Fingerprint and Barcode Reader for Voting System

Kamaran Hama Ali Faraj[1]**, Haval Mohammed Sidqi**[2]**, Galawezh Muhammad Najeeb**[3]

[1] Department of Computer, Sulamani University,
[2] Department of Computer, Sulamani Polytechnic University,
[3] Department of Engineering, Sulamani polytechnic University,
KRG-IRAQ.

[1] kamaranfaraj@yahoo.com, [2] havalms@yahoo.com, [3] Gashshox@gmail.com

ABSTRACT

Elections process in Kurdistan Region Government (KRG) is neither traditional nor electronic even until several months ago. It was in a fully traditional system (paper ballot) and pen before the computer-internet or information communication technology (ICT) era. For example; the elections that are completed by traditional methods are inappropriate any more due to the long period preparation experiences, being a slow-paced process and corruption. Apart from those mentioned before the voters and Elections polling staffs must do many physical activity and efforts for Elections process (EPs). The most recent EP in the country were semi electronic Election system (SEES) with two tier architecture (2TA) by blended using of fingerprint, barcode reader, ICT and paper-ballot. SEES is not fully distributed system and far from real time approaches, but it enhanced and solves some of the traditional Elections system (TES). The attractive of the proposed system is to enhance SEE toward to electronic elections system (EES) over three tier architecture (3TA) with availability of disturbed system, results transparency, real time and, also the EES process solved time and money consuming for the government with lots of untidiness, paper work, that effect unfairness of results with free and fair voting. The Quality Improvement (QI), Quality of information (QoI) and Quality of Service (QoS) of TES is very poor if compared to SEE and EES over both 2TA and 3TA. The most recent election in the KRG was by using of some ICT technologies namely semi-electronic election (SEE) or Blended E-election (BEE), that Voters record their options confidentially by ticking the boxes next to candidate on Paper-ballot and the counting is done manually. The modification of paper-ballot to web-ballot in the proposed system is avoid paper work and create communication between dynamic web site (web-ballot), barcode reader, fingerprint and computer server over public network. The attractive of our proposed system is to improve toward fully EES with load balancing by separation of fingerprint and bar code reader as a frontend, C++ is middleware and MSQL is backend over public network and TCP protocol. The suitability of the EES measured by speed.exe application software for fingerprint and bar code reader tools, the both tools are tested one time simultaneously and another time individually in frontend. The simultaneously or individually working together both tools in front end and backend will be tested and find out the best results.

Keywords: Fingerprint, Barcode Reader, Tier Architecture, E-voting

INTRODUCTION

As in the manual voting system where the voters need to come to the polling booth and cast their vote and also while result counting some people should be assigned to count the votes there are chances of committing mistakes these all drawbacks have motivated us to develop online voting using fingerprint identification where the voter by sitting in one place can cast voter to a particular candidate belonging to a particular party and there are no mistake while counting the votes [JD13]. Also all voters became an active voter in one of the point that voters don't need to go to specific polling station; thus this is one factor of modifying inactive voters (manual voting) to active voter (Electronic voting). In an active voter isn't long queue wait and the time-consume and efficiency for achieving voting process in E-voting is constant. Since technology has made great strides over the past decade, the most important and revolutionary item is certainly the Internet, because of the convenience and popularity of the Internet, it becomes increasingly necessary to offer services via the web [FM14]. The proposed E-Election system that focused on blended of biometrics-fingerprint and ID barcode reader for enhancement of the voting system in KRG and modifies the paper ballot to web bases ballot. Biometrics is the term given to the use of biological traits or behavioral characteristics to identify an individual. The traits may be fingerprints, hand geometry, facial geometry, retina patterns, voice recognition, and handwriting recognition. In our proposed system the combine uses of impression for the purpose of voter identification or authentication, barcode reader for (voter ID Cared) and thumb as the thumb impression of every individual is unique, it helps in maximizing the accuracy. A database is created containing the thumb impressions of all the voters in the constituency. Illegal votes and repetition of votes is checked for in this system. Hence if this system is employed the elections would be fair and free from rigging [KUM12]. One of the most important government services like elections became a severe pressure on people involved in that process, according to many constraints that must be applied to the beneficiaries of this service and which are divided into two parts, *candidates* and *voters* [AAUA13]. Nevertheless, in the KRG the traditional manual method of Election had been revolutionized by the emergence of the ICT Internet. In the past few months, the ICT (i.e. fingerprint and barcode reader) has significantly changed the face of Elections and the ways citizens think about the voting or looking after in "right person for right place" function. Since the Kurdistan's Independent National Electoral Commission (INEC) advised by Kurdish Citizens in order to better election process and decided to move toward to semi-electronic voting system over two tier architecture(2TA) to has since designated its interest in using the electronic voting (also Known as biometric voting) system for future elections. If the KRG-Nations Electoral Commission is determined to conduct a credible poll in the future elections, then electronic voting should be seen as an absolute option to achieve its aim.

MODELS VARIATION RELATED TO E-ELECTION

E-government constituents include citizens, employees, businesses, and other Governments, and leads to four categories of e-government: G2C, G2E, G2B, and G2G. The first category of e-government, and the one most closely related to e-voting processes, is government-to-citizen (G2C). This refers to electronic communications and transactions that occur between a government and one or more of its citizens. Governments tend to focus on this type of interaction because a founding principle of governance is to serve its citizens [JK05], also as mentioned in a previous section our proposed system is mostly related to G2C. Many models have been developed to handle E-electing requirements that support processes and activities, also the use of ICTs can connect all three important parts they are considered as part of e-governance, the following are these models:

G2C

It covers the E-election system that is supported by the government and governing by the private sector namely Independent National Electoral Commission (INEC). Thus, the private INEC responsibilities of the proposed systems are controlling all voting processes with support of government, also it's a communication between voters and

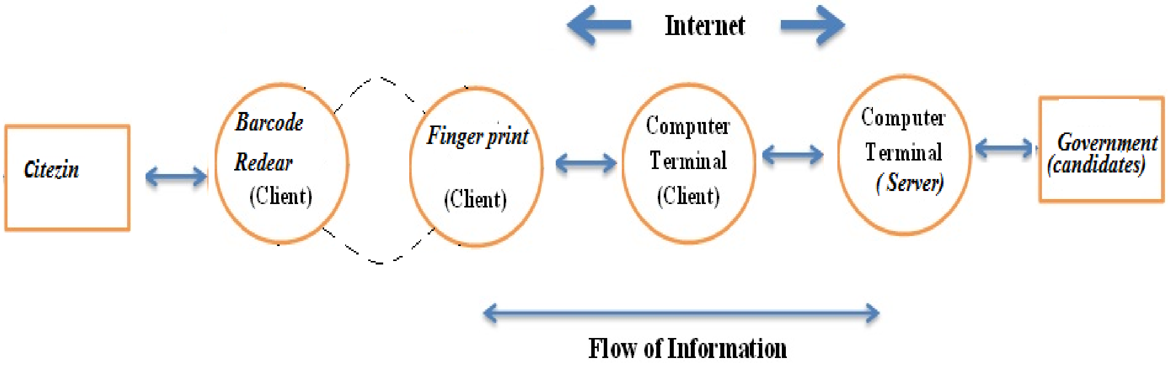
Internet
Citezin
Barcode
Redear
(Client)
Finger print
(Client)
Computer
Terminal
(Client)
Computer
Terminal
(Server)
Government
(candidates)
Flow of Information

Figure 1. Shows the communication of C2G2C flow of information

Candidates for the reason of selecting right candidate; it's more or less alike G2C e-government that communicated between government and citizen via internet or Local Area Networks (LANs). The Figure1 shows the communication between government and citizens also Citizen and Government.

C2G or Voter to Candidates (V2C)

Voters to candidates without doubt are the most flexible, full featured and completely automated election. Voters to candidates were achieved by voters to decide on the best candidate in web ballot list; it supposes that voters can reach candidate to position of ruling, the selecting government electronically to governance society is E-governance. The QoC, QoI, and QI are in higher level than before. The architecture tier used for V2C is 3TA or NTA. In fact our proposed system is mixture from C2G and G2C, citizen select government-candidates is C2G in order to the government service the citizen in society and it will be G2C. Also our proposed system is a good tool for governing the society; C2G2C is mean the citizen voting for government-candidate and the elected government-candidate by citizen (E-government) and provide better services to citizen (E-governance).

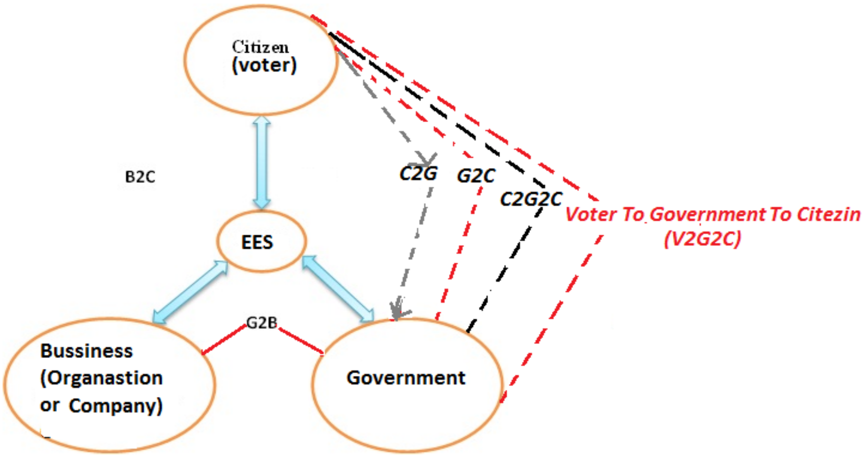
Citizen
(voter)
B2C
C2G
G2C
C2G2C
Voter To Government To Citezin
(V2G2C)
EES
G2B
Bussiness
(Organastion
or Company)
Government

Figure 2. Models Variation related to voter to government

E-Governance is a broader topic that deals with the whole range of the relationship and networks within government regarding the usage and application of ICTs. In fact E-Government is a narrower regulation dealing with the development of online services to the citizen. The Figure 2 shows models variation related to voter to government and government to citizens.

G2B

Government-to-business (G2B) initiatives refer to communications and transactions facilitated by electronic means between a government and a non-profit or for-profit organization. For example, the collection of corporate taxes would be a G2B process. Government members or committees are to ask a private company to design for example voting application software to governing election process. Figure3 show the Government to Business. Also Figure4 show the model variated Government to Business.

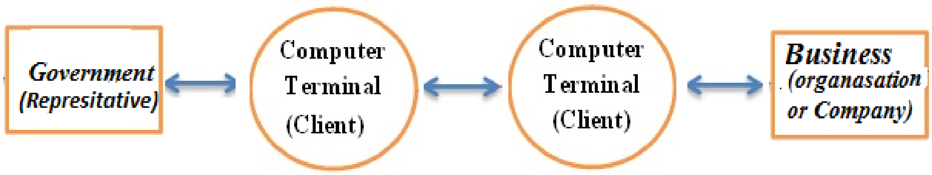

Figure 3. Government to Business

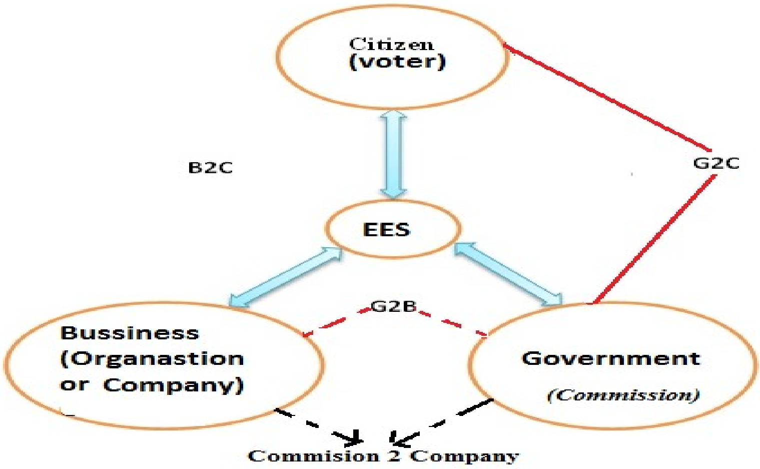

Figure 4. Models Variation related to government 2 Business in E-Election

E-ELECTION SYSTEM

An election is a decision that is made by voting, it's either electronically or manually the decision that is made by allowed citizen to voting. Every modification from past until now is create new generation and each modification of ICT and computer science creates new election generation because there are direct relations between computer and ICT modifications with E-Election for example; the internet facility changed traditional election to EES [MA13]. The improvements of technology develop the election steadily and facilitate fast and continuous enhancement in better security by both of the bar code reader and fingerprint. The price performance [MA14] of mentioned E-Election is much higher if compare to manual voting or other fingerprint or barcode reader individually. The bar code reader, fingerprint and web ballot together help better QoS with premium security. The design of a "good" voting system whether electronic or using traditional paper ballots or mechanical devices must satisfy a number of sometimes comparing criteria [EEEETS11]. Nowadays election is a very important serious topic and much concentration is paid on it, therefore E-Election has becoming a growing interest for the electors, candidates, citizens and all the stakeholders involved, E-Election refers to the use of modern ICTs to convenience requirements of citizens and government.

Fingerprints are one of many forms of biometrics used to identify individuals and verify their identity. Fingerprint recognition or fingerprint authentication refers to the automated method of verifying a match between two human fingerprints. In this project we will be using a Fingerprint reader for providing access to the voter as well as making a log if the person has voted or not [Amo11]. Electronic democracy (e-democracy) is a necessity in this era of computers and information technology. Electronic election (e-election) is one of the most important applications of e-democracy, because of the importance of the voters' privacy and the possibility of frauds. Electronic voting (e-voting) is the most significant part of e-election, which refers to the use of computers or computerized voting equipment to cast ballots in an election. Electronic voting are passes three impotent steps which are: 1) Pre-voting (preparation and administrating, committee, candidates, and voters). 2) Voting (Voting process itself) and 3) (Post-Voting (Result Counting and generating reports) [EEEETS11]. While all steps in traditional voting system are more costly in term of money and time than the E-voting and the security of the traditional voting is not controlled. Finally, the all outcomes from the system provide an excellent suggestion to become conscious that cooperation between three parts, namely independent national electoral commission (INEC), votes, and candidates makes election strategy enhanced because the system is a perfect intermediate between three parts. Figure5 elucidate the improvement of election strategy.

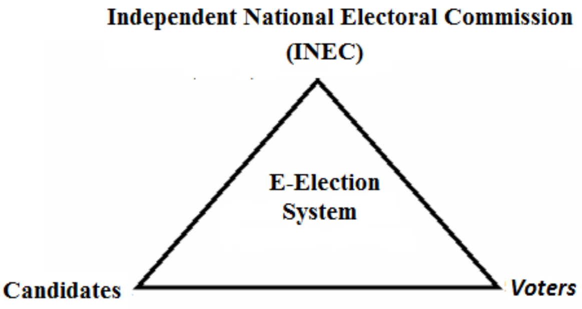

Figure 5. Enhanced Triangle Election: Voters, INEC, Candidates

ARCHITECTURE OF PROPOSED SYSTEM

Generally, our proposed system was designed to improve the earlier election by machines voting system (MVS) were run over 2TA only locally in every election polls in the country for the reason of avoiding to vote several times. The improvement of our proposed system is over 3TA or NTA, furthermore it designed to run either locally or globally base networked computers with any network scale (for example; intranet, extranet and internet). The installed copy of the system in a single personal computer (PC) and connected to a fingerprint and barcode reader; couldn't be considered as a fully traditional or fully electronic voting system, it is named as the semi electronic election system (SEES) and MVS is example of SEES. MVS could be located on any PC-machine, and can make a communicating environment between fingerprint and barcode reader. Obviously, SEES or MVS is more powerful, reliable and economical than the traditional voting system. The MVS match the barcode ID in the Database and save the image finger of voters in the database and give the ballot (papers) to voter by administer and guide voter to go to a private room to tick one box next to the candidate in the ballot and put ballot into the voting-box. The MVS was used in the previous election is couldn't be considered as traditional no electronic election system as well; it is named as the SEES with 2TA. SEES or Blended E-Election System (BEES) is only helping the traditional election to provide better service. Figure 6 shows the used software development tools over 2TA for MVS. Apart from avoiding duplicate voting by MVS, the proposed system gives much better service than MVS because it is more powerful, reliable and economical than both traditional voting and MVS. Our system can reduce the size, time, price and all differences rate of the election center and reduce health and safety hazard and run on NTA for better load balancing also stronger security. Figure 7 shows the used software development tools over 3TA for BVS.

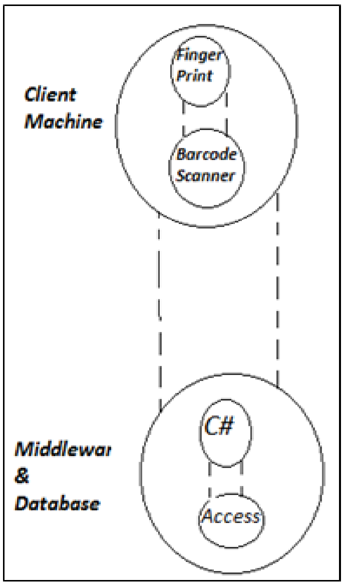
Client
Machine
Finger Print
Barcode Scanner
Middlewar
&
Database
C#
Access

Figure 6. The used software Development tools of MVS Over 2TA

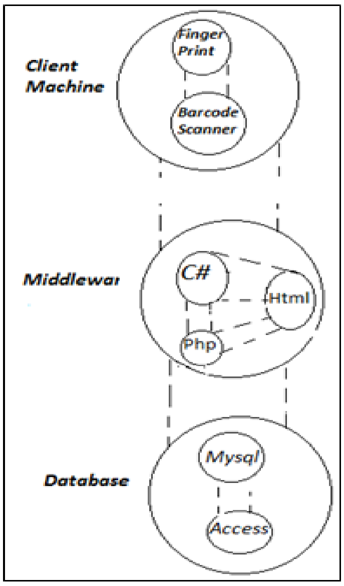
Client
Machine
Finger Print
Barcode Scanner
Middlewar
C#
Html
Php
Database
Mysql
Access

Figure 7. The used software Development tools of BVS over 3TA

Figure 8 shows the used software development tools over NTA for BVS. As mentioned before the more tire that create by more hardware separation and called tier architecture, but the separation or use more software and separation the software on different hardware called logical architecture. BVS over 3TA and NTA are both based upon three participant's voters, poll (station) center and matchmaking technique.

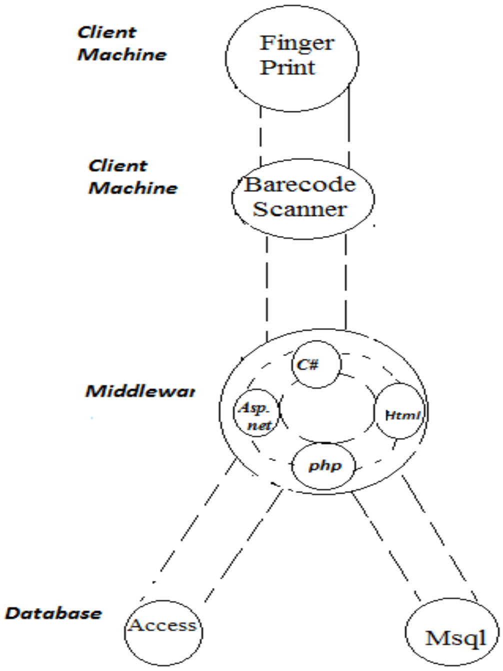
Client
Machine
Finger Print
Client
Machine
Barecode Scanner
Middlewar
C#
Asp. net
Html
php
Database
Access
Msql

Figure 8. The used software development tools of BVS over NTA

The matching algorithm finds out whether there is a match by comparing two templates extracted by the characteristics point extraction algorithm, especially by comparing the positions of BVS over 3TA and NTA are both based upon three participant's voters, poll (station) center and matchmaking technique. The matching algorithm finds out whether there is a match by comparing two templates extracted by the characteristics point extraction algorithm, especially by comparing the positions of each characteristics point and the structure. When both data in pre-register days and voting day are exactly same and match each other the system let voter to carry on to next step. The Figure 9 shows the matchmaking algorithm between pre-register thumb image of voter and thumb image of voter in voting day. Figure 10 shows General structure of E-Election Techniques.

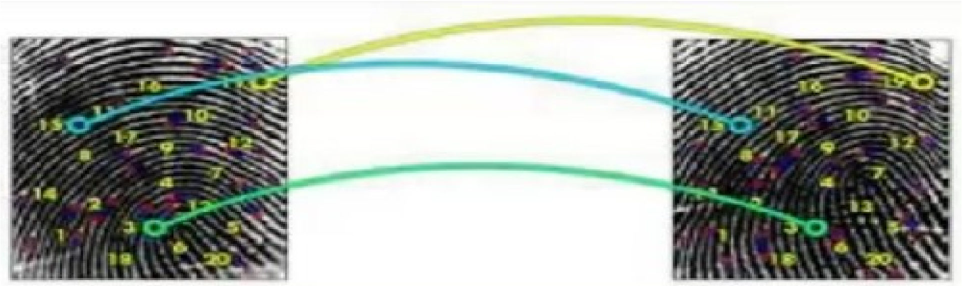

Figure 9. Matchmaking algorithm between pre-register thumb image and real thumb image of voter in voting day

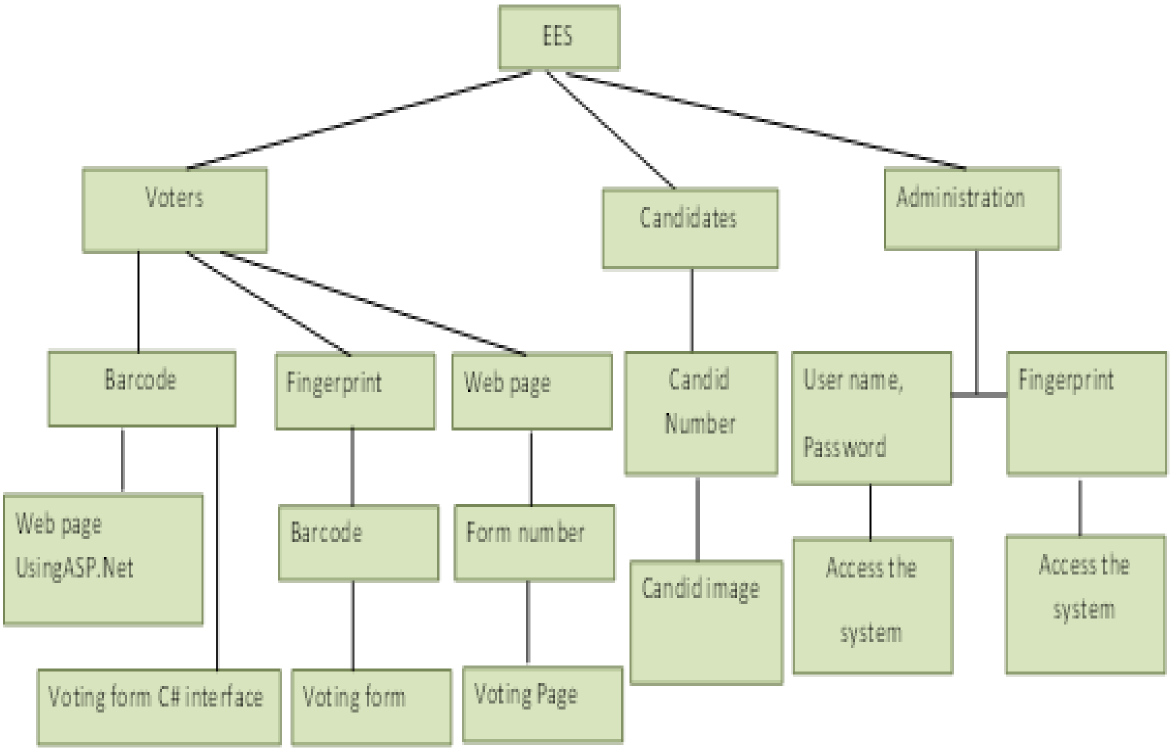
EES
Voters
Candidates
Administration
Barcode
Fingerprint
Web page
Candid Number
User name, Password
Fingerprint
Web page UsingASP.Net
Barcode
Form number
Candid image
Access the system
Access the system
Voting form C# interface
Voting form
Voting Page

Figure 10. General structure of E-Election Techniques

Finally, the main components of the interface are divided into three categories, the first category is for voters, the second is for candidates, and third is commission as administrator. The entire categories have the following major inputs, functionality and outputs:

Inputs

1. Apart from their registered fingerprint image and ID barcode in the database backend as administrator and for the reason of higher security the Independent National Electoral Commission (INEC) must provide them a random username and password for those staffs are working in voting stations.
2. The voters must entered valid fingerprint and barcode ID into the system in any voting station in the city and there are computers with web-ballot for voters.
3. When the system recognized getting a valid barcode ID with fingerprint. The web-ballot interface with a vote-push-button appears and after tick the box next to the candidate must click on vote-push-button.
4. By clicking on vote-push-button in the web-ballot, it let voter to vote and store elected candidate into database backend.
5. The separated tier architecture helps to input data and maintain each tier easily with better security.

Functionality

1. Registration: New administrator, voter and candidate can register using (barcode, fingerprint and form number).
2. Authentication: Registered admin, voter can get access to system through their ID, fingerprint and form number.
3. Storage: The profile of admin, candidates and voter are registered in a database.
4. Matching: The tools are developed in order to make suitable recommendation for admin and users.
5. Identification: Identifies the users and admin by fingerprint and barcode.
6. Verification: Verifies the users and admin by fingerprint verification process.
7. Prevent duplication: Prevents voting by same user more than ones.
8. N-tier architecture helps load balancing of the system.

Outputs

1. Displays votes account or vote result in a table.
2. Display vote result by chart and number.
3. Display message box for those voter made a mistake and elect two candidates by message “sorry must select only one option”
4. Display a message box for those voters want to vote more than once and the message is “sorry duplicate”.
5. Display a message for those voters that forget to vote by message box “sorry must select only one option “in case of not selecting any option.

Specification and Aspects

1. While a new administrator becomes a member of the system, and he/she is added to the database by taking fingerprint, user name and password from each admin.

2. When voter becomes a member of the system, and voter is added to the database by taking the fingerprint, barcode from each voter (the period of a month for that process of pre-register).
3. A Part from registered barcode ID and fingerprint to the database, any Admin must get (Username, Password) as well from the INEC.
4. The username and password is random and valid for several hours.
5. Voters who live outside of the counter can vote through E-form.
6. System admin can login via username, password and fingerprint and barcode ID as well.
7. INEC can delete, update, and insert any information about candidates and voters.
8. Voters can login through his/her ID barcode and fingerprint.
9. Admin can account votes.
10. Admin can show result by table and chart (real time).
11. Admin can add new candidate.
12. Admin can add new user.

TIER ARCHITECTURE SPEED TEST

The test of our proposed system achieved over several different tiers architecture namely; one tier architecture (1TA), two tier architecture (2TA) and three tier architecture (3TA) or NTA.

One Tier Architecture (1TA)

As mentioned before the one tier architecture is inapplicable for our proposed system due to not based on client and server(C/S).

Two Tier Architecture (2TA)

When the networked based on C/S connected between server and clients. The only suitable 2TA is thin-2TA because the functionality (middleware) and Data tier (back end) are in a server side. When the finger is taking as image, the functionality tier is responsible to transfer to backend tier (database). The fat-2TA is inapplicable because middleware always place it with database and it's impossible to place middleware with client. Figure 6 shows the used software development tools over 2TA. Also

Table1 show the speed test of thin-two tier architecture.

Table 1. The Speed test of thin- 2TA

Two Tier Architecture		
E-voting Methods		*Time/millisecond*
Login Module	*E-voting Interface*	
Barcode	Web Page using ASP.Net	80
Barcode	C Sharp (C#)	40
Finger Print & Barcode	C Sharp (C#)	300

Three Tier Architecture (3TA)

The three tier architecture is separation of hardware into three different tiers which; presentation tier, functionality tier, and database tier. As shown in figure 7 the used software

Development tools of BVS over 3TA. The better service is 3TA then the 2TA in respect of BVS. Also table 2 shows the speed test of three tier architecture

Table 2. The Speed Test of 3TA

Three Tier Architecture		
E-voting Methods		*Time/millisecond*
Login Module	*E-voting Interface*	
Barcode	Web Page using ASP.Net	170
Barcode	C Sharp (C#)	297
Finger Print & Barcode	C Sharp (C#)	351

N Tier Architecture (NTA)

The four or more tier architecture is separation of hardware into more three different tiers which; presentation tier, functionality tier, and database tier. As shown in figure 8 the used software Development tools of BVS over NTA. The better service is NTA then the 3TA in respect of BVS. Also Table 3 show the speed test of N tiers architecture.

Table 3. The Speed Test of NTA

N-Tier Architecture		
E-voting Methods		*Time/millisecond*
Login Module	*E-voting Interface*	
Barcode	Web Page using ASP.Net	550
Barcode	C Sharp (C#)	421
Finger Print & Barcode	C Sharp (C#)	706

There are three different types of tests, each tier is used for different purpose and different limit numbers of users, the NTA is most suitable one for our proposed system due to load balancing and better security and maintenance.

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