# DESIGN AND CONSTRUCTION OF AN ELECTRONIC CARD-BASED VOTING SYSTEM

BY

OLUPONA MICHAEL OLUSEGUN

2003/15439EE

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING.

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

NIGER STATE.

NOVEMBER, 2008

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A THESIS SUBMITTED TO THE DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF BACHELOR DEGREE (B.ENG).

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING.

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## DEDICATION

This project is dedicated to God Almighty, my parents Engr. and late Mrs Bayo Olupona, my sisters Toyin and Funso Olupona.

# DECLARATION

I, Olupona Michael declare that this project and research work was done by me under the supervision of Mr. B. Zungeru in partial fulfillment of the requirement for the award of Bachelor of Engineering (B.TECH) in Electrical and Computer Engineering.

## CERTIFICATION

I, Olupona Michael Olusegun, certify that this work was done by me under the supervision of Mr. B. Zungeru in partial fulfillment for the award of Bachelor of Engineering (B.TECH) in Electrical and Computer Engineering of The Federal University of Technology, Minna.

Olupona Michael.O

12/11/2008

Date

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(supervisor)

11/11/08

Date

Dr.Y. A. Adediran (H.O.D)

Date

External Examiner

Date

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I give all glory to God for his faithfulness and goodness over my life from birth till date. My profound gratitude goes to my supervisor Mr Zungeru for his support and advice throughout this project work.

I appreciate all members of The Redeemed Christian Fellowship, FUT.Minna Chapter for their love, prayer, support and care given me all through my stay in school. Gloria Audu, Tolu Giwa, Owolabi Olulegan, Stella Aliyu, Asebiomo Favour, Kemi,Olaseile Ibukun, Paul Olayiwola, Adebisi Victoria and the rest. I love you all.

My special love and appreciation goes to my LOVE and fiancé, Afeni Bukola who stood by me all through, I love you.

## ABSTRACT

Electronic card-based voting system is an electronic voting system that uses smart card as the medium of voting, unlike the ballot box voting system where ballot boxes and papers are used. The card is inserted into a card reader which serves as an interface between the card and the PC.

This system provides security to voting system and provides solution to fraud in elections. Only the voters have access to their voting cards which contains their Biodata.

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# CHAPTER ONE

## 1.0 INTRODUCTION

Voting is a way people exercise their right to choose whosoever they desire to rule, lead or govern them.It is a process used in selecting individuals into different positions in government, private institutions, educational institution etc.Voting is a major tool in democratization, as that determines who is eligible to govern after winning a proposed election.

In most parts of the world,elections are done through open balloting, where ballot boxes are used to house ballot papers. The ballot papers contain all parties contesting for positions as well as the position they are contesting for.Voters tick or mark who they desire to vote for on the ballot paper and they insert the papers into the ballot box. At the end of the voting process, the ballot papers are counted and recorded, results are then collated.

Over time, this process of election nas become fraudulent especially in developing countries like Nigeria.Cases like ballot snatching,improper counting of ballot papers etc have characterized elections.A lot African countries have gone to war due to rigging during elections.People want to be in power at all cost and they get themselves into leadership positions through election malpractices. This has made the open balloting ineffective.

The card-based voting system provides solution to most of these problems. It helps to tackle the problem of fraud during and after elections which the ballot system has not been able to tackle,through this,democracy will be truly achieved(government of the people,by the people,and for the people).The card-based system uses smart cards instead of the ballot papers for voting,ballot boxes are not used as well a computer monitor,a card recorder and smart cards are required.

## 1.1 AIMS AND OBJECTIVES

Basically,this project work aims at the following:

1) To ensure a free and fair election
2) To eradicate fraudulent acts such as rigging during elections
3) To reduce the task of counting and evaluation of data during and after elections
4) To help in the ensuring prompt wnd timely release of results after elections
5) Introduction of technology in democratic process
6) To also encourage computer education and the use of computer by citizens.

## 1.2 CARD-BASED VOTING SYSTEM OVERVIEW

The card-based voting system uses smart cards in place of ballot papers as earlier mentioned.The system has the following characteristics

i. The same smart card can be used for all voting exercises
ii. Each smart card can be tagged once the user has voted for a contestant running for an office
iii. The cards will be issued serial numbers(ID)so that effective monitoring can be effected
iv. The card would be coded with the user-name,to utilize it for voting.A different person cannot use it.
v. The same card can be used after one election for the next one.The cards only need to be reconfigured and the software re-written so that cards used in the previous elections are no longer in compliance with the revised software specifications.
vi. The actual voting is done on the computer,making it transparent.The offices being contested for and contestants areselected via the PC monitor and voting is effected by

the clicking the mouse.Counting of voting scores foe each contestant is constantly updated,but not displayed.

The design realization embodies a two-unit interconnected system;

i. A card-reader

ii. The PC back end

**1.2.1 CARD-READER:** The card reader is designed to control the voter's card.The reader is designed around a microcontroller which executes system software that:

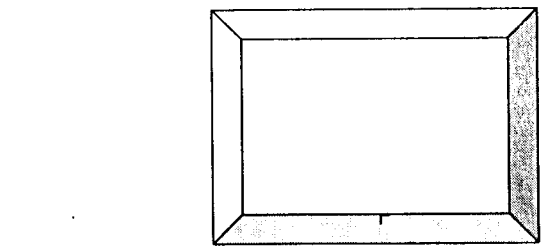
i. Validates the card to ascertain if it is actually issued by the electoral office

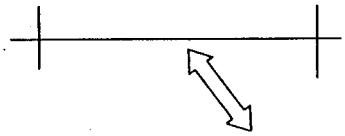
ii. Decodes whatever information is stored on the card(password,serial number,card lock,number of offices already voted for etc)

iii. Interface the PC backend and the card.

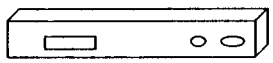
**1.2.2 MICROCONTROLLER**: An 8-bit controller (AT89C2051) is used as the controller element in the card-reader.The card contains a small amount of non-volatile memory to hold whatever parameters are needed. A visual Basic application provides user-interractivity,the terminal application monitors the card state and generates messages as deemed fit.The application configures the card as voting progresses to prevent the same card from being used twice for the same office by tagging some bytes with values that the software actually crosschecks.

## SYSTEM OVERVIEW

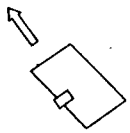




COMPUTER



CARD READER



VOTING CARD

# CHAPTER 2

## LITERATURE REVIEW

### 2.1. EARLY VOTING

Ancient Greek had one of the earliest forms of democracy, since at least 508BC.Each year, the Greeks had a negative election...voters were asked to cast a vote for the politician they most wanted to exile for ten years. Votes were written on broken pots, ostrake in Greek and from this name come our present word to ostracize. If any politician received more than 6,000 votes, then the one with the largest number of votes was exiled. If no politician received 6,000 votes then all remained. If there were a fairly even spread of votes, nobody would get over 6,000 and no one would get exiled....hence only very unpopular politicians were ostracized and exiled.

Voting rights in ancient Greece were only for male landowners, so the number of voters was small. Today, there are few politicians who would survive 6,000 negative votes! [1]

The Venetian state was built up in the $13^{th}$ century and they elected a great council of 40 members which was raised to 60 by the middle of the century. Various electoral systems were used; in particular the Venetians introduced approval voting around the time. In this system, if there are n candidates, then electors cast one vote for every candidate they find acceptable and more for those whom they deem unacceptable. This has a number of attractions as a system, and certainly the winner is the person who is acceptable to the largest number of voters. Where there are more than two candidates, the situation is very complicated and several different definition of ''fair'' have been given, as well as many different electoral systems being approved. For example one suggestion is that if one person is to be elected from a collection of n people, then the election is fair if the person elected would have won in a head-to -head contest with every

one of the other n-1 candidates. Although this does indeed seem 'fair', there is the problem that in many cases, there would not be anyone who would beat other candidates on a head-to-head contest. [1]

In 1433 Cusa proposed a different system which would always result in a winner. Cusa produced candidates for king, then voters should give the candidate they favored least one point, the next candidate two points and so on until they reached their most favored candidate for king who they would give n votes. This system is used today in certain elections but it does not have the deficiency that the candidate elected may not have anyone's first choice.

The simple system in which every voter gives a single vote to their favorite candidate lead to a tactical voting. If a voter would like to see candidate C elected but feels that candidate B is the only candidate who stands a chance at stopping A being elected, then the voter may vote B rather than their first choice C. Such tactical voting was evident in an election in Scotland in1990s.At this election, there were four major parties (and therefore four main candidates in most regions) and voters had a single vote. Not a single conservative candidate was elected despite the party getting a reasonable proportion of vote, since in regions where the conservative was thought likely to win, many supporters of the other three parties voted for the candidate they thought of most likely to beat the conservative. The difficulty in all voting systems is that it has been proven that no satisfactory system exists.

## 2.2 PAPER BALLOT SYSTEM

The use of paper ballot to conduct an election appears to have been in Rome in 139BC and the first use of paper ballot in the United States was in 1629 to select a pastor for the Salem church. [2]. The ballot box system has since been used all over the world for voting. This system

of voting is also called the secret ballot. The secret ballot box was seen as a means to increase voter's participation because voters would not be scrutinized for how they voted but has with fraud because there is no direct verification that the voters' intent was followed. The ballot boxes are used to collect the ballot papers during voting. Here, the voters indicate who they voted for either by ticking against the candidates or the party or by shading the boxes to the allocated to the candidates. These papers are slotted into the ballot boxes through the slot on the boxes. At the end of the voting exercise, the ballot papers are counted one after the other and records are taken. This system of voting has brought about the highest level of fraud in voting history. The results are left to the hands of the counters. In Africa, ballot snatching and use of fake ballot boxes and papers have seriously ruined credible voting and election.

## 2.3 ELECTRONIC VOTING

Electronic voting also known as e-voting is a term encompassing several different types of voting, embracing both electronic means of casting a vote and electronic means of counting votes. Electronic voting technology can include punch cards, optical scan voting systems and specialized voting kiosks (including self-contained Direct-recording electronic (DRE) voting systems, use of electronic smart cards). It can also involve transmission of ballots and votes via telephone, private computer networks or the internet.

Electronic voting technology can speed up the counting of ballots and can provide improved accessibility to voting. Electronic voting system for electorates has been in use since 1960s [3] when Punch card system debuted. The newer optical scan voting system allow a computer to count a voter's mark on a ballot. DRE voting machines which collect and tabulate votes in a single machine are used by all voters in all elections in Brazil, and also on a large scale

in India, the Netherlands, Venezuela, and the United States. Internet voting systems have gained popularity and have been used for Government elections and referendums in the United Kingdom, Estonia, and Switzerland as well as municipal elections in Canada and Party Primary elections in the United States and France.[3].

There are also hybrid systems that include an electronic ballot marking device (usually a touch screen system similar to a DRE) or other assistive technology to print a voter-verifiable paper ballot, and then use a separate machine for electronic tabulation.

Electronic voting systems may use electronic ballots to store votes in computer memory. Systems which use them exclusively are called DRE voting systems. When electronic ballots are used, there is no risk of exhausting the supply of ballots. Additionally, these electronic ballots remove the need for printing of paper ballots, a significant cost. When administering elections in which ballots are offered in multiple languages, electronic ballots can be programmed to provide ballots in multiple languages for a single machine. The advantage with respect to ballots in different languages appears to be unique to electronic voting. For example, king country; Washington's demographics require them under U.S federal election law to provide ballot access in Chinese. With any type of paper ballot, the country has to decide how many Chinese-language ballots to print, how many to make available at each polling place etc. Any strategy that can assure that Chinese language ballot will be available at all polling places.

Electronic voting system can offer solutions that allow voters to verify that their vote is recorded and tabulated with mathematical calculations. These systems can alleviate concerns of incorrectly recorded votes. One feature to mitigate such concerns could be to allow a voter to

Punched cards were first used around 1725 by Bastille Bouchon and Jean-Baptiste Falcon as a more robust form of the perforated paper rolls than in use for controlling textile looms in France. This technique was greatly improved by Joseph Marie Jacquard in 1801. Herman Hollerith developed punched cards processing technology for 1890 us census and founded the Tabulating Machines Company (1896) which was one of three companies that merged to form Computing Tabulating Recording Cooperation (CTR) later renamed IBM. From the 1900s, unto the 1950s, punched cards were the primary medium for data entry, data storage and processing in institutional computing. During the 1960s, they were gradually replaced as the primary means for data storage by magnetic tape, as better, more capable computers became available. Punched cards were still commonly used for data entry and programming until the mid 1970s when the combination of lower cost magnetic disk storage and affordable interactive terminals on less expansive minicomputers made punch cards absolute.

Today, punched cards are mostly obsolete and replaced with other storage methods, except for a few legacy systems and specialized applications. In the 1996 American presidential election, some variation of the punch card system was used by 37.3% of registered voters in United States. [6].

### 2.3.2 DIRECT-RECORDING VOTING SYSTEM.

This system was commonly used in the United States until the 1990s (and commonly known as lever machines); direct recording voting systems are mechanical systems to tabulate votes. Commonly, a voter enters the machine and pulls a lever to close the curtain, thus locking the voting levers. The voter then makes his or her selection from a list of switches denoting the appropriate candidate or measures. The machine is configured to prevent over votes by locking

out other candidates when one candidate's switch is flipped. When the vote is finished, a lever is pulled which opens the curtain increments the appropriate counters for each candidate and measure. The results are then handwritten by the officer at the conclusion of voting.

### 2.3.3 DIRECT-RECORDING ELECTRONIC VOTING SYSTEM

It is a successor to the recording voting system. It records votes by means of an electronic display provided with mechanical or electro-optical components that can be activated by the voter; that processes voter's selection by means of a computer program, and that records that processed voting data in memory component. It produces a tabulation of the voting data that is stored in a removable memory component and may also provide printed resolutions of the data. The system may further provide a means for transmitting the processed vote data to a central location in individual or accumulated forms for consolidating and reporting results from precincts at a central location. DRE systems additionally can produce a paper ballot printout that can be verified by the voter before they cast their ballot. [7].

## 2.4 VOTING SYSTEM USING SMART CARDS

Recently, the use of smart cards was introduced to reduce the risk of fraud in elections. The smart cards are programmed devices (cards) and programs are written in the card as it sooth the programmer. The cards are slotted into a card reader that serves as an interface between the computer and the cards. This type of voting is done with the computer via the mouse where clicking and voting is achieved.

The security feature of this type of voting is reliable as compared to the voting systems where fraud can be easily carried out. These cards are coded which gives only the user access to its use.

The complexity of voting procedures makes it challenging to design a secured electronic voting system. In many proposals, the security of the system relies mainly on a block box voting machine. Meanwhile, the most advanced proposals base their security arguments on (complicated) cryptographic protocols e.g. blind signatures or homomorphic schemes.

Canard and Traore proposed cryptographic primitives dedicated to provide anonymous services using smart cards. Among these primitives, list signatures are especially suitable for e-voting, as they provide specific properties such as multiple vote dictation. Moreover, unlike blind signatures, they do not involve a signing authority during the creation process. [8].

An e-voting scheme is a set of protocols allowing voters to securely vote by interacting with a set of authorities who collect the vote and calculate the result of the election. We usually distinguish between two types of e-voting: online, e.g. via internet, and off-line electronic voting.

E-voting systems translate the traditional vote to a digital context. Several experimentations have already taken place, based either on black box machines or on cryptographic frameworks. The purpose of these systems is to obtain the results immediately after the end of the poll, while (at least) preserving the security of the traditional vote. Cryptography-based frameworks are designed to enhance security while providing some functionalities that mainly theoretical in traditional voting because of practical issues.

Smart card-based e-voting scheme is designed to ensure the main properties that one can expect from such a scheme. This scheme is designed in a flexible way, which means some parts of it can be slightly modified, or some components may be added, in order to have it adapted to the election laws of most countries.

The point is to propose a system adapted to the constraints of the smart card environment. Thus we use only cryptographic primitives that already exist in smart cards, so as to complement a prototype using real smart cards.

# CHAPTER THREE

## 3.0. DESIGN AND CONSTRUCTION

The design work comprises of two interlinked parts:

i. Hardware (card reader),

ii. System software front –end.

The Hardware (card reader) was used to interface the voting medium (improvised memory card) with the software front end .The reader was designed around an 8-bit microcontroller (AT89C51) connected over the serial port via a logic level translator. The schematic is given in Fig.3.0.

## 3.1. POWER SUPPLY

The reader was run off a tightly regulated 5.0V DC Supply present on the USB port. Since the reader is always connected to the system, using a power supply from the computer board was very feasible.. Besides, the reader draws an almost negligible power.

## 3.2. THE READER

The reader was designed to:

i. Accept user voting media,

ii. Transfer card content to the PC-resident software.

iii. Write manipulated data back to the card.

The above requirements were met using the versatile RS 232 Serial port interface. The reader is divided into three sections:

i. The microcontroller

ii. The RS232-CMOS Logic level converter

iii. The card holder

### 3.2.1. MICROCONTROLLER

A micro-controller (also MCU or μC) is a functional computer system-on-a-chip. It contains a processor core, memory, and programmable input/output peripherals.

Microcontrollers include an integrated CPU, memory (a small amount of RAM, program memory, or both) and peripherals capable of input and output.

It emphasizes high integration, in contrast to a microprocessor which only contains a CPU (the kind used in a PC). In addition to the usual arithmetic and logic elements of a general purpose microprocessor, the microcontroller integrates additional elements such as read-write memory for data storage, read-only memory for program storage, Flash memory for permanent data storage, peripherals, and input/output interfaces. At clock speeds of as little as 32KHz, microcontrollers often operate at very low speed compared to microprocessors, but this is adequate for typical applications. They consume relatively little power (milliwatts), and will generally have the ability to retain functionality while waiting for an event such as a button press or interrupt. Power consumption while sleeping (CPU and peripherals off) may be just nanowatts, making them ideal for low power and long lasting battery applications.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, remote controls, office machines, appliances, power tools, and toys. By reducing the size, cost, and power consumption compared to a design using a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to electronically control many more processes.

Since the design requirements were easily met by an 89C51 device, it was chosen to carry out the task. The controller has the following specifications :

i. 4KB of electrically erasable and reprogrammable FLASH memory.

ii. 128 byte of on-chip RAM.

iii. 32 GPIO ports

iv. Full duplex UART.

The device was coded for software $I^2C$ emulation since this was the interface provided on the card. The generic 89C51 lacks a dedicated $I^2C$ bus, therefore, a software work-around was provided. The $I^2C$ Bus is a bidirectional two-wire communication interface protocol developed by Philips. The standard $I^2C$ bus run at 400KHz, but newer implementations run on bus speeds up to 2MHz or higher.

The controller was configured for serial port operation at 9600bps using an 11.0592MHz crystal. Since the device cannot produce the bipolarity signaling voltages required on the 232 –to – CMOS / 232 –to –CMOS Logic level translator was interposed between the controller and the 232 port of the host system. The controller was interfaced with two LEDs providing system status indication

i. RED : Power indication

ii. GREEN : Indicates reader –system communication progress.

The controller was also interfaced with an improvised card made of veroboard and holding a 256-byte 24CO2 $I^2C$ electrically erasable programmable read only memory ($E^2PROM$). The controller-card interface was effected using an ISA socket into which the card plugs. The controller was polled every second by the software front end for card insertion. If card insertion is detected (accomplished by reading the same memory location twice and checking for the acknowledge flag from the $E^2PROM$), the controller then returns a card detect status to the controller, along with the card data (about 60 byte).The controller board component interface is shown in Fig.3.1.

The RED LED turn on to indicate system READY. The GREEN LED flashes every time a command is received from the host PC over the serial link. This also indicates a connection has been established between the reader and the host. The LED can also be used to detect disruption in the communication link.

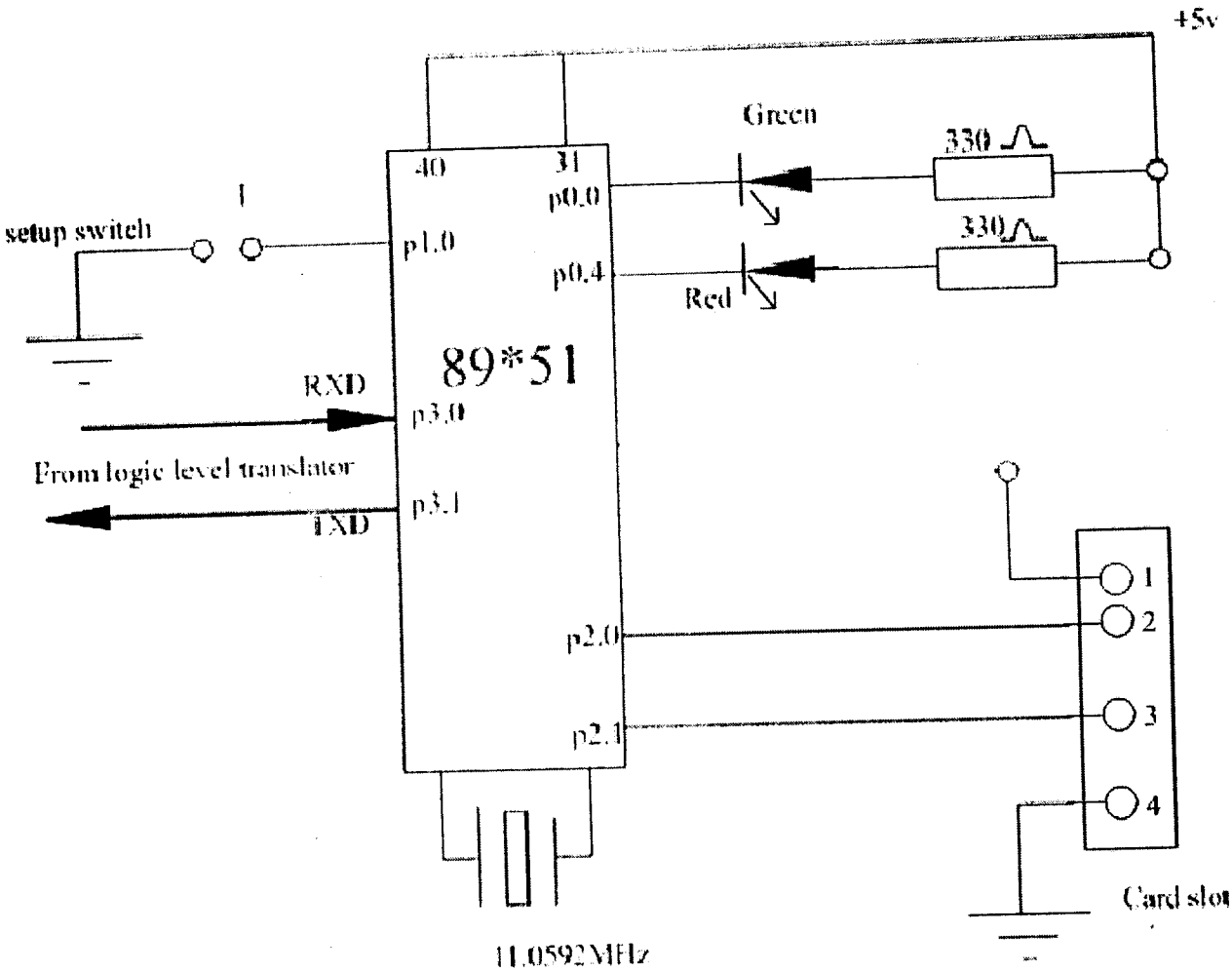



**Figure 3.1 CONTROLLER BOARD COMPONENT INTERFACE**

### 3.2.2 LOGIC LEVEL CONVERTER

A discrete-realization of the standard RS 232 logic level converter was implemented. This consists basically of two transistors and associated components as shown in Fig.3.2

01 is used to adapt the logic level from CMOS to bipolarity logic, while 02 translates the bipolarity logic levels to CMOS signaling voltages. The 232 signaling employs ±VCC to indicate LOW and HIGH conditions respectively. This ±VCC typically corresponds to ±3V to ±12V, depending on the system board architecture. On the system used, it was a measured ±9V. -9V represented a '1', and +9V a '0'. With T×D inactive (high), 01 is turned off since VB =VE. The R×D input on the host PC is therefore at the minimum voltage level. However, when a low logic is sent from P3.1, 01 is turned ON for the duration of the bit time. The collector voltage then increases by a value corresponding to its emitter voltage, i.e. -9V + 5V = -4V. This voltage change is detected as a zero ("0") by the bond electronics. Conversely, when a '1' is sent from the host system, 02 is turned OFF and its collector remains high.The diagram is shown below

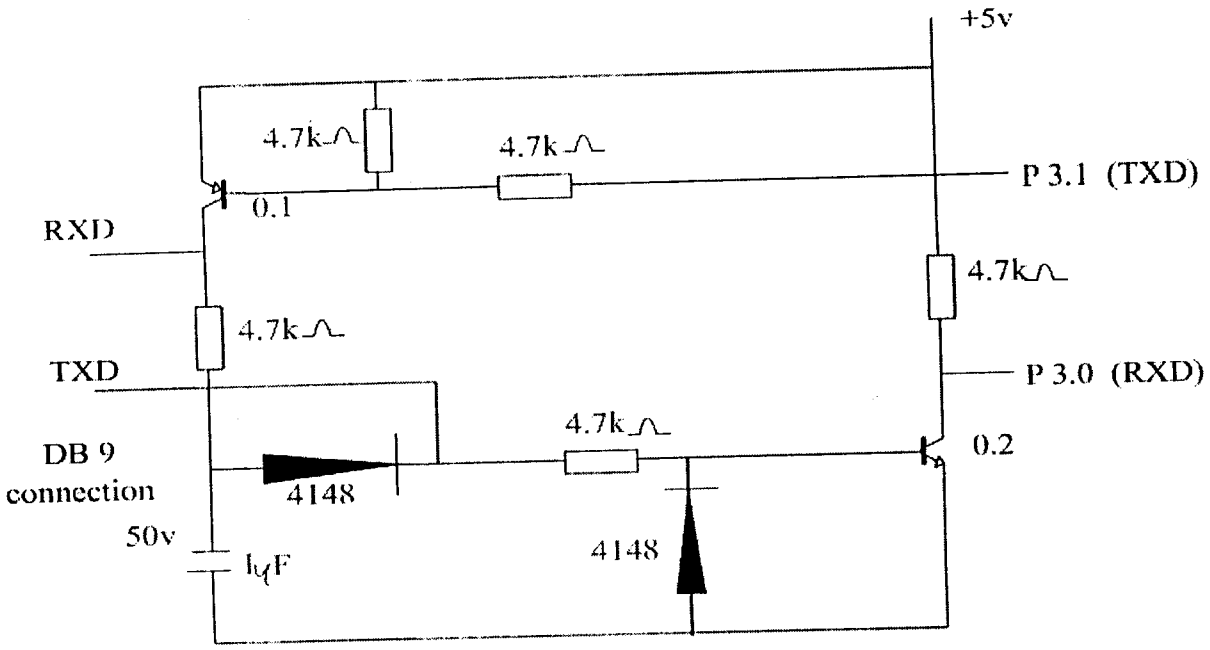



**Figure 3.2** **LOGIC LEVEL CONVERTER**

### 3.2.3. MEMORY CARD

An improvised memory card was used as the voting medium. The card was encoded with the following DataStream,

: INEC0000000001000000003238303930382 (username.)

The colon ' : ' was used as a marker to signify the start of the record. The four characters after the colon (INEC) were used by the system software to authenticate the validity of the card. The eight zeros following immediately after are the card PIN code. This can also be used for authenticating each card.

The two character '01' designate the State code. (01- Niger, for example). Ten separate offices were also coded written on the card. The date of issue is also written to the card, alongside the username, consisting of 24 characters. The character immediately preceeding the username designates the sex of the holder.

The above entries can be visualized in the software environment by clicking 'VIEW'. For simplicity, few fields were inserted in the data packet from the card. In a more elaborate arrangement, any desired data can be encoded in the data payload.

The physical form of the card is given below,

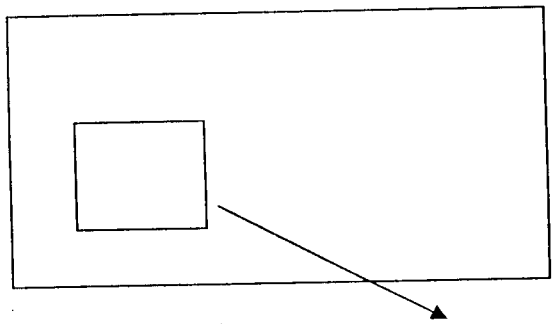



Fig.3.4 MEMORY VOTING CARD

### 3.2.4. SYSTEM SOFTWARE

For maximum user interactivity, a visually oriented HLL (VB) was used in the design and creation of the software interface. The software was modularized for ease of debugging and fine tuning. Nine separate forms were used, with the forms automatically loaded according to user mouse click commands.

Form 1 displays the reader's status (connected/offline) with no card inserted. It also provides access to the total count of the voting process. For non-volatibility, a semi-permanent storage of the vote counts was kept as a file on the system disk. A 4-party implementation was used: PDP, ANPP, AD, and APGA. Four posts were also designed for : President, Governor, House of Representatives, Chairman.

The voting process can be divided into the following stages :

i. Card insertion /detection

ii. Card validation /scan of previous elections

iii. Auto load of a view detail / vote | exit page depending on the result of stage 2.

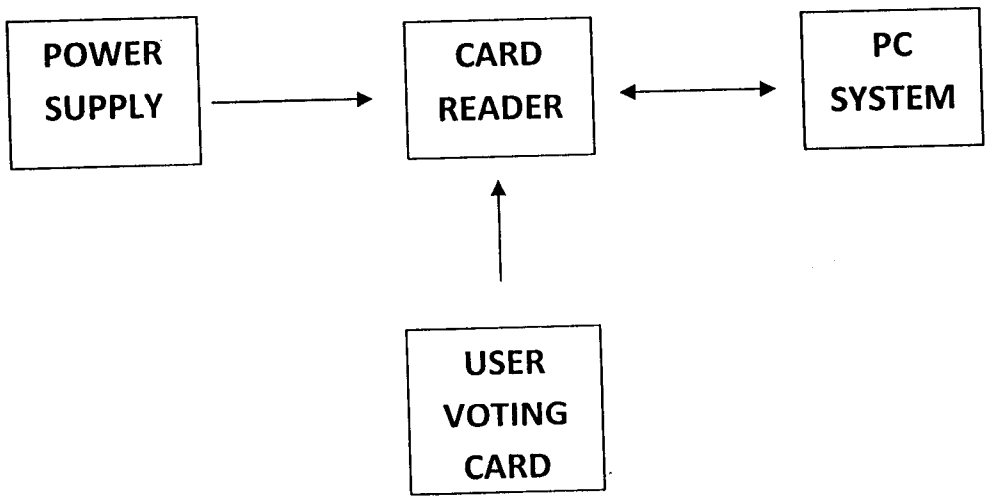
iv. Voting and card removal.

Assuming an initial unused card is inserted into the reader, the software enables voting option for the four separate posts available. When a vote is cast in favour of a party for a post, the system software updates the card data and rewrites it back to the card via the reader. The data update is essentially a write operation to solve designated portions of the card which prevents double voting for the same port. The update is done before the vote count for the elected party is incremented. If a reader/system error occurs, the party count is not incremented.

The card data can be visualized by clicking on the 'TOTALIZE' botton on form 2. The card data is then displayed on a seperate form for validation against any known database.

Some variables were not used in the software, even ethough they were encoded on the card.An example of this is the card pin code, any card can be easily tracked for uniqueness.The state code prevents a card designated for a particular state from being used in another state . As it were, the system design and realizations reinforces the simple truth that electronic voting is possible and very flexible too. Double voting is also detected by the software in the event of the card holder having exploited his voting chances. This happens when votes have been cast for the four seperate offices, and such a card is reinstated into the reader.The requests that the card be removed as a result of double voting

# BLOCK DIAGRAM



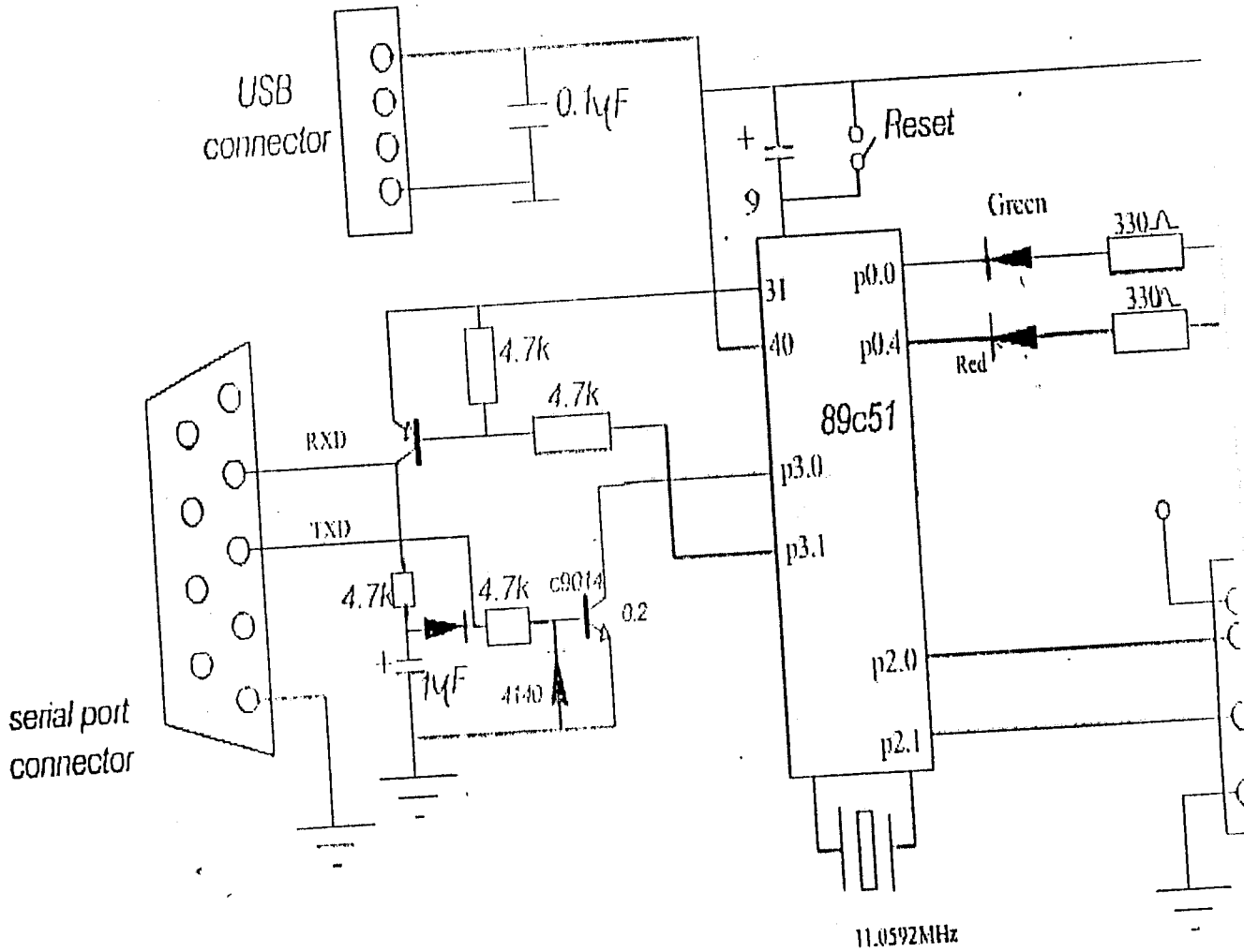



**Fig.3.0** **CARD READER**

# CHAPTER FOUR

## 4.0. TESTING AND RESULT

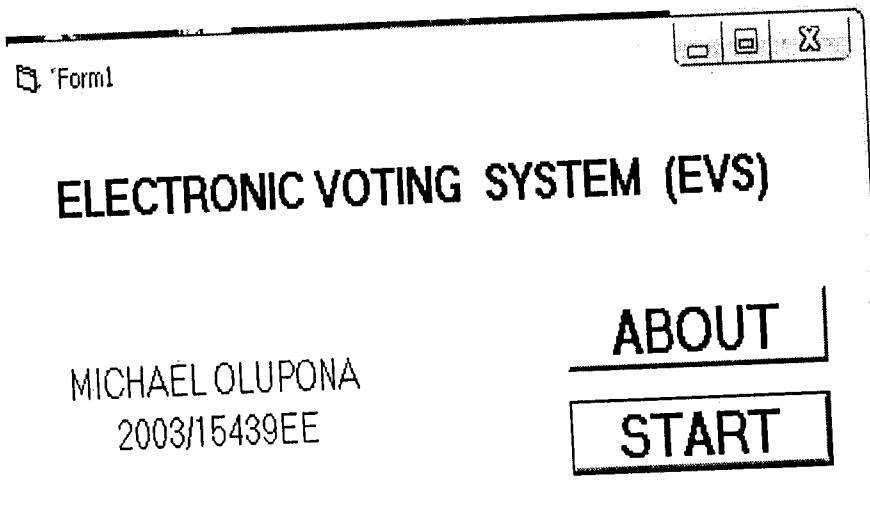
The card-reader which serves as an interface between the voting card and the computer system is connected to the P.C. via serial port. The card-reader gets power from USB (Universal serial Bus).

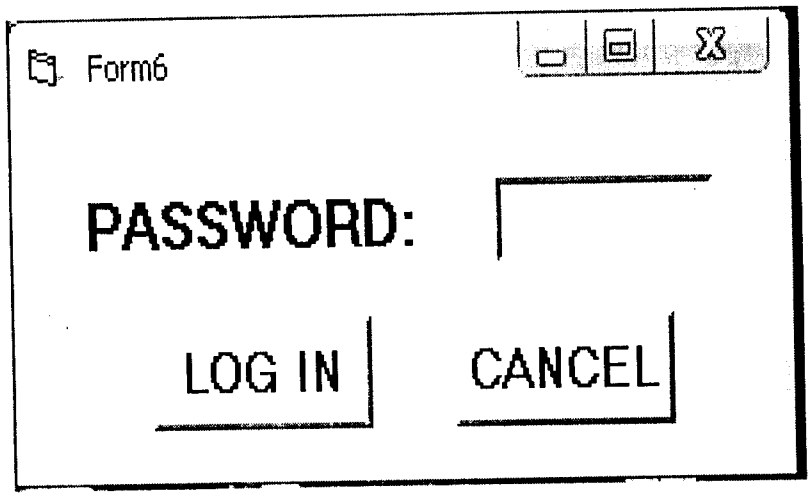
The system requests that the smart card be inserted into the voting machine , which is the card-reader. Vote casting cannot be done until the card is inserted into the card-reader and the system validates the card. As soon as the card is recognised and validated, the system requests the voter to cast his/her vote. As soon as the voter clicks the vote button, the page 2 opens (office page). Here, the positions and offices are displayed. The voter selects the position he wants to vote for and the page 3 opens (party page). The various parties are displayed on this page and the voter is requested to select the party of his choice .e.g.PDP, ANPP, AD etc. When this is done, voting is completed by the voter.

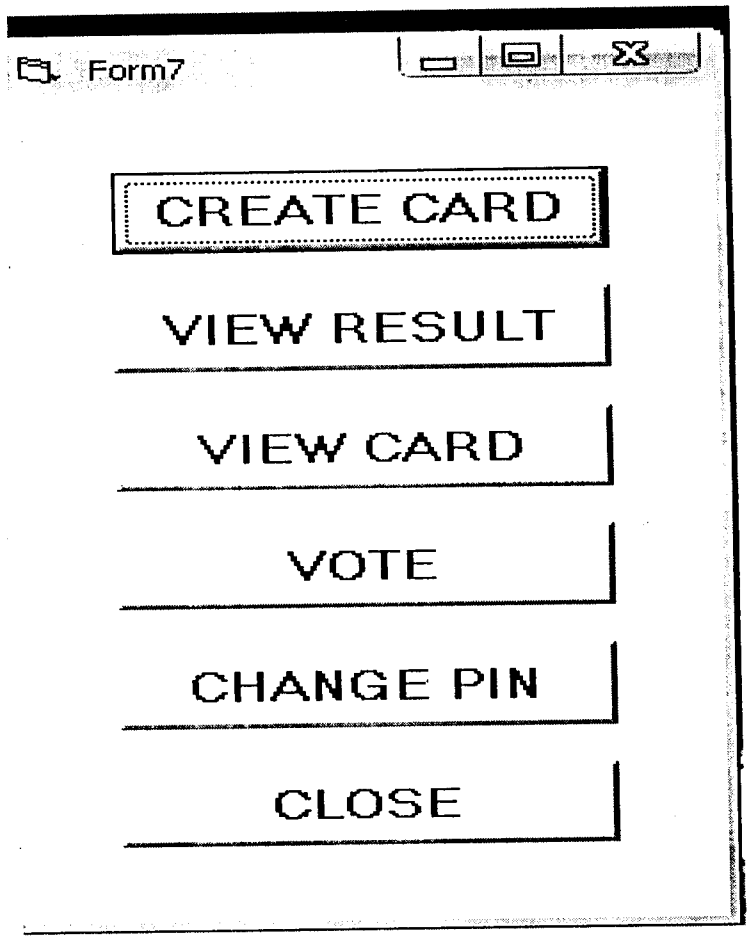
The system automatically counts the votes each time a voter casts his/her vote. Double vote-casting cannot be executed. This was tested and confirmed to be very correct. As soon as a voter votes for say PDP's candidate for president, he cannot vote for the position of president any longer, the system tags the card. This takes cares of the use of multiple cards and voting in various voting centres with the same card. As soon as a voter exhausts his/her voting chances, he cannot use the card any longer until the card is reprogrammed by INEC after submission. If the voter inserts the exhausted voters' card into the card reader, the system requests that the card be removed as a result of double voting. No voter can be allowed to vote more than once.

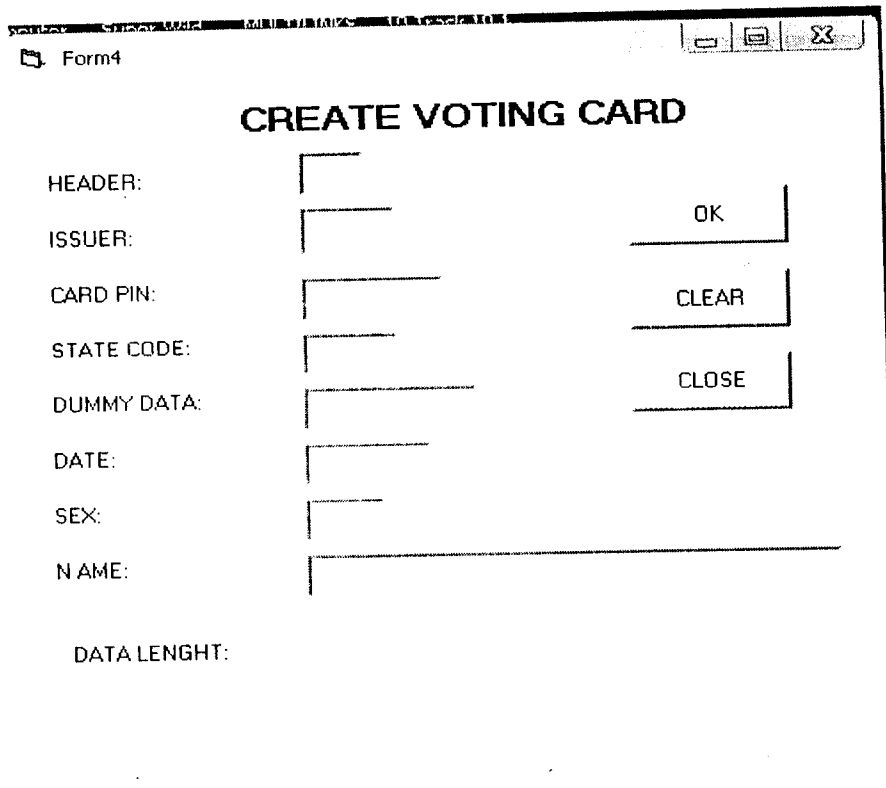
Checking of results can be done during or after election, from time to time results can be checked and documented depending on the electoral commision. At the end of the election, the system provides the results of elections at that polling centre. The results at each polling centre can be sent to INEC central office on-line where all results are collected, collated, and announced on the same day.

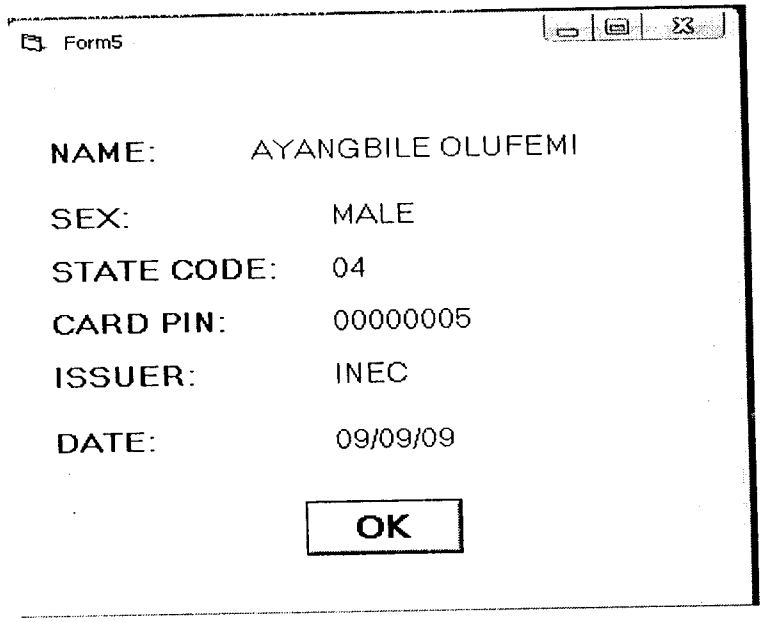
Elections can be monitored on-line by citizens for the sake of transparency.This can be achieved by the voting systems on-line via the internet. As results are received from all polling centres say every time anyone votes, the results are at the same sent on-line for monitoring.

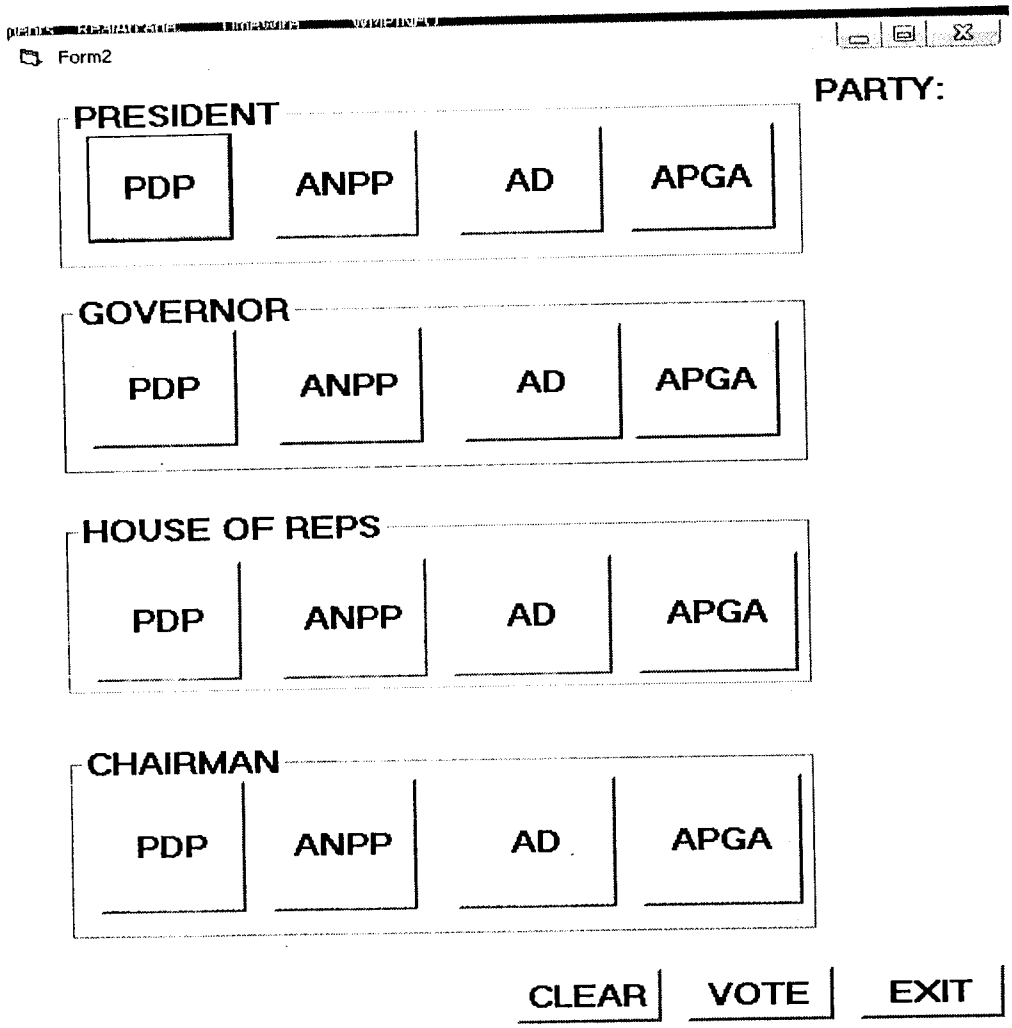


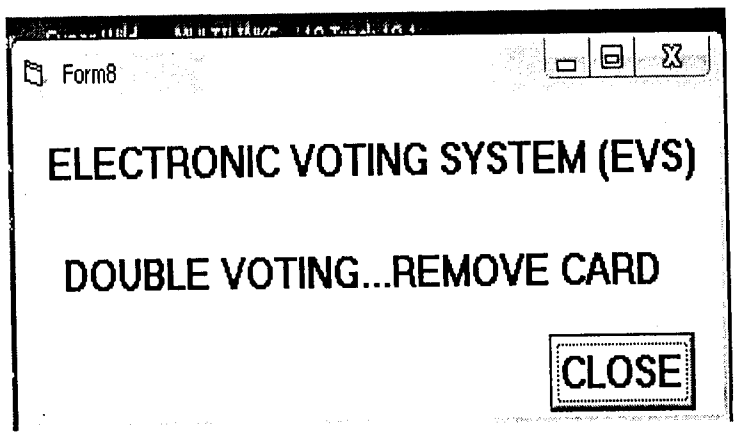

Form6
PASSWORD:
LOG IN
CANCEL

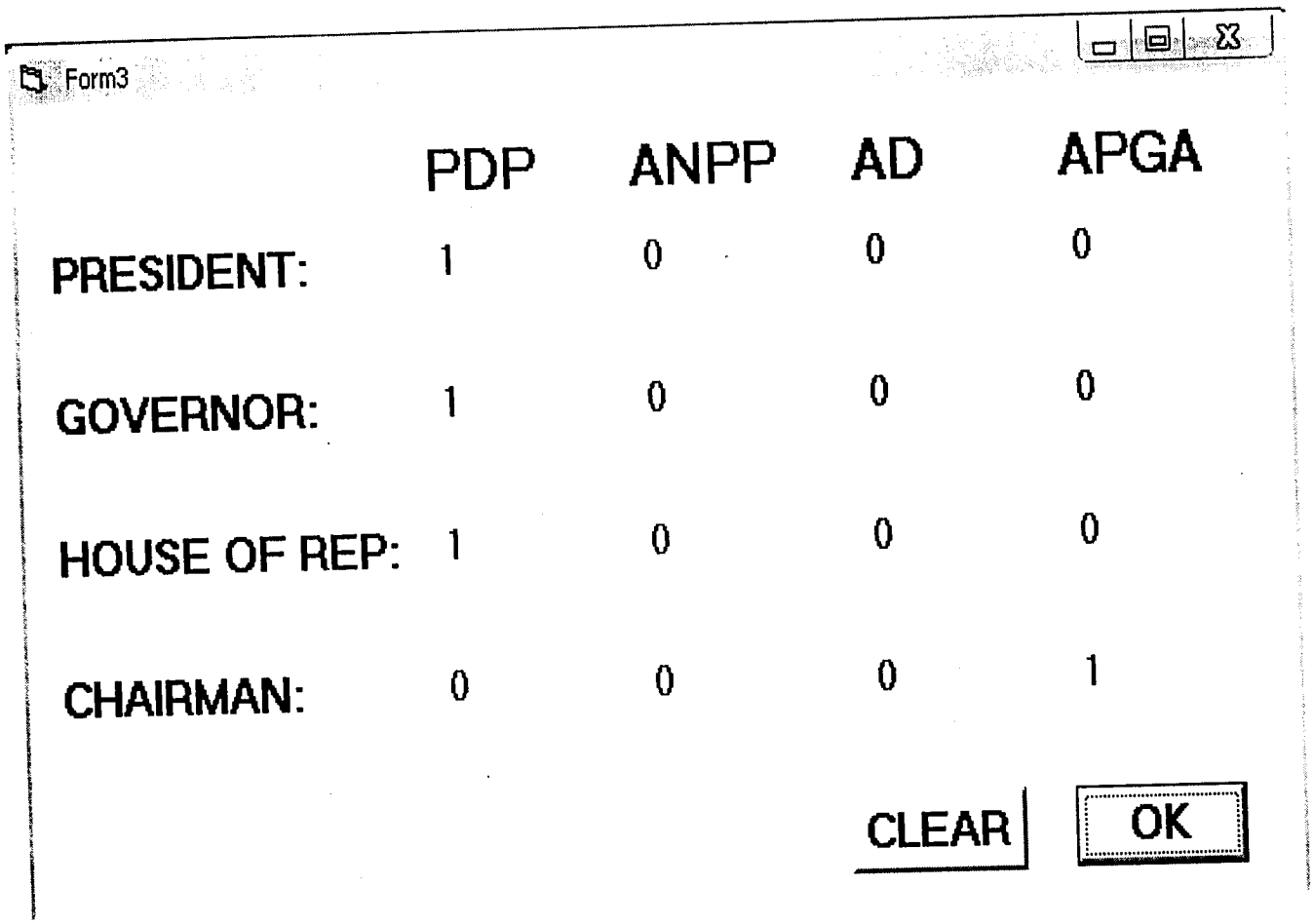

Form7
CREATE CARD
VIEW RESULT
VIEW CARD
VOTE
CHANGE PIN
CLOSE


Form4
CREATE VOTING CARD
HEADER:
ISSUER:
CARD PIN:
STATE CODE:
DUMMY DATA:
DATE:
SEX:
N AME:
DATA LENGHT:
OK
CLEAR
CLOSE


Form5
NAME: AYANGBILE OLUFEMI
SEX: MALE
STATE CODE: 04
CARD PIN: 00000005
ISSUER: INEC
DATE: 09/09/09
OK


Form2
PARTY:
PRESIDENT
PDP
ANPP
AD
APGA
GOVERNOR
PDP
ANPP
AD
APGA
HOUSE OF REPS
PDP
ANPP
AD
APGA
CHAIRMAN
PDP
ANPP
AD
APGA
CLEAR
VOTE
EXIT


Form8
ELECTRONIC VOTING SYSTEM (EVS)
DOUBLE VOTING...REMOVE CARD
CLOSE


Form3
PDP
ANPP
AD
APGA
PRESIDENT:
1
0
0
0
GOVERNOR:
1
0
0
0
HOUSE OF REP:
1
0
0
0
CHAIRMAN:
0
0
0
1
CLEAR
OK

# CHAPTER FIVE

## 5.0. CONCLUSION

The electronic card-based voting system provides an effective , effecient, secured and unbiased process.It puts into consideration security and credibility of voting system which is the bedrock of free and fair election. It is a system that follows the trend of technological development that has taken over world development. It is a better option to the ballot box system still used in many countries, where fraud during and after election has characterized election processes. Electronic voting, especially the card-based type of voting should be embraced and used as it provides the most effective desired results, and should be employed especially in developing nations where it has not been tested before.

## 5.1. RECOMMENDATION

The principal aim of this project is to introduce the card-based voting system as a better alternative to the ballot box voting system. I recommend that the project be properly looked into and adopted in the school and nation. The school already started the electronic voting system even though the first election was defrauded, the second was successful. The card-based voting system is a better option that takes care of fraudulent practices. The card can be multi-purposed.i.e. it can be used for various purposes at the same time. The school Identity (I.D.) card can be electronical using smart cards for its design. It will contain the students' Biodata such as name, matriculation number, department, level, CGPA, courses registered for the session etc. During clearance, all the students need do is to submit their Identity card for screening by the school authority.This same card can also be used for voting.I also recommend this work to the

Independent National Electoral Commission (INEC) as a solution to electoral failures and crisis in Nigeria. This system if tested would be found to be very reliable and effecient.

Challenges I encountered during this project work include:

1. Inadequate materials on electronic voting and unavailability of past project work.
2. Little experience on electronic voting as one solely depended on research since the country has not adopted the system of voting.

For future modification, I suggest that whoever wishes to improve on this work should improve on its security features, he/she should ensure that the card requests for the voter's PIN code immediately it is inserted into the card-reader, this would be the first step of card validation. There may be no need for the election controllers to screen voters before they be allowed to vote, so that voters are given maximum privacy.

REFERENCES

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[4] Benaloh. J. and Truinsra, D. Free secret ballot elections. In proceedings of the twenty-sixth Annual ACM Symposium on the theory of computing. (May 23-25 1994) pp. 544-553.

[5] Nurmi, H. Salomaa. A. And Santean. L. Secret ballot elections in Computer networks and security, 36, 10. (1991) pp.553-560.

[6] 'Punch cards, a definition'.U.S. Federal Election Commision.

[7] U.S. Federal Election Commision: Direct Recording Electronic.

[8] Canard, S., Traore, J. List signature schemes and application to electronic voting.Proceedings of workshop on coding and cryptography (WCC'03), 2003, 81-90.

[9] Cranor, L. Crytron. R. Design and implementation of a practical security conscious electronic polling system, Technical Report WUCS -96 -02, Washington University, 1996

```
Option Explicit


Private Sub Command2_Click()

Load Form3

Form3.Show

Form1.Hide

End Sub


Private Sub Command3_Click()

TEMP2 = Label2.Caption

Label2.Caption = "MIKE 2008"

DELAY_2_sHOW

Label2.Caption = TEMP2

End Sub


Private Sub Command4_Click()

Close #1
```

```
End

End Sub


Private Sub Form_Load()

COMMAND_SENT = False

Command2.Caption = "TOTALIZE"

Command3.Caption = "ABOUT"

Command4.Caption = "X"

Command2.Enabled = True

Command3.Enabled = True

Command4.Enabled = True

Label1.Visible = True

Label2.Caption = "READY..."

INIT_FORM

INIT_SERIAL

SETUP_TIMER

End Sub
```

```
Public Sub INIT_FORM()



End Sub



Public Sub SETUP_TIMER()

Timer1.Interval = 500

Timer1.Enabled = True

End Sub



Public Sub INIT_SERIAL()

If MSComm1.PortOpen = True Then

MSComm1.PortOpen = False

End If

MSComm1.Settings = "9600,N,8,1"

MSComm1.InputLen = 1

MSComm1.InBufferSize = 1024
```

```
MSComm1.InputMode = comInputModeBinary

MSComm1.Handshaking = comNone

MSComm1.EOFEnable = False

MSComm1.DTREnable = False

MSComm1.RThreshold = 1

MSComm1.SThreshold = 0

MSComm1.CommPort = 1

MSComm1.PortOpen = True

End Sub


Public Sub DELAY_2_sHOW()

COUNT2 = 0

Do

DoEvents

COUNT2 = COUNT2 + 1

Loop Until COUNT2 > 100000

End Sub
```

```
Private Sub MSComm1_OnComm()

If COMMAND_SENT = True Then

If MSComm1.CommEvent = comEvReceive Then

SDATA = MSComm1.Input

CARD(COUNT1) = AscB(SDATA)

COUNT1 = COUNT1 + 1

TIMEOUT = 0

End If

End If

End Sub


Private Sub Timer1_Timer()

WE_VOTE

End Sub


Public Sub read_card()
```

```
'For TIMEOUT = 0 To 50000

'Next TIMEOUT

TIMEOUT_FLAG = False

TIMEOUT = 0

COUNT1 = 0

CARD_vALID = False

MSComm1.Output = "$" + "0" + "1"

COMMAND_SENT = True

Do

DoEvents

TIMEOUT = TIMEOUT + 1

Loop Until (TIMEOUT >= 1000000) Or (COUNT1 >= 58)

Debug.Print COUNT1

COMMAND_SENT = False



If TIMEOUT >= 1000000 Then

Form1.Label2.Caption = "READER OFFLINE..."
```

```
TIMEOUT_FLAG = True

GoTo fallout

End If


If CARD(0) = AscB("$") And CARD(1) = AscB("0") And CARD(2) = AscB("1") Then

Form1.Label2.Caption = "READING..."

DELAY_2_sHOW

End If


If CARD(4) = AscB("I") And CARD(5) = AscB("N") And CARD(6) = AscB("E") And
CARD(7) = AscB("C") Then

CARD_vALID = True

Debug.Print Chr(CARD(4)) + Chr(CARD(5)) + Chr(CARD(6)) + Chr(CARD(7))

GoTo fallout

Else

If CARD(0) = AscB("$") And CARD(1) = AscB("0") And CARD(2) = AscB("1") And
CARD_vALID = False Then

Label2.Caption = "UNRECOGNIZED VOTING MEDIA..."
```

```
DELAY_2_sHOW

End If

End If


If CARD(0) = AscB("$") And CARD(1) = AscB("E") And CARD(2) = AscB("1") Then

Form1.Label2.Caption = "READY..."

End If


fallout:

End Sub


Public Sub GET_VOTE()

PRESIDENT_LOCK = False

GOVERNOR_LOCK = False

REP_LOCK = False

CHAIRMAN_LOCK = False

READ_PIN
```

```
If (CARD(18) - AscB("0")) <> 0 Then

PRESIDENT_LOCK = True

End If


If (CARD(19) - AscB("0")) <> 0 Then

GOVERNOR_LOCK = True

End If

If (CARD(20) - AscB("0")) <> 0 Then

REP_LOCK = True

End If


If (CARD(21) - AscB("0")) <> 0 Then

CHAIRMAN_LOCK = True

End If
```

```
If PRESIDENT_LOCK = False Or GOVERNOR_LOCK = False Or REP_LOCK = False Or
CHAIRMAN_LOCK = False Then
VOTE_NOW
Else
Label2.Caption = "DOUBLE VOTING...REMOVE CARD"
DELAY_2_sHOW
End If
End Sub

Public Sub WRITE_cARD()
TIMEOUT_FLAG = False
'For TIMEOUT = 0 To 10000
'Next TIMEOUT
COMMAND_SENT = True
MSComm1.Output = "$" + "0" + "2"
For TIMEOUT = 0 To 10000
Next TIMEOUT
```

```
COUNT2 = 0

For COUNT1 = 3 To 57

TEMP_CARD(COUNT2) = CARD(COUNT1)

COUNT2 = COUNT2 + 1

Next COUNT1



SDATA = TEMP_CARD()

MSComm1.Output = SDATA



COUNT1 = 0

TIMEOUT = 0

Do

DoEvents

TIMEOUT = TIMEOUT + 1

Loop Until (TIMEOUT >= 4000000) Or (COUNT1 >= 58)

COMMAND_SENT = False

If TIMEOUT >= 4000000 Then
```

```
TIMEOUT_FLAG = True

WRITE_OK = False

Else

If CARD(0) = AscB("$") And CARD(1) = AscB("0") And CARD(2) = AscB("2") Then

TIMEOUT_FLAG = False

WRITE_OK = True

Else

If CARD(0) = AscB("$") And CARD(1) = AscB("E") And CARD(2) = AscB("2") Then

TIMEOUT_FLAG = False

WRITE_OK = False

End If

End If

End If'

End Sub

Public Sub WE_VOTE()

read_card

If CARD_vALID = True Then
```

```
GET_VOTE

End If

End Sub



Public Sub VOTE_NOW()

'Load Form2

'Form2.Show

'Form1.Hide

Load Form4

Form4.Show

Form1.Hide

End Sub


Public Sub READ_PIN()

PIN_0 = CARD(8) - AscB("0")

PIN_1 = CARD(9) - AscB("0")
```

PIN_2 = CARD(10) - AscB("0")

PIN_3 = CARD(11) - AscB("0")

PIN_4 = CARD(12) - AscB("0")

PIN_5 = CARD(13) - AscB("0")

PIN_6 = CARD(14) - AscB("0")

PIN_7 = CARD(15) - AscB("0")

PIN_0 = (PIN_0 * 16) + PIN_1

PIN_1 = (PIN_2 * 16) + PIN_3

PIN_2 = (PIN_4 * 16) + PIN_5

PIN_3 = (PIN_6 * 16) + PIN_7

CARD_PIN = (PIN_0 * 16777216) + (PIN_1 * 65536) + (PIN_2 * 256) + PIN_3

STATE_CODE = ((CARD(16) - AscB("0")) * 10) + (CARD(17) - AscB("0"))

```
End Sub Public vote_ok As Boolean

Private Sub Command1_Click()

PDP_PRESIDENT = True

ANPP_PRESIDENT = False

AD_PRESIDENT = False

APGA_PRESIDENT = False

Label2.Caption = "PDP"

Command1.Enabled = False

Command2.Enabled = False

Command3.Enabled = False

Command4.Enabled = False

End Sub


Private Sub Command10_Click()

PDP_REP = False

ANPP_REP = True

AD_REP = False
```

```
APGA_REP = False

Label4.Caption = "ANPP"

Command9.Enabled = False

Command10.Enabled = False

Command11.Enabled = False

Command12.Enabled = False

End Sub


Private Sub Command11_Click()

PDP_REP = False

ANPP_REP = False

AD_REP = True

APGA_REP = False

Label4.Caption = "AD"

Command9.Enabled = False

Command10.Enabled = False

Command11.Enabled = False
```

```
Command12.Enabled = False

End Sub


Private Sub Command12_Click()

PDP_REP = False

ANPP_REP = False

AD_REP = False

APGA_REP = True

Label4.Caption = "APGA"

Command9.Enabled = False

Command10.Enabled = False

Command11.Enabled = False

Command12.Enabled = False


End Sub


Private Sub Command13_Click()
```

```
PDP_CHAIR = True

ANPP_CHAIR = False

AD_CHAIR = False

APGA_CHAIR = False

Label5.Caption = "PDP"

Command13.Enabled = False

Command14.Enabled = False

Command15.Enabled = False

Command16.Enabled = False


End Sub


Private Sub Command14_Click()

PDP_CHAIR = False

ANPP_CHAIR = True

AD_CHAIR = False

APGA_CHAIR = False
```

```
Label5.Caption = "ANPP"

Command13.Enabled = False

Command14.Enabled = False

Command15.Enabled = False

Command16.Enabled = False

End Sub


Private Sub Command15_Click()

PDP_CHAIR = False

ANPP_CHAIR = False

AD_CHAIR = True

APGA_CHAIR = False

Label5.Caption = "AD"

Command13.Enabled = False

Command14.Enabled = False

Command15.Enabled = False

Command16.Enabled = False
```

```
End Sub


Private Sub Command16_Click()
PDP_CHAIR = False
ANPP_CHAIR = False
AD_CHAIR = False
APGA_CHAIR = True
Label5.Caption = "APGA"
Command13.Enabled = False
Command14.Enabled = False
Command15.Enabled = False
Command16.Enabled = False
End Sub


Private Sub Command17_Click()
CLEAR_FORM
```

```
End Sub


Private Sub Command18_Click()
disable_commands
If PDP_PRESIDENT = True Or ANPP_PRESIDENT = True Or AD_PRESIDENT = True Or
apga_presidnet = True Then
CARD(18) = AscB("1")
vote_ok = True
End If
If PDP_GOVERNOR = True Or ANPP_GOVERNOR = True Or AD_GOVERNOR = True Or
APGA_GOVERNOR = True Then
CARD(19) = AscB("1")
vote_ok = True
End If
If PDP_REP = True Or ANPP_REP = True Or AD_REP = True Or APGA_REP = True Then
CARD(20) = AscB("1")
vote_ok = True
End If
```

```
If PDP_CHAIR = True Or ANPP_CHAIR = True Or AD_CHAIR = True Or APGA_CHAIR =
True Then

CARD(21) = AscB("1")

vote_ok = True

End If



If vote_ok = True Then

Command19.Enabled = False

vote_ok = False

Call Form1.WRITE_cARD

If WRITE_OK = True Then

Label6.Caption = "VOTE OK"

Form1.DELAY_2_sHOW

UPDATE_REC

Else

MsgBox ("CARD/READER ERROR...RETRY")
```

```
End If

End If

DETECT_cARD

End Sub



Private Sub Command19_Click()

vote_ok = False

Command18_Click

End Sub



Private Sub Command2_Click()

PDP_PRESIDENT = False

ANPP_PRESIDENT = True

AD_PRESIDENT = False

APGA_PRESIDENT = False

Label2.Caption = "ANPP"
```

```
Command1.Enabled = False

Command2.Enabled = False

Command3.Enabled = False

Command4.Enabled = False

End Sub


Private Sub Command3_Click()

PDP_PRESIDENT = False

ANPP_PRESIDENT = False

AD_PRESIDENT = True

APGA_PRESIDENT = False

Label2.Caption = "AD"

Command1.Enabled = False

Command2.Enabled = False

Command3.Enabled = False

Command4.Enabled = False

End Sub
```

```
Private Sub Command4_Click()

PDP_PRESIDENT = False

ANPP_PRESIDENT = False

AD_PRESIDENT = False

APGA_PRESIDENT = True

Label2.Caption = "APGA"

Command1.Enabled = False

Command2.Enabled = False

Command3.Enabled = False

Command4.Enabled = False


End Sub


Private Sub Command5_Click()

PDP_GOVERNOR = True

ANPP_GOVERNOR = False
```

```
AD_GOVERNOR = False

APGA_GOVERNOR = False

Label3.Caption = "PDP"

Command5.Enabled = False

Command6.Enabled = False

Command7.Enabled = False

Command8.Enabled = False

End Sub


Private Sub Command6_Click()

PDP_GOVERNOR = False

ANPP_GOVERNOR = True

AD_GOVERNOR = False

APGA_GOVERNOR = False

Label3.Caption = "ANPP"

Command5.Enabled = False

Command6.Enabled = False
```

```
Command7.Enabled = False

Command8.Enabled = False


End Sub


Private Sub Command7_Click()

PDP_GOVERNOR = False

ANPP_GOVERNOR = False

AD_GOVERNOR = True

APGA_GOVERNOR = False

Label3.Caption = "AD"

Command5.Enabled = False

Command6.Enabled = False

Command7.Enabled = False

Command8.Enabled = False


End Sub
```

```
Private Sub Command8_Click()

PDP_GOVERNOR = False

ANPP_GOVERNOR = False

AD_GOVERNOR = False

APGA_GOVERNOR = True

Label3.Caption = "APGA"

Command5.Enabled = False

Command6.Enabled = False

Command7.Enabled = False

Command8.Enabled = False


End Sub


Private Sub Command9_Click()

PDP_REP = True

ANPP_REP = False
```

```
AD_REP = False

APGA_REP = False

Label4.Caption = "PDP"

Command9.Enabled = False

Command10.Enabled = False

Command11.Enabled = False

Command12.Enabled = False

End Sub


Private Sub Form_Load()

vote_ok = False

Form1.Timer1.Enabled = False

Label1.Caption = "PARTY:"

Label2.Caption = " "

Label3.Caption = " "

Label4.Caption = " "

Label5.Caption = " "
```

Command1.Caption = "PDP"

Command2.Caption = "ANPP"

Command3.Caption = "AD"

Command4.Caption = "APGA"

Command5.Caption = "PDP"

Command6.Caption = "ANPP"

Command7.Caption = "AD"

Command8.Caption = "APGA"

Command9.Caption = "PDP"

Command10.Caption = "ANPP"

Command11.Caption = "AD"

Command12.Caption = "APGA"

Command13.Caption = "PDP"

Command14.Caption = "ANPP"

Command15.Caption = "AD"

Command16.Caption = "APGA"

Command17.Caption = "CLEAR"

```
Command18.Caption = "VOTE"

Command19.Caption = "EXIT"

CLEAR_FORM

End Sub


Public Sub CLEAR_FORM()

PDP_PRESIDENT = False

AD_PRESIDENT = False

ANPP_PRESIDENT = False

APGA_PRESIDENT = False


PDP_GOVERNOR = False

AD_GOVERNOR = False

ANPP_GOVERNOR = False

APGA_GOVERNOR = False


PDP_REP = False
```

```
AD_REP = False

ANPP_REP = False

APGA_REP = False


PDP_CHAIR = False

AD_CHAIR = False

ANPP_CHAIR = False

APGA_CHAIR = False

Label2.Caption = " "

Label3.Caption = " "

Label4.Caption = " "

Label5.Caption = " "

disable_commands

enable_commands

End Sub


Public Sub disable_commands()
```

```
Command1.Enabled = False
Command2.Enabled = False
Command3.Enabled = False
Command4.Enabled = False
Command5.Enabled = False
Command6.Enabled = False
Command7.Enabled = False
Command8.Enabled = False
Command9.Enabled = False
Command10.Enabled = False
Command11.Enabled = False
Command12.Enabled = False
Command13.Enabled = False
Command14.Enabled = False
Command15.Enabled = False
Command16.Enabled = False
Command17.Enabled = False
```

```
    Command18.Enabled = False
End Sub


Public Sub enable_commands()
If PRESIDENT_LOCK = False Then
Command1.Enabled = True
mmand2.Enabled = True
nmand3.Enabled = True
mand4.Enabled = True
nand18.Enabled = True
nand17.Enabled = True
f


OVERNOR_LOCK = False Then
nmand5.Enabled = True
mmand6.Enabled = True
Command7.Enabled = True
```

```
Command8.Enabled = True
Command18.Enabled = True
Command17.Enabled = True
End If

If REP_LOCK = False Then

Command9.Enabled = True
Command10.Enabled = True
Command11.Enabled = True
Command12.Enabled = True
Command18.Enabled = True
Command17.Enabled = True
End If

If CHAIRMAN_LOCK = False Then
Command13.Enabled = True
```

```
Command14.Enabled = True
Command15.Enabled = True
Command16.Enabled = True
Command18.Enabled = True
Command17.Enabled = True
End If

End Sub

Public Sub DETECT_cARD()
Command19.Enabled = False
Label6.Caption = "REMOVE CARD"

AGAIN:
Form1.read_card
f TIMEOUT_FLAG = True Then GoTo RETIRE
If CARD_vALID = False Then GoTo RETIRE
```

```
GoTo AGAIN



RETIRE:

Label6.Caption = " "

Unload Form2

Unload Form4

Form1.Show

Form1.Timer1.Enabled = True

End Sub


Public Sub UPDATE_REC()


REC_ID = 1

Open "C:\vote_rec.txt" For Random As #1 Len = Len(VOTE_REC_file)

et #1, REC_ID, VOTE_REC_file
```