Review Paper

Enhancing the Democratic Process: A Proposal for an Electronic National Referendum System Using Preferential Voting

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Abstract— The legislative arm of government was created primarily to formulate laws and check the activities of the executive arm. However, in Nigeria, these functions have over the years been inefficiently executed and riddled with undue bias, to the detriment of Nigerians. With the steady increase in the number of internet users in the country, this project proposes a solution which leverages technology to allow the populace vote on key issues in the National Assembly. A web-based consensus system was developed, which will optimize the law-making process by providing a platform for citizens to vote on proposed bills and policies. Also, the preferential voting system was adopted. It involves the ranking of options in an order of preference. For an option to be selected, it must achieve an absolute majority, which is at least 50% of the total formal votes. This helps to ensure that selected option represents the true mind of the citizens. The Waterfall methodology was adopted in designing this application. The system was designed using HTML and JavaScript, while SQL was used to implement the database.

Keywords— Consensus, Democracy, E-voting system, National Referendum, Policymaking, Preferential Voting

1. Introduction

Since Nigeria's independence in 1960, the power to make and amend laws in Nigeria has rested solely on the legislative arm. Each senatorial zone elects a senator for the upper chamber, and each constituency a representative for the lower chamber, totalling 109 senators and 306 representatives. Decisions taken by these houses ultimately become binding on the nations over 200 million citizens, upon the assent of the president.

They also have power to impeach high-ranking government officials and confirm candidates the president nominates into designated positions. The lawmakers are expected to enact laws and policies that reflect the interests of the zone or constituency they represent. However, the prevailing legislative procedures are marred with irregularities that defeat the aim of its existence. Bills take too long to be passed, decisions taken do not reflect the choice of the populace, and there is unusually undue influence from the executive arm.

As a result of this, citizens have begun to clamour for more participation in the law-making process of the country. With recent advancements in technology, a system could be developed that would enable citizens vote on bills and suggest modifications to existing laws and policies. The application will leverage the rapid rate of digitization and extensive internet access to enable Nigerians participate in the law-making process. Nigeria has about 109.2 million internet users which represents 51.0% of the population and this number is rapidly increasing. The system should, however, be auditable and tamper-proof for it to be accepted by all concerned parties.

The aim of this study is to design a digital National Referendum System using Preferential Voting, which involves the ranking of a set of options from most-preferred to least-preferred. The development of the system would be done using JavaScript, HTML, and MySQL for database implementation.

This paper's findings on the development of an electronic national referendum system utilizing preferential voting hold significant practical applications. Preferential voting systems are widely recognized for their ability to capture voter preferences more accurately and provide a fair representation of public opinion. By implementing preferential voting in an e-voting application, our study addresses the practical need for a technologically advanced and efficient voting solution.

The system allows voters to rank their options in order of preference, enabling a more nuanced and comprehensive expression of their choices. This not only improves the accuracy of election outcomes but also ensures that options with broader support are selected, thereby enhancing the

democratic process. The practical application of our study lies in its potential to revolutionize electoral systems by introducing a secure, user-friendly, and efficient electronic balloting that facilitates preferential voting, promoting fairness, and fostering public trust in the process.

2. Related Work

A referendum is a simple, comprehensive vote in which the electorate is required to cast a ballot on a specific proposal that could lead to the adoption of a new law or policy.

2.1 Common types of Referendums

Considering the application of referendum across countries, it could be classified as follows:

   i. Obligatory referendum: a vote of the populace that is automatically convened in situations specified by law. The vote's results are typically final. As a result, if a proposal is approved, the government must implement it. On matters of utmost national importance, such as the approval of international treaties, the delegation of authority to international institutions, and duties relating to remittances and public expenditures, mandatory referendums may be required. In most countries, it is also required that any proposed constitutional revisions be put to a vote in a referendum.

   ii. Facultative referendum: The populace is allowed to cast their votes, which are typically prompted by a formal demand, which may be from the executive branch, a group of lawmakers, or several individuals. The referendum's results are not necessarily legally binding. In the case of significant political issues, a government may opt to launch a referendum. It might decide to do so in response to public clamor for a referendum or because the public is divided on the subject at hand.

   iii. Abrogative referendum. A policy or law that has already been approved and implemented by the legislature may be retained or repealed by a vote of the electorate. Typically, citizens gather a certain number of signatures in favor of a vote to demand a vote.

The use of referendums, combined with electronic means of public voting, would facilitate wider participation of the Nigerian electorate in the law-making process.

Utilization of technological tools and advancements to promote inclusion of citizens, promote democratic processes, and embolden representative democracy is known as "e-democracy" [1]. It also refers to the use of internet-based tools and digital technology to encourage public participation, engagement, and deliberation in democratic processes. It has two major objectives:

   i. It equips citizens with adequate access to information and the political process, services, and choices available.

   ii. It also enables the citizen to move from passive to active participation

E-voting, a voting system that employs electronic ballots to allow voters to send their votes to a collation centre via the Internet in a tamper-proof and encrypted medium, is closely related to e-democracy.

In Nigeria, violence is usually employed by the ruling class in to have their way and gain control over the nation's resources [2]. Also, the existence of diverse cultures, traditions, values, and norms in the country usually gives the elites room to create division and disunity among the populace [3].

The use of electronic voting has many advantages which provides solutions to most of the issues encountered in the traditional systems, especially in Nigeria. It will help put power back in the hands of the governed. E-voting promises improved security, speed, accuracy, and a decrease in the violence that frequently occurs at the polling places.

The Nigerian electoral process has been embattled by rigging, ballot theft, vote manipulation and lack of transparency [4] An E-voting election system will eliminate these challenges and increase voter confidence.

2.2 Preferential Voting Systems

Generally, there are different voting electoral systems which allow voters select their choice candidates in various ways. In the preferential voting electoral system, voters rank candidates in order of preference by selecting a number from 1 for their first pick, a number from 2 for their second pick, a number from 3 for their third pick, and so on. A choice is selected right away if it receives an absolute majority of first-preference votes. If no candidate receives a majority of the vote, the option with the fewest votes is eliminated, and the ballots from those voters are re-examined to determine their second preferences, which are then given to the remaining candidates in the order they were put on the ballot. Until one choice has a clear majority or there are no more votes to count, this process is repeated.

Donald Horowitz, a political scientist from the United States, proposed that the necessity for parties and candidates to swap preferences in the race for victory motivates changes between competing interests, making it particularly appropriate for elections in profoundly divided communities [5].

The preferential voting system gives room for increased interaction between the candidates and their constituents [6]. The candidates' cultivation of a better public image is encouraged by the greater contact, as seen. Additionally, compared to other voting systems, the electorate recalls candidates at a higher rate [7]. A significant feature of the preferential voting system is that candidates are certain to be elected if the sum of votes they obtain is above a given limit. Candidates acquiring sufficient preferential votes are elected irrespective of their position on the initial ranking [8].

In nations where the government wants to give voters more influence, the preferential voting system has been put into place. Most elections in Australia and the election of the president of Ireland employ this approach. Since 1978, Sri

Lanka has held presidential elections using a method of preferential voting known as the "Preferential Vote." Several referendums have also used it. Australia was searching for a new national anthem in 1977. Australians might have chosen a national song that only about three-quarters of them liked if four options had been considered. Voters made their choice using a preferred system. God Save the Queen, Advance Australia Fair, The Song of Australia, and Waltzing Matilda were listed in that order, with each voter's personal favourite song at the top of the list. The winning song, Advance Australia Fair, became the national anthem.

Similarly, New Zealand was looking for a new flag in 2015–16. In a 2015 referendum, the public chose between five designs following a design competition using the preferential voting system. The winning choice then attempted a one-on-one match with the current flag in 2016 but was unsuccessful. The government may have used a First-Past-the-Post voting procedure in each of these referendums, in which the choice receiving the most votes at the end of the voting process is chosen. However, without most the populace's backing, this might have resulted in a different alternative winning.

Another example is the province of Prince Edward Island (P.E.I.). In 2016, citizens had the option of choosing a new electoral system. Voters were given the chance to express their preferences among the following five options: Mixed Member Proportional Representation, First-Past-the-Post Plus Leaders, and First-Past-the-Post.

Voters can express their support for numerous candidates through preferential voting rather than having to select just one. Additionally, it makes sure that the winning candidate receives widespread support from the electorate as opposed to just a majority of votes.

The preferential voting System was used in the 2002 Papua New Genuine general election as a deviation from their usual method of first-past-the-post electoral system. Upon analysis of the election, it was found that the voting system brought about reduced electoral violence, improved governance, and improvements female candidates [9].

Mollison also states that preferential voting has citizen empowerment and option at its core. He compared it with alternatives like Member Proportional (MMP) and List Proportional Representation based on three aspects of broad linearity, the threshold for gaining a majority and the threshold for representation and concluded that the preferential voting system was a better option if the true voice of the masses would be reflected [10].

3. Experimental Design

3.1 Choice of Methodology
The Waterfall approach for system development was adopted owing to its clear and structured approach. The methodology ensures that each phase, comprising of: requirements gathering, system design, implementation, testing, deployment, and maintenance, is executed before proceeding to the next phase. This enables the early identification and resolution of risks.

This approach minimizes the possibility of critical problems arising later in the development cycle. It ensures that all requirements and design specifications are well-documented, serving as a valuable reference for developers, testers, and future maintenance activities.

By following a sequential approach, the Waterfall methodology allows testing to be conducted thoroughly, thereby increasing the confidence in the system's performance.

The proposed system as depicted in Figure 1, consisting of the registration platform, login platform, voting interface, and result interface, imbibes the systematic and modular approach facilitated by the Waterfall methodology, enabling effective communication and integration of different components through a centralized database server.
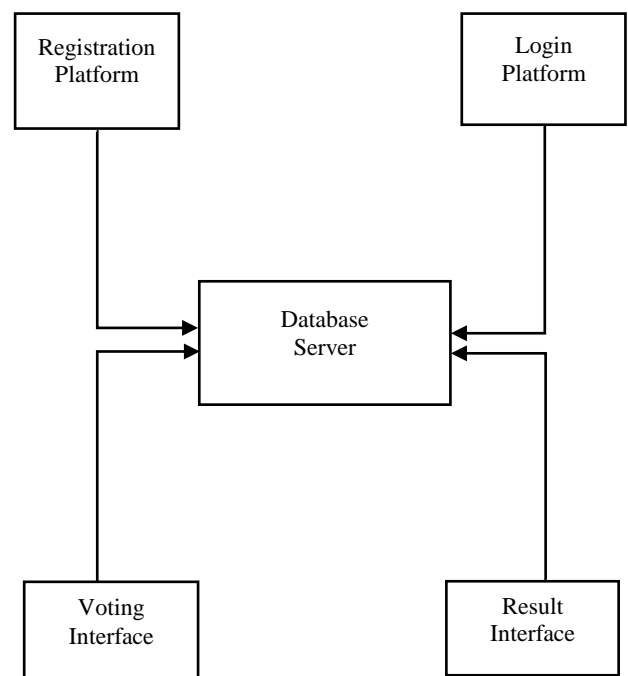

Figure 1. High level model of the voting system

3.2 System Functional Flowchart

The system flowchart is designed to be simple and secure as depicted in the flowchart below, to enable a user successfully to cast a vote securely. It depicts the summary of how the system functions. The first process requires voters to rank their choices in an increasing order of preference. Afterwards, the users are prompted to verify their choices before final submission. Upon submission, the cast votes are sent to a server for storage, collation and visualization to the electorate.
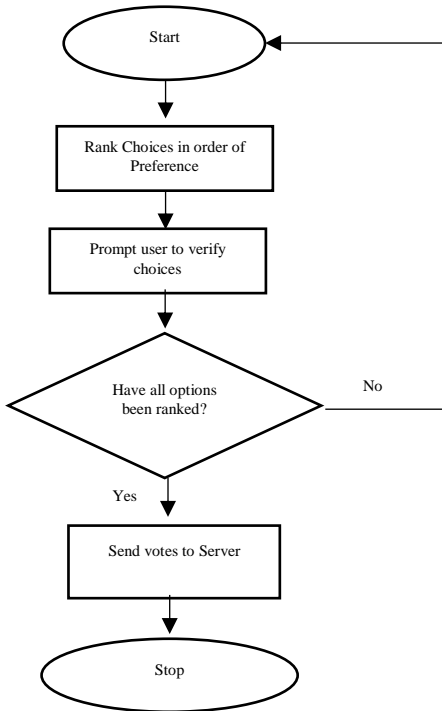The system function flowchart is shown in figure 2 below.

Figure 2. System functional flowchart

3.3 Model of the Voting Interface

The voting interface is the part of the system where the citizens can make their choices. It begins by capturing the details of the user in a registration process, afterwards the user logs in and makes their selections. The preferential voting algorithm is executed, and the live results are also available to be viewed by the user.
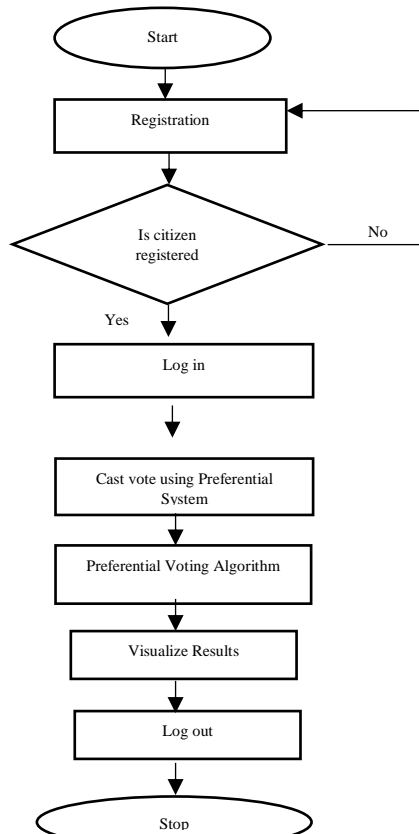
Figure 3. Flowchart of the Voting Interface

3.4 Model of the Preferential Voting System

The preferential voting system enables voters' rank their choices in an order of preference. The flowchart below illustrates the process of selecting a winning option after voting has been completed.
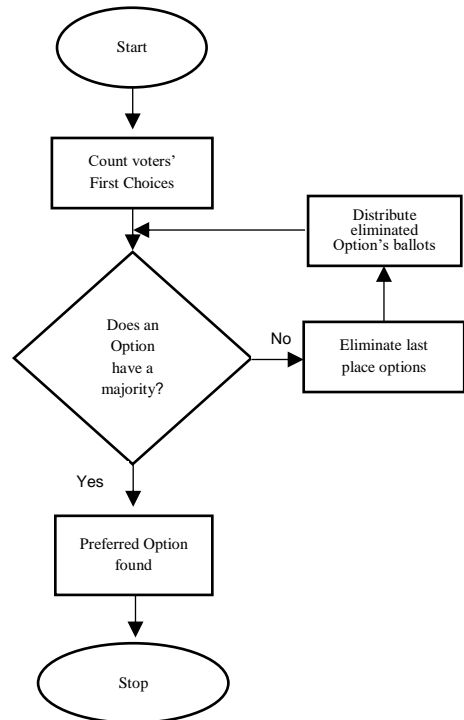
Figure 4. Flowchart preferential voting

Here's how preferential voting works:

The options are ranked on the ballot according to the voters' preferences, starting with their top pick at the top and moving down the list.

The votes are then counted, with the first-choice votes for each option tallied first.

If an option receives a majority of first-choice votes (more than 50% of the total votes), they are declared the winner.

The option with the least most-preferred votes is eliminated, if no option wins a most of those ballots, and the votes are then redistributed in accordance with the second-choice preferences on those ballots.

The votes are then counted again, and the process is repeated until one option has a majority of the votes.

5. Results and Discussion

5.1 Summary of the Results

The development and testing of our e-voting platform yielded promising results. We successfully created a user-friendly, secure, and efficient platform that streamlines the voting process. Through rigorous testing and analysis, we obtained valuable data that highlights the platform's effectiveness in

enhancing accessibility and ensuring the integrity of the voting process.

5.2 Comparison with Objectives

Our objectives were to develop an e-voting platform that offers increased efficiency, and improved usability compared to traditional voting systems. The developed software demonstrates that our platform achieved these objectives by providing a seamless user experience and transparent result collation window.

5.3 Discussion of Findings

The findings from our study signify a significant advancement in the field of e-voting. By addressing the limitations of traditional voting systems, our platform offers a more efficient and secure solution. The reduced time for vote tabulation not only expedites the results announcement but also minimizes the chances of errors and ensures a transparent voting process.

5.4 Limitations

While our study yielded promising results, it is important to acknowledge certain limitations. The testing phase was conducted on a smaller scale due to resource constraints, which may impact the generalizability of the findings. Additionally, the platform's effectiveness relies on a stable internet connection, which may pose challenges in certain regions with limited connectivity. These limitations should be considered when implementing the platform on a larger scale.

5.5 Practical Implications

The practical implications of our developed e-voting platform are far-reaching. Its deployment in real-world elections can streamline the voting process, ensuring faster and more accurate results.

The platform's user-friendly interface empowers voters of all demographics, including those with limited technological literacy. Nevertheless, the implementation should consider potential challenges related to infrastructure, user training, and public acceptance, requiring comprehensive planning and stakeholder engagement.

5.6 Application Dashboards

On successful login from the login page, the admin is directed to the dashboard where they can perform the following actions:
1.   Create referendum
2.   Close a referendum from being voted
3.   View list of created, closed and open referendums and perform actions – delete, edit, close, view details and vote referendum
4.   Change profile details
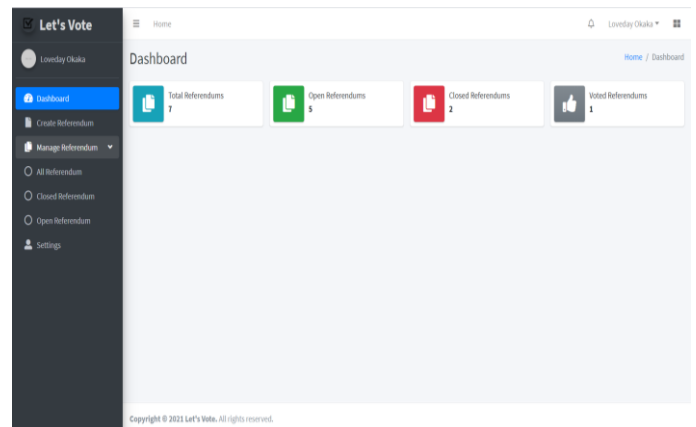The dashboards below shows the interfaces where the afore-mentioned actions can be performed:

Figure 5. View of administrator dashboard

From figure 5 shown above, the admin can view all created referendums on the system, closed referendums, open referendums from the sidebar in the above figure.
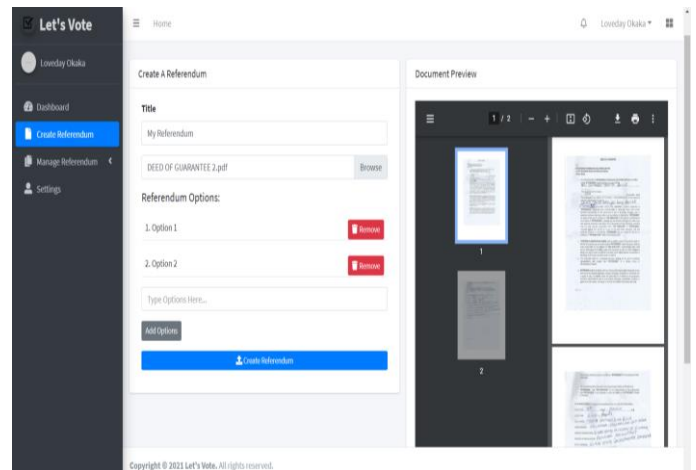

Figure 6. View of registration page

Figure 6 shows the page where the admin can create new referenda in the application and have other users vote based on their preference.
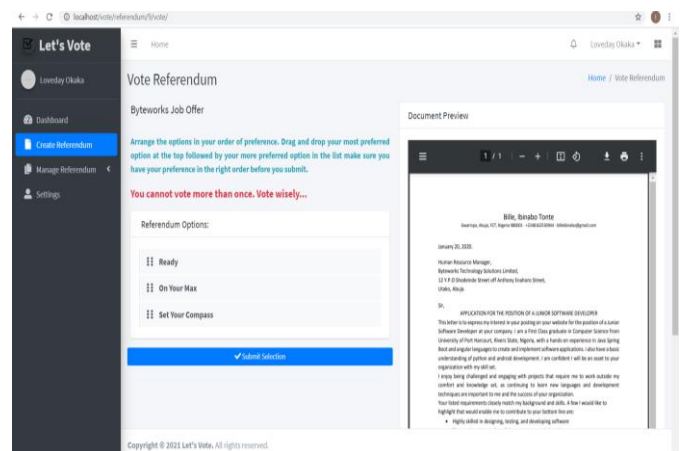

Figure 7. View of voting page

Figure 7 shows a screenshot of the voting page. On this page, users can cast their vote by ordering the available options from the most preferred to the least preferred.

5.2 Database Specification

The database used in the design of this work is MySQL. A sample database was created for the purpose of system testing and demonstration. It has five (5) tables namely:

- I. Portal User
- II. Referendum
- III. Referendum Notification
- IV. Vote
- V. Vote Notification

The specifications of some of the tables are shown below.

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
1	id	int(16)			No	None		AUTO_INCREMENT	Change Drop More
2	first_name	varchar(80)	utf8mb4_general_ci		No	None			Change Drop More
3	last_name	varchar(80)	utf8mb4_general_ci		No	None			Change Drop More
4	gender	varchar(10)	utf8mb4_general_ci		No	None			Change Drop More
5	email	varchar(100)	utf8mb4_general_ci		No	None			Change Drop More
6	phone_number	varchar(18)	utf8mb4_general_ci		No	None			Change Drop More
7	password	varchar(255)	utf8mb4_general_ci		No	None			Change Drop More
8	nin	varchar(20)	utf8mb4_general_ci		No	None			Change Drop More
9	created	datetime			No	None			Change Drop More
10	verification_link	varchar(255)	utf8mb4_general_ci		No	None			Change Drop More
11	verified	tinyint(2)			No	0			Change Drop More
12	role	varchar(10)	utf8mb4_general_ci		No	None			Change Drop More

Check all   With selected: Browse   Change   Drop   Primary   Unique   Index   Fulltext   Add to central

Figure 8. Database representation of Portal User table and Vote table

6. Conclusion and Future Scope

The implementation of a referendum system using preferential voting can play a critical role in improving the democratic process and facilitating policymaking in Nigeria. The use of this system can provide an avenue for the government to better understand the will of the people and ensure that policies are reflective of their needs and desires. The system is user-friendly, transparent, and offers clear results using appropriate charts, making it a reliable tool for policymakers and the public.

Looking to the future, there is significant potential that the adoption of this system can contribute to Nigeria's socio-economic development and growth. In addition to providing a more efficient way to optimize the policy formulation process and promote inclusive governance, it can also help to reduce the over bloated cost of the legislative arm and increase citizen participation. It is recommended that further research is conducted to assess the feasibility of implementing the system on a national scale and to identify any potential complications that may come up.

Furthermore, it is essential that the government consider the digital divide and ensure that the system is accessible to all citizens, regardless of their level of technological expertise or geographic location. This can be achieved through the encouragement of information technology literacy programs and the provision of necessary resources and support to ensure that all citizens have access to the system.

In conclusion, the proposed national referendum system using preferential voting has the potential to significantly enhance the democratic process in Nigeria and provide a platform for Nigerians to actively participate in policymaking. As such, it is recommended that the government considers the adoption of this system as a means of promoting transparency, inclusivity, and effective governance.

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