



Development of Microcontroller Based Biometric Electronic Voting System

BELLO Saheed Akinbola¹, ADESINA Morenikeji Dele², DARAMOLA Serah Oluwatosin³

¹ Lecturer I, Electrical Electronic Engineering, Federal Polytechnic, Ile Oluji, Ondo State, Nigeria

² Lecturer II, Electrical Electronic Engineering, Federal Polytechnic, Ile Oluji, Ondo State, Nigeria

³ Technologist II, Electrical Electronic Engineering, Federal Polytechnic, Ile Oluji, Ondo State, Nigeria

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ABSTRACT

Voting is the most important process of democratic setting where by people determines who lead or represent their interest. Despite series of regulations, conventional voting system has been generally characterized with many fundamental challenges which ranges from systemic to human problems thereby rendering outcome of the process widely unacceptable due to series of malpractices at various levels of the process notwithstanding the huge amount of resources that might have been committed. Manipulated process is bond to give counter-productive results which eventually leads to bad governance, poor representation diversification of public opinion and interest for personal gains. This pose need for a more perfect voting system, which outcome could hardly be challenged no matter the way it goes. Achieving this is to move away from the paper-based voting scheme which has ballot paper at the center of focus to electronic voting system whereby voting data is collected and processed digitally. The system consists of controller hardware and software. The hardware is implemented with microcontroller incorporated with finger-print module while software code is developed in C programming language for interfacing the ARM processor with finger-print module. Pre-voting, voting, and post voting are captured and processed electronically. Features of the proposed system include flexibility, user-friendly, minimum power consumption and cost-effectiveness.

1. Introduction

Biometrics is the science and technology of measuring and analyzing biological data. Biometrics refers to technologies that measure and analyze human body characteristics, such as DNA, fingerprints, eye retinas and irises, voice patterns, facial patterns and hand measurements, for authentication purposes. The field of biometrics was formed and has since expanded on to many types of physical identification. Among the several human fingerprints remain a very common identifier and the biometric method of choice among law enforcement. These concepts of human identification have lead to the development of fingerprint scanners that serve to quickly identify individuals and assign access privileges. The basic point of these devices is also to examine the fingerprint data of an individual and compare it to a database of other fingerprints Villafiorita, A. et al (2009). Potential of fingerprint, which is the uniqueness of individual, is hereby used for the purpose of voter authentication. Therefore elections would no longer be tedious and expensive job and it will be more credible.

The conventional voting, that is the paper based voting system is not only stressful and time consuming, but also costly in implementing as voters register, ballot papers result sheets and other accessories are to be produced every time there is election, be it national or organization decision making process. In case of large population the process requires days before conclusion. The complex nature of this system give room for multiple voting and manipulation in various forms, thereby subverting the will of the majority. Naser, W. E. (2017)

To tackle these problems associated the conventional thumb on paper voting system, electronic voting is the way out. E-voting is the incorporation of electronic devices to make a voting system. Experience about manual voting system in Nigeria and history of the electronic voting system, types of voting technology was reviewed by (Ajayi, L. B. 2004.) with the aim of proffering solution to the malpractices that characterized manual voting. A three-tier web-enabling application such as apache as a web server with extended capacity for Hypertext Preprocessor (PHP) scripting language and MySQL relational database was used though confidentiality, integ-

rity, convenience and auditability of e-voting functional and security requirements could not achieved. Samsul, J. A. and Limkar, M. B. (2014) proposed a biometric-secure cloud based e-voting system for election processes. To solve the problems of multiple voting and high cost of ballot paper production using Histogram Equalization and Fourier Transform for fingerprint and iris identification. The authentication of the voters was achieved, however confidentiality, integrity, secrecy, transparency, convenience and auditability of e-voting functional and security requirements are still challenges.

Panja, S. and Mondeddu, S. (2015) used biometric fingerprint based electronic voting system for a better voting process using FIM 3030N scanner to extract, process and store the ridges of the fingerprint in the database. Authentication was achieved leaving of confidentiality, integrity, secrecy, transparency and convenience unaddressed. ATmega2560 microcontroller, SD cards, crystal oscillator, power jack, a USB connection were among other devices for authentication and voting were used by Syed, R. H, et al, (2015) for authentication and voting. A simple user friendly device was achieved. Though the capacity for storage is small however, results stored in the SD card could be altered.

Every credible voting require accreditation process through conformation on voters register with voters identity card. This manual checking of voter's ID card which often lead to illegal voting by false voters, high probability of multiple votes by the same voter need attention. This led to design development of a fingerprint and RFID based electronic voting system. AT89S52 microcontroller was used linked with the RFID tags for authentication and voting. Algorithm that integrated RFID of Aadhaar and fingerprint to achieve the authentication e-voting requirement was presented by Mary, H. H, et al (2016). Nithya, S. et al, (2016) presented an advanced secure voting system with the internet of things (IoT) towards achieving free and fair election.

2. Proposed System

Components of the proposed system are described in the following section with the block diagram as shown presented in Figure 1.

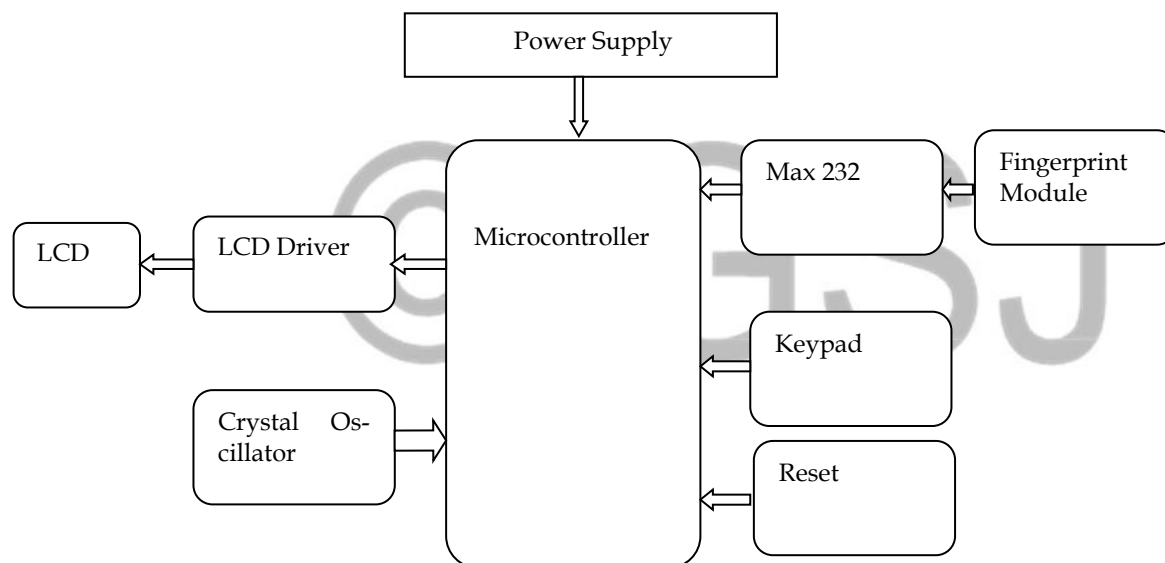


Fig- 1: Power Supply Unit

Power supply is a very important part of this circuit. It requires fixed +5 V supply obtained with a voltage regulator. 7805 Voltage regulator which output fixed +5 volt is to be used.

2.1 Voting Unit (Fingerprint module)

This is where the accreditation and casting of vote is carried out. A finger print module is to be used to authenticate the voter as an eligible voter and cast vote concurrently. The fingerprint module served as an input device, responsible for processing and capturing a digital image of the fingerprint pattern. During the fingerprint enrolling process, the user was required to input their finger twice, allowing the system to generate a template of the finger based on the processing results and store it.

2.2 Control Unit

Operation of the whole system is controlled in this unit with the use of integrated chip ATMEGA microcontroller consisting of input and output ports, processing unit, memories and timers.

2.3 LCD

An LCD (liquid crystal display) was employed to display candidate information, including their names and acronyms. Additionally, a keyboard was provided for voters to select and vote for a specific candidate.

2.5 Microcontroller

The Arduino atmega32 microcontroller was specifically designed to handle more intricate projects. The Arduino atmega32 microcontroller board provides ample space and opportunities for projects with its32 analogue inputs. It also features UARTS, also known as hardware serial ports, which offer additional support to the microcontroller. This comprehensive

board includes everything necessary to assist the microcontroller in its operations.

3. Implementation and Working Principle

The membrane buttons are directly connected to pin PA2 (switch key 1), PA3 (switch key 2) of microcontroller with respect to the ground or PA4. And a light emitting diode (LED) is connected at pin PC2 of microcontroller with respect to ground through a 1k resistor. Fingerprint module's receiver signal (Rx) and transmitter signal (Tx) directly connected at serial pin PD1 and PD3 of microcontroller. 5V supply is used for powering the whole circuit by using lm7805 voltage regulator which is powered by 12V dc adaptor. A 20x4 liquid crystal display (LCD) is configured in 4-bit mode and its RS, RW, EN, D4, D5, D6, and D7 are directly connected at pin PB0, PB1, PB2, PB4, PB5, PB6, PB7 of Microcontroller. RTC module is connected at 12Cpin PC0 SCL and PCI SDA. And PD7 is used as soft UART transmitter signal (Tx) pin for getting the current time.

Principle of Operation

- a. **Voter's Registration:** The stage creates a database for eligible voters using biometric capturing of fingerprint. Multiple registrations is made impossible. Key F2 on the keyboard is used to initialize system variables for voter's registration entering voters details such as name, age, address with key F11 to save the task after which the fingerprint will be captured with F12 ending registration process. The flowchart is presented in Fig-2
- b. **Party/Contestant Registration**
 System variables initialization for political party registration is enabled through key F3 of the keyboard accepting either name or acronyms of the contestants as the case may be. The process is saved and end F11 and F12 respectively.
- c. **Nature of Election Registration**
 To initialize the system variables for nature of election registration key F5 is press and the category of election is entered such as President, Governor, Senate, Sport Director etc. this is saved by pressing key F11 and the process is ended with Key F12.

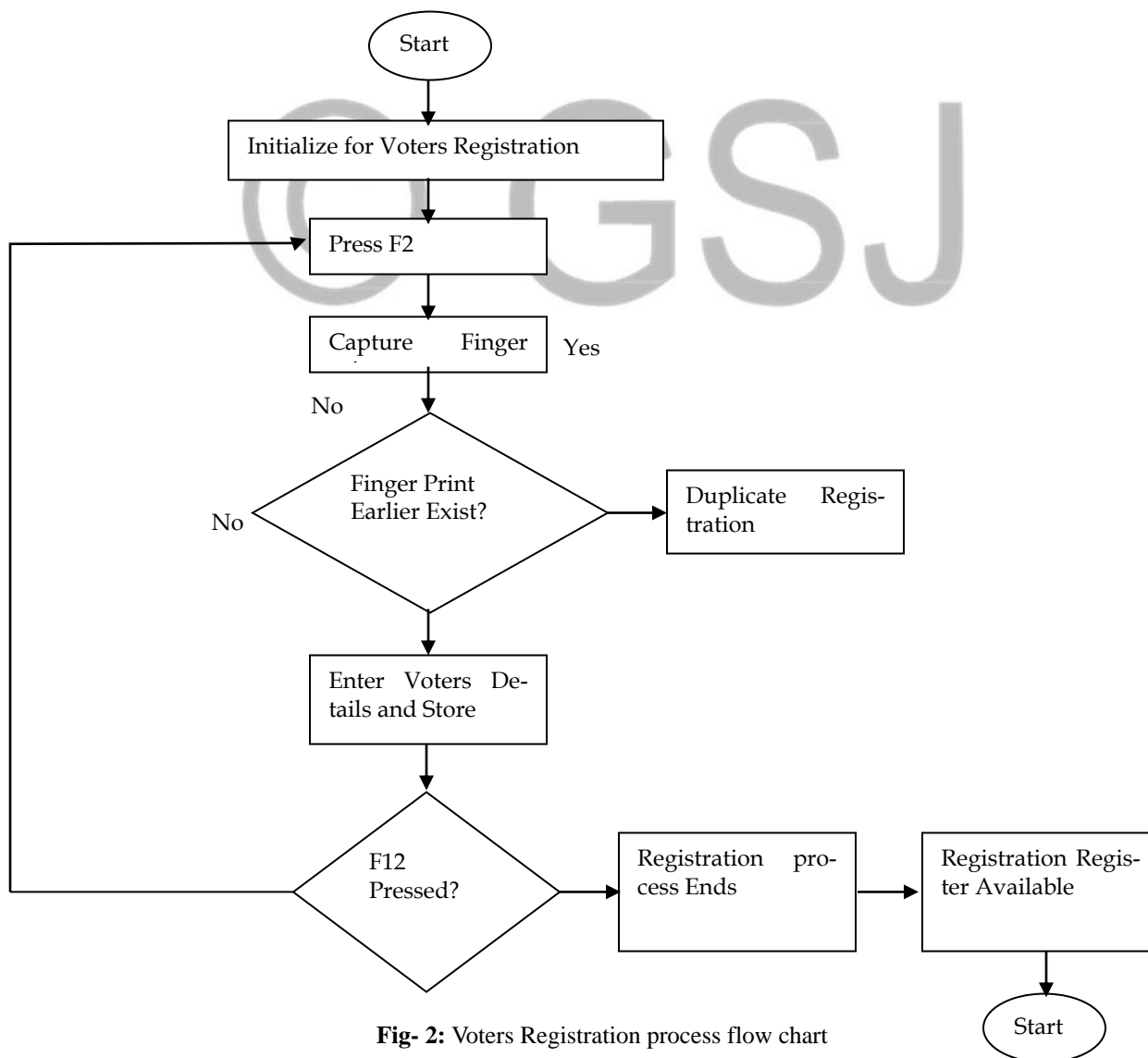


Fig- 2: Voters Registration process flow chart

d. Voting Process

The actual voting process as demonstrated with the flow chart in Fig-3 can only take place after all the previous stages a-c has been carried out. Since multiple registrations of voters is not possible so also multiple voting This is achieved with the aid of biometric capturing using fingerprint. System variables for voting is initialize process by pressing key F7 of the keyboard. Thereafter voter's fingerprint is captured and confirms earlier registration. After which:

- party acronym or contestant of choice is selected by pressing down arrow key.
- enter key pressed to confirm choice..

e. VIEWING OF ELECTION RESULT

- Key F8 is pressed on the keyboard interface to compute the voting result.
- date and time is displayed 20x4 LCD screen with Press PG down key to click on next action
- Pressing PG down key again display result of the votes cast
- Key F12 is pressed to end voting process.

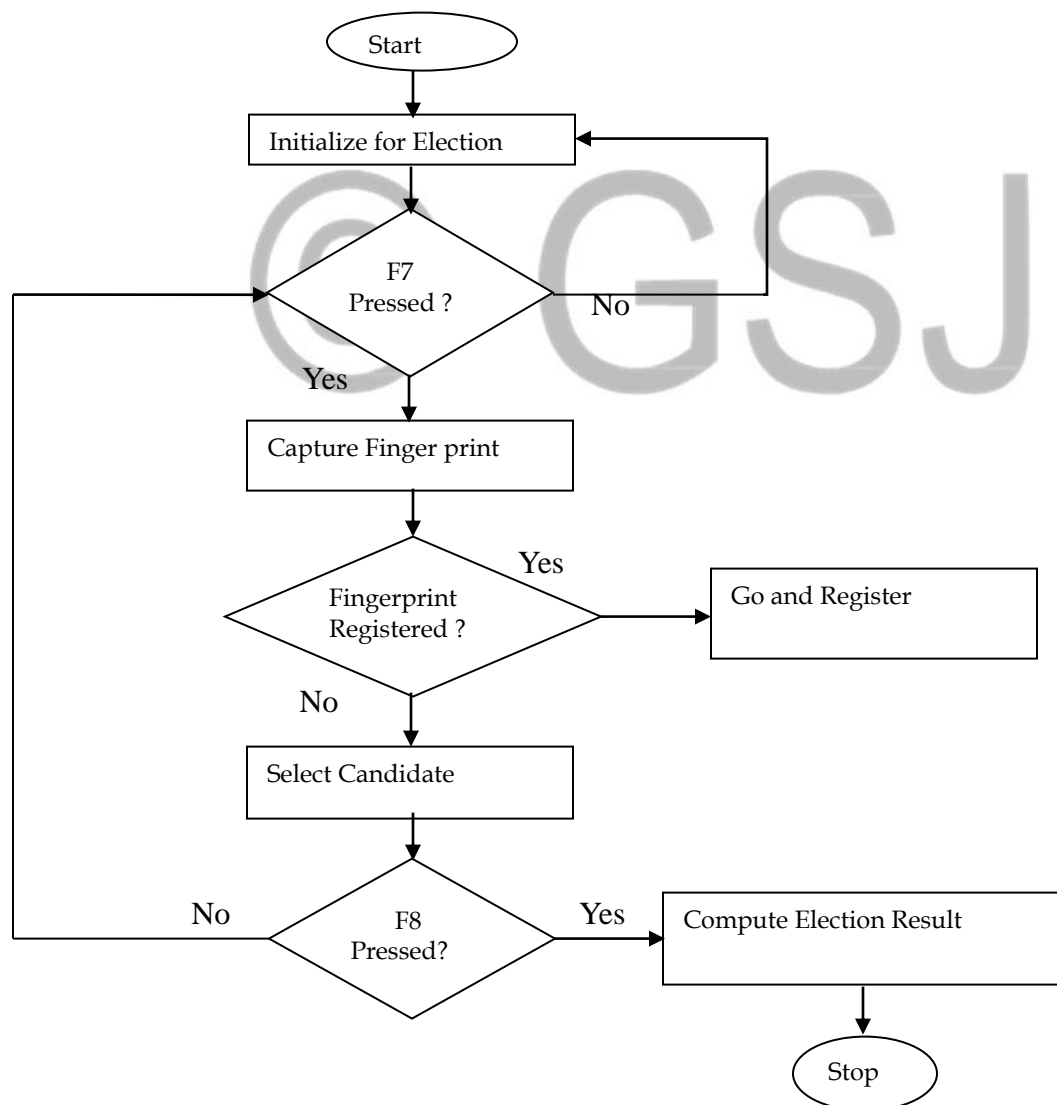


Fig- 3: Voting process flow Chart

4. CONCLUSIONS

The fact that everybody is with a unique fingerprint makes fingerprint voting system a technology to bit in any process where decision making is required with integrity. This fingerprint voting system is implemented and evaluated successfully. The evaluation of the system is done with general sampling of individuals. The result shows the system works perfectly and implementable for all sort of elections.

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