type, orientation; quality of neighbourhood region. In Ratio of rational distance matching algorithm, common minutiae points set are obtain. The main objective of this phase is to identify the number of similar minutiae points set present in both the fingerprint templates. After the comparison of these techniques, the minutiae based matching algorithm found best in comparison of the other two methods in terms of memory usage and time consumption. To start this project we have studied a many more articles out of them some, we found of our main concern which are directly or indirectly related to our project. Some of those useful researches are discussed here as follows:

An improvement of minutiae based fingerprint matching is described in this paper. Hybrid method is used for improvement. Information of neighbour minutiae point is considered for matching. Problems resulting due to distortion are sorted and improvement in accuracy in fingerprint matching is also discussed. [4] has presented the performance analysis of minutiae based fingerprint matching algorithms. Comparison of different algorithms is also explained in this paper. All algorithms are implemented using .NET and C# language. Database creation using R305 Fingerprint module is taken from [5], which represents the fast Bio-metric fingerprint payment system. Triplet matching stage is proposed in [6]. Extension of the ordinary disc harmonics moments using the algebra of quaternions is introduced in this paper. Automatic fingerprint recognition is discussed in [7]. To handle the large number of different fingerprint templates data, machine learning approach is used in this paper. [8] discusses that Sometimes false minutiae points are recognised due to low quality of images. To identify the reliable minutiae points, multiple thresholding methods of enhancement are used in this paper. [13] has described the matching algorithm using nearest neighbour minutiae quadruplets and highlighted that time and space complexity is also reduced in the result section of this paper.

PROBLEM FORMULATION

Proposed system is privacy protected authentication system in which database of biometric identities is created using fingerprint templates. The first part of this work is to create database of different fingerprints of voter, who are eligible for voting in election. R 305 fingerprint sensor is used for scanning of finger and generates the templates. Two templates of the same finger are used to generate a single template for matching. This reduces the alignment problem in the scanning of finger. After creating a database, the complete process is classified in three parts. First one is identification in which, fingerprint of the voter is matched with the

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previously stored templates in database. Second part is verification, in which whether the voter is valid or not is to be checked. If one of the templates matches with the finger of voter then, the voter is eligible for voting. Repeated voting is also monitored in this process, which is not allowed by the same candidate. Third part of the work is voting, in which, voter will choose the option, which is available on electronic voting machine. All the coding of these works has been done in IDE software of Arduino AT MEGA 2560 microcontroller board. The main target of the developed system is to reduce the time consumption in verification and authentication during the process of election

PROPOSED ARCHITECTURE

The architecture as proven in Fig.1 is proposed, in which the voting system comprises of R305 fingerprint module, which is used to scan finger for enrolment and identification of user. Output image of the module is send to pc for processing of fingerprint templates. Within the enrolment section, the optical sensor of module scans one finger of the consumer two times to create the identity.

Minutiae features are extracted to produce the templates and the minutiae positions and direction of alignment in the image of fingerprint are available in database. During identification, template available in database is matched with the fingerprint of voter and voter is identified [4]. The stored templates maintain security as it is made through two level processes and highly secure from external elements.

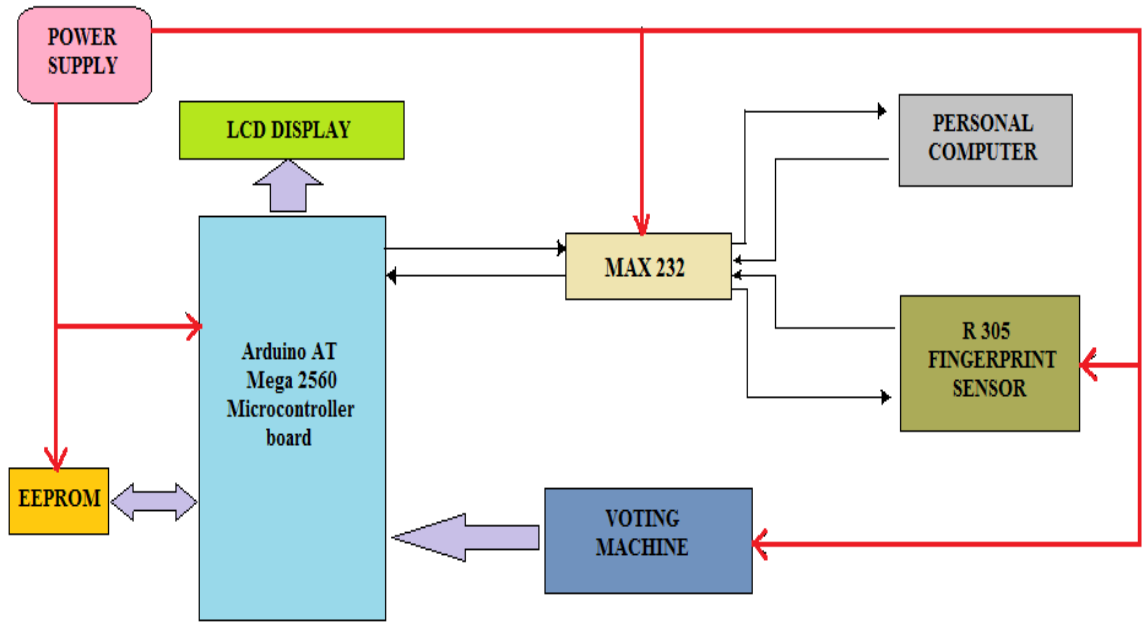

Fig: 1. *Block Diagram of Fingerprint Based Voting System [1]*

The hardware used in the proposed system are Fingerprint module (R 305), Arduino AT Mega 2560 microcontroller board, Laptop, LCD display (16 x 2), LED, Buzzer and push buttons.

SYSTEM DESCRIPTION

The developed system is categorized into four stages that are enrolment, identification, verification and voting. At

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the time of capture of the fingerprint image, the enrolment stage is applied to it and the output of the first stage is applied as an input to the next stage. All stages which are required for authentic voting are described below.

Enrolment

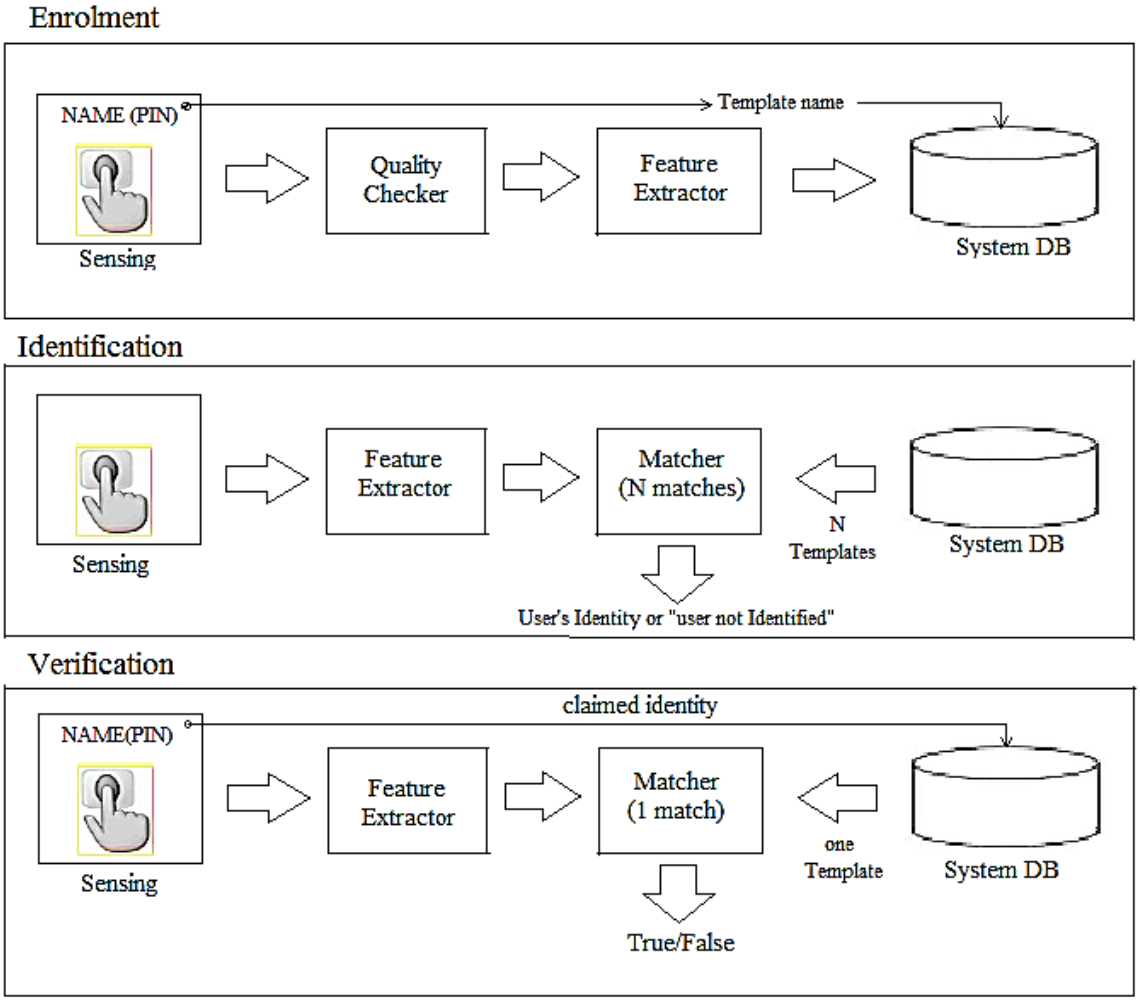

Fig:2. *Process of Enrolment, Identification and Verification [2]*

Before starting the complete process of the developed system, first we have to create data base of fingerprint templates of valid voters. R 305 fingerprint module is used to take impression of finger. User needs to enter the same finger two times to generate a single template, which reduces the problem of alignment during verification process. Each template is identified by different names of voters and stored in this module. Hex codes are used to communicate with the module. After the pre-processing stage of creating database, system is ready to use.

Identification

This process is used to check the voter identity and the main target of this process is to identify that which voter has accessed the system. When user place the finger on optical sensor of module then the features of that finger is extracted and match (1: n) with all templates which is previously stored in database [5]. If fingerprint is matched with any of the templates then information stored along with that template is used for further processing. When fingerprint is not matched with any

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of the templates then system is programmed to match that finger again and again [9]. After several times of matching, voter is declared as invalid voter, as that fingerprint template is not stored in the database.

Fig: 3. *Voting Machine Commands on IDE platform*

Verification

Verification is the process to check whether the user is valid for voting or not. One to one matching (1:1) is performed in this process [5]. It can also monitor that voter has voted once or more. More than one vote by the same candidate is not allowed in this system. After identification, first it is checked that the user has voted or not. If user has not voted then only voting is allowed. In this process, how many minutia points are matched is also checked. This shows the confidence level of matching during verification.

Voting

After the process of verification voting is allowed to the user. In the process of election, Voting machine is constructed with the help of push buttons, LED, buzzer and LCD screen.

Push buttons is used by the user to give vote to the candidate. Arduino AT Mega 2560 microcontroller board is used for the programming of voting machine. Commands related to voting machine on IDE platform are shown in Fig 3. One pushbutton & LED is allocated to each candidate who is contesting the election. When pushbutton is pressed for voting then LED and buzzer assures that voting is successfully done. At the same time, LCD display indicates that the casted vote by the user goes to which particular candidate. All the votes are separately added according to the candidates. One push button is also allocated to display the results.

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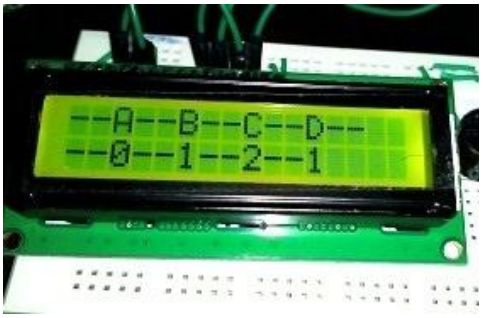
EXPERIMENTAL RESULTS

The developed prototype has been tested under different operating conditions. The work is done in the sequence start from the first stage which is pre-processing. The results of pre-processing stage are displayed on Serial Monitor. The system is programmed to display three statements in creating the database. First it shows, R 305 module is connected properly or not. After placing the same finger two times on optical sensor of module it shows, both fingerprints are matched properly or not. After matching the fingerprints serial monitor displayed, templates are stored or not. Results of minutiae matching and graphical representation of three fingers samples are shown in Fig.4 and Fig.6.



Sample No.	Finger No.1	Finger No.2	Finger No.3
1	78	135	110
2	86	138	107
3	92	152	118
4	98	122	132
5	89	124	107
6	104	137	88
7	73	148	108
8	78	145	123

Fig: 4. *Statistical table of fingerprint matching* ***Fig:5.*** *Result of voting on 16 X 2 LCD Display*

Other outcomes and instructions related to identification, verification and voting machine are displayed on 16 x 2 LCD display and serial monitor both.

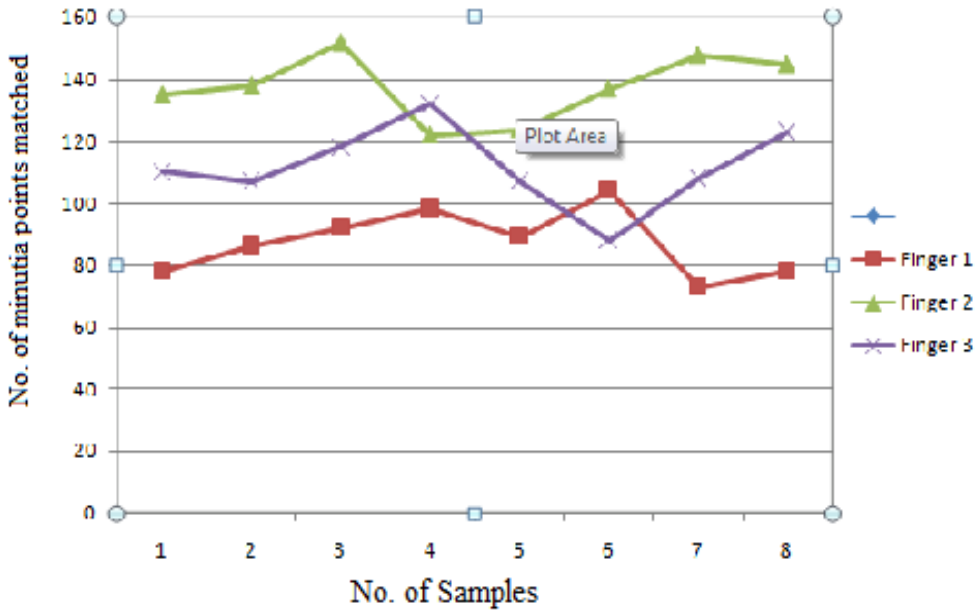


Fig: 6.*Graphical representation of minutiae matching*

When finger is placed on fingerprint module during the process of Identification and verification, then serial monitor shows the name of template which is matched with placed finger and also gives the confidence level based on minutiae points matched. When more than 50 minutiae points are matched then system is programmed tocheck that user has voted or not.

If user has not voted, then only voting is allowed to the user otherwise not permitted for voting. Fig. 5 shows the results of fingerprint matching. After the

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process of verification, voting is to be done and the LCD display is used to show that the vote given by the user goes to which candidate after pressing the vote button. When push button allocated to result is pressed, and then number of votes of the respective candidates is displayed separately as shown in Fig. 5.

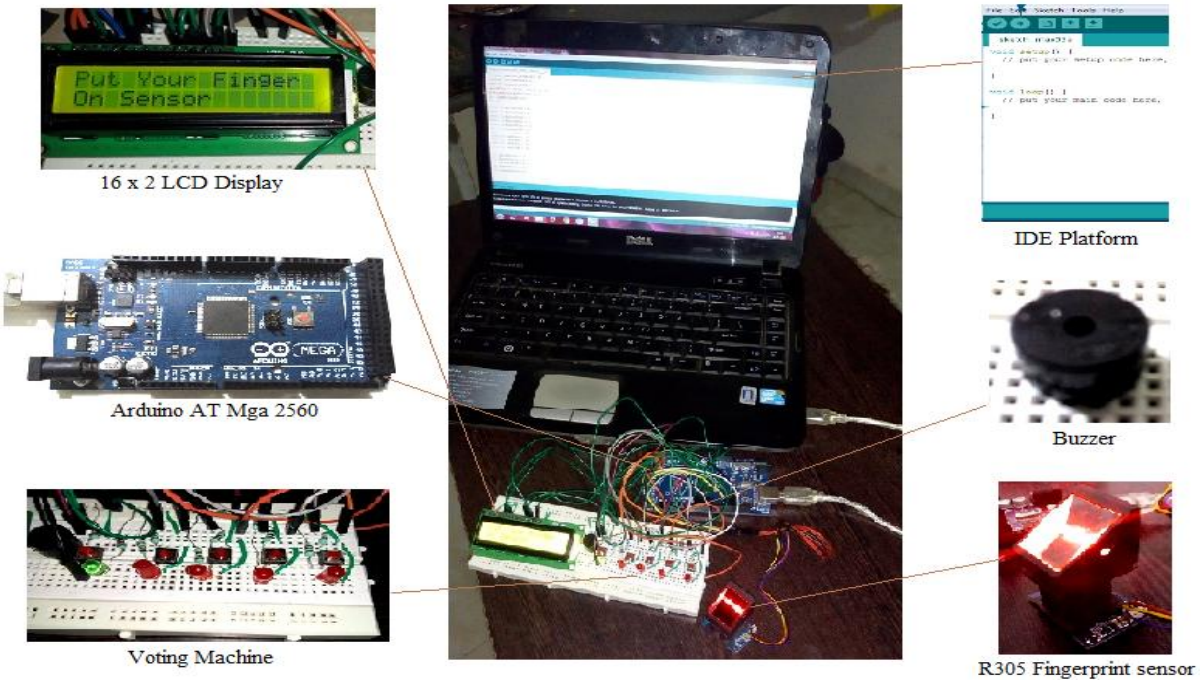

Fig: 7. *Final test setup of prototype*

CONCLUSION AND FUTURE WORK

A privacy protected fingerprint based voting machine is developed in this paper. Biometric identification and verification through fingerprint templates are successfully done in this prototype. Authenticity of the voter is also monitored with the confidence level based on minutiae matching [7]. Illegal voting by the invalid voter is completely eliminated. The developed system is also programmed to calculate the results of voting [2]. Hence, the proposed system will execute a electronic voting machine with security and privacy. In future, the system can be expanded by including the following features to it as listed below:

1. Implementation via neural network and fuzzy logic can be done in order to enhance the performance of fingerprint matching during identification and verification.
2. The developed prototype can be tested with large number of database, by matching with time complexity based on minutiae points.
3. It is also possible to develop a high resolution fingerprint matching framew -ork that utilizes three levels of features.

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