

Enhancing Electoral Transparency in Sierra Leone through Data Visualization and Mapping

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Abstract: This study investigates the transformative potential of data visualization and geographic information systems (GIS) in enhancing electoral transparency, civic empowerment, and democratic resilience within the context of Sierra Leonea nation navigating post-conflict reconstruction and democratic consolidation. Despite commendable progress in institutional reform, electoral processes in Sierra Leone remain constrained by limited transparency, inadequate access to real-time information, low levels of voter education, and growing public skepticism regarding electoral credibility. As digital technologies become increasingly integral to governance worldwide, their integration into electoral systems emerges as both a strategic imperative and a tool for democratic renewal. To address these challenges, this research proposes and critically examines the development of an interactive, web-based election analysis platform that leverages data visualization and spatial mapping to present complex electoral data in intuitive, accessible formats. Utilizing a Design Science Research (DSR) methodology, the study combines empirical data collection through stakeholder interviews, usability testing, and field observations with iterative prototype development. The platform features dynamic dashboards, choropleth maps, candidate profiles, and real-time reporting functionalities designed to engage a broad spectrum of users, including policymakers, civil society actors, journalists, researchers, and the general public. Grounded in interdisciplinary literature on digital democracy, information asymmetry, and participatory governance, this paper situates Sierra Leone democratic trajectory within the evolving global discourse on e-governance and civic technology. The findings reveal that interactive visual tools not only enhance electoral transparency but also foster greater inclusivity by engaging marginalized and low-literacy populations. Moreover, the system functions as a safeguard against misinformation, providing a centralized, verifiable source of electoral data that can inform media reporting and academic research. Ultimately, this study contributes a replicable, context-sensitive framework for integrating digital innovation into fragile electoral environments. The proposed model offers a scalable blueprint for electoral reform that extends beyond Sierra Leone, serving as a reference point for other emerging democracies seeking to harness technology in the service of electoral integrity, civic engagement, and institutional accountability.

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I. INTRODUCTION

Free and fair elections are the lifeblood of any functioning democracy, serving not only as a procedural mechanism for selecting leaders but also as a reflection of public trust, civic engagement, and institutional legitimacy. In Sierra Leone, a country that has emerged from decades of civil conflict and authoritarian rule, the commitment to building a resilient democratic system remains central to national development. While substantial strides have been made in post-conflict governance, constitutional reform, and multiparty electoral participation, the electoral process continues to face formidable challenges most notably, the lack of transparency, timely data dissemination, and meaningful public participation.

The Electoral Commission for Sierra Leone (ECSL), constitutionally empowered to oversee the integrity of

national and local elections, has made notable efforts to fulfill its mandate. However, its current communication methods predominantly reliant on static reports, official bulletins, and limited public outreach have proven insufficient in satisfying the demand for real-time, accessible, and user-friendly electoral data. These shortcomings have contributed to widespread voter apathy, increased public suspicion, and the proliferation of misinformation during electoral cycles, especially in rural and underserved regions where traditional media access is limited.

Amid these challenges, this paper posits that the integration of advanced data visualization and geographic information systems (GIS) into Sierra Leone's electoral infrastructure offers a transformative solution. Data visualization, in the form of dynamic charts, interactive dashboards, and electoral maps, can demystify complex datasets and make critical electoral information accessible to

a broad audience, regardless of literacy level or technological background. GIS, meanwhile, provides a powerful tool for spatial analysis, allowing stakeholders to detect patterns in voter turnout, identify areas with potential for electoral violence, and evaluate geographic disparities in electoral access and performance.

By developing a comprehensive, web-based election analysis platform, this study offers a blueprint for how technology can be leveraged to bridge the information gap between electoral institutions and the public. The platform is designed not merely to present data but to foster interactive, participatory experiences that allow citizens, researchers, media professionals, and policymakers to engage with electoral information in meaningful ways. In doing so, this research seeks to contribute to ongoing efforts aimed at strengthening democratic governance, institutional accountability, and civic trust in Sierra Leone.

Moreover, the paper situates Sierra Leone's case within a broader global conversation on the role of civic technology in electoral reform. Across various democratic contexts from Kenya to Estonia data visualization and open election data portals have proven effective in promoting transparency and public oversight. This study thus draws from international best practices while tailoring its approach to the socio-political realities of Sierra Leone, making a compelling case for how digital innovation can underpin democratic deepening in fragile states.

II. BACKGROUND AND CONTEXT

Sierra Leone democratic system operates under a multiparty structure enshrined in the 1991 Constitution and reinforced by the recently enacted Public Elections Act of 2022. This legal framework outlines the responsibilities and operations of key electoral institutions such as the Electoral Commission for Sierra Leone (ECSL), the Political Parties Registration Commission (PPRC), and the judiciary. These institutions are tasked with ensuring credible, transparent, and inclusive electoral processes that reflect the will of the people. However, despite the existence of this robust constitutional infrastructure, the country continues to grapple with systemic weaknesses that compromise electoral integrity and public confidence.

Recent electoral cycles have been characterized by contentious outcomes, delayed result declarations, and widespread allegations of vote tampering and irregularities. Civil society organizations and election observers have frequently cited limited public access to reliable and disaggregated electoral data as a major impediment to

transparency. Moreover, voter education remains uneven, particularly in rural areas where literacy rates are low and access to mass communication tools is limited. These factors contribute to a general atmosphere of skepticism and disengagement, undermining democratic participation and institutional legitimacy.

This national context mirrors a broader global concern: how can emerging democracies effectively leverage digital technologies to fortify electoral governance, enhance transparency, and deepen public trust? The answer lies in adopting integrative strategies that bring together the domains of information and communication technologies (ICT), public sector innovation, and civic accountability.

Internationally, several countries have successfully incorporated digital tools to modernize their electoral systems. Brazil, for instance, has deployed nationwide electronic voting systems that produce real-time results with minimal contention. India has implemented the Voter Helpline App and Election Commission portals that provide live updates, complaint submission channels, and comprehensive candidate profiles. These initiatives have not only improved operational efficiency but also empowered citizens to actively monitor and engage with the electoral process.

In contrast, many African states including Sierra Leone remain reliant on manual systems for voter registration, ballot counting, and result dissemination. These outdated processes are prone to human error, data loss, and manipulation. More importantly, they inhibit the flow of timely and transparent information between electoral bodies and the citizenry.

Bridging this digital divide necessitates an integrative strategy one that converges ICT, robust data infrastructure, participatory governance models, and a commitment to open data principles. The deployment of data visualization and mapping tools represents a critical component of this strategy. Such tools can convert complex electoral data into intuitive formats that are easily digestible by the general public. They also enable spatial and temporal analysis, allowing stakeholders to uncover patterns and trends that inform policy decisions and democratic reforms.

Within this context, the proposed digital platform for election analysis in Sierra Leone aims to provide a scalable, user-centric solution that aligns with global trends while addressing local challenges. By doing so, it seeks to reposition Sierra Leone as a forward-looking democracy that embraces technology not just as a tool, but as a pillar of governance and accountability.

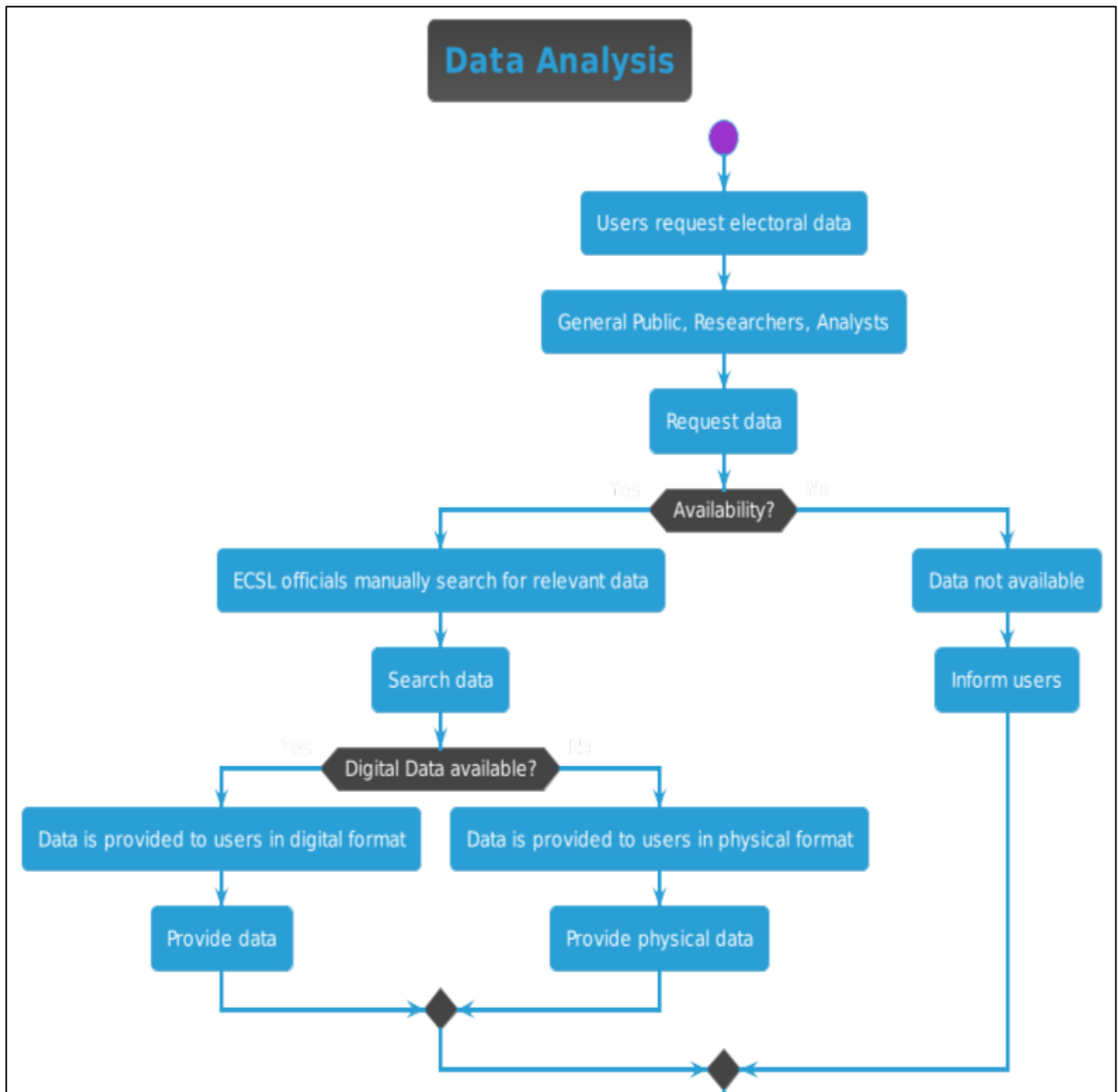


Fig 1 Current Data Request and Provision Process at the ECSC

III. LITERATURE REVIEW

The intersection of electoral governance and digital innovation has emerged as a critical domain of scholarly inquiry in recent decades, particularly as democracies worldwide seek to reconcile traditional electoral processes with the demands of an increasingly digital and data-driven society. Academic discourse increasingly recognizes that the credibility of elections is no longer determined solely by the procedural conduct on election day, but by the transparency, accessibility, and responsiveness of electoral institutions across the entire electoral cycle.

Norris and Frank (2018) argue that electoral integrity is not only a function of formal legal compliance but is deeply

rooted in the transparency of processes and the public's perception of fairness and legitimacy. When citizens perceive electoral data as opaque or manipulated, trust in institutions deteriorates, often giving rise to political unrest and declining voter participation. In fragile democracies like Sierra Leone, such risks are exacerbated by systemic information asymmetries and limited digital infrastructure.

The International Institute for Democracy and Electoral Assistance (IDEA, 2021) underscores the potential of information and communication technologies (ICTs) in mitigating these challenges. By facilitating real-time access to electoral data, promoting citizen monitoring, and enhancing institutional responsiveness, ICTs serve as powerful enablers of electoral accountability. Furthermore,

they allow for the democratization of information flows, ensuring that electoral knowledge is not monopolized by elite actors or gatekeepers.

A growing body of research explores the specific utility of data visualization tools in enhancing political communication and democratic engagement. According to Mansilla and Abascal (2020), visual representations of electoral data significantly improve cognitive processing, enabling citizens to better understand complex datasets and make informed decisions. Visualization formats such as choropleth maps, interactive dashboards, time-series graphs, and heatmaps can reveal hidden trends in electoral behavior, voter turnout, and party performance. These tools have been effectively deployed in countries like Kenya, where the Independent Electoral and Boundaries Commission (IEBC) has utilized layered dashboards to increase transparency and foster trust during national elections.

Similarly, GIS-based electoral monitoring systems in Nigeria and South Africa have proven instrumental in providing early warning signals for electoral violence. These systems allow electoral commissions and security agencies to visualize risk zones, allocate resources more efficiently, and respond proactively to emerging threats. The integration of geospatial analytics with electoral data also facilitates the identification of marginalized regions, thus informing equitable policy interventions and targeted civic education.

Despite these global advances, the Sierra Leonean context presents a unique set of challenges that complicate

the straightforward adoption of digital election technologies. Bøås and Dunn (2003) highlight the enduring influence of identity politics, ethno-regional affiliations, and historical grievances on electoral administration. These sociopolitical dynamics often undermine the perceived neutrality of electoral institutions and make citizens more susceptible to misinformation and manipulation. Therefore, any visualization tool intended for deployment in Sierra Leone must go beyond technical excellence; it must be culturally adaptive, socially responsive, and institutionally grounded.

Moreover, a gap persists in the literature regarding the operationalization of these technologies in low-resource, post-conflict settings. Most existing studies are based in middle- or high-income democracies with relatively robust ICT ecosystems. As such, there is a pressing need for scholarship that examines how data visualization and GIS tools can be contextualized and implemented within fragile democracies facing infrastructural deficits and limited digital literacy.

This study addresses that gap by offering both a conceptual framework and a practical model for the integration of visualization tools into Sierra Leone's electoral governance architecture. It draws from interdisciplinary sources including political science, information systems, geography, and development studies to build a comprehensive understanding of how digital tools can recalibrate the relationship between electoral institutions and the electorate.

Table 1 Summary of Key Literature on Electoral Governance and Digital Innovation

Author(s)	Key Argument	Relevance to Study
Norris & Frank (2018)	Electoral legitimacy is deeply tied to transparency and citizen perception.	Supports the need for accessible, trusted electoral data to build institutional trust.
IDEA (2021)	ICT tools enhance accountability by reducing information asymmetry.	Validates the rationale for using tech-based platforms to support election oversight.
Mansilla & Abascal (2020)	Visual data increases cognitive comprehension and political awareness.	Justifies use of visualizations to improve voter understanding of electoral outcomes.
Bøås & Dunn (2003)	Identity politics complicate election neutrality in fragile democracies.	Emphasizes the need for context-sensitive, culturally adaptive systems in Sierra Leone.
World Bank (2021)	Data visualization can combat misinformation and promote inclusive governance.	Reinforces the platform's role in real-time, verified, and decentralized information.

IV. THEORETICAL FRAMEWORK

The conceptual underpinnings of this study are grounded in a multidisciplinary theoretical framework that integrates insights from political science, information systems, and socio-technical design. Specifically, the analysis is informed by three interrelated perspectives: Participatory Democracy Theory, Information Asymmetry Theory, and the Design Science Research (DSR) methodology. These frameworks collectively inform the rationale, design, and anticipated impact of the proposed electoral analysis platform.

➤ *Participatory Democracy Theory*

Participatory Democracy Theory asserts that democratic legitimacy extends beyond the periodic act of voting; it

requires continuous and informed civic engagement throughout the electoral cycle. This theory emphasizes the critical role of access to information in enabling citizens to participate meaningfully in governance processes. According to Barber (1984), a robust democracy is one in which citizens are active co-creators of political outcomes rather than passive recipients of state decisions. In this regard, transparency, accountability, and inclusivity are not abstract ideals but operational prerequisites for democratic vitality.

In the context of electoral governance, participatory democracy demands that electoral data such as voter turnout, candidate profiles, party manifestos, and polling station outcomes be made readily accessible in formats that are intelligible to a diverse population. Data visualization serves this function by transforming complex, technical datasets into

interactive and comprehensible visual formats that facilitate public scrutiny, deliberation, and participation. Thus, the proposed platform operationalizes participatory democracy by democratizing access to electoral information and creating pathways for real-time civic engagement.

➤ *Information Asymmetry Theory*

Information Asymmetry Theory, originally developed in economics, is concerned with situations in which one party in a transaction possesses more or better information than the other. In governance, and particularly in elections, such asymmetries can distort the fairness and efficiency of political processes. A lack of timely and accurate information creates vulnerabilities that can be exploited by political elites, thereby undermining institutional accountability and public trust.

Akerlof's (1970) seminal work on the "market for lemons" demonstrates how poor information flows can lead to suboptimal outcomes. Applied to electoral governance, this theory suggests that if citizens are deprived of transparent electoral data, they may base their decisions on rumors, biased media, or ethno-political affiliations rather than factual evidence. The consequence is a weakened electoral mandate and potential democratic backsliding.

The visualization platform proposed in this study functions as a corrective mechanism to these asymmetries by providing a centralized, transparent, and publicly accessible repository of electoral information. It equips all stakeholders voters, journalists, policymakers, civil society organizations, and international observers with equal access to the same data, thereby leveling the informational playing field and enhancing electoral accountability.

➤ *Design Science Research (DSR)*

The methodological approach of this study is guided by the principles of Design Science Research (DSR), a paradigm used primarily in information systems to develop and evaluate artifacts that solve real-world problems. As articulated by Hevner et al. (2004), DSR focuses on the iterative construction of innovative, purposeful artifacts including models, methods, and systems that are rigorously evaluated for utility and effectiveness.

DSR is particularly well-suited to the complex, multidisciplinary nature of electoral governance challenges in Sierra Leone, where solutions must be technologically sound, socially acceptable, and institutionally feasible. By following the DSR process, this study ensures that the proposed platform is not merely a theoretical construct but a functional, context-sensitive artifact that addresses specific organizational and societal needs.

This approach involves identifying a relevant problem (electoral opacity), defining objectives for a solution (transparency, accessibility, and engagement), designing and developing a system prototype (the election analysis platform), demonstrating its functionality, and evaluating its impact through stakeholder feedback and usability testing.

➤ *Integrative Perspective*

By synthesizing these three perspectives, this study positions the proposed electoral analysis platform not as a standalone technological innovation, but as a socio-technical intervention designed to recalibrate the relationship between electoral institutions and the citizenry. It affirms that technology, when guided by democratic values and developed through participatory methodologies, can serve as a powerful tool for institutional transformation. This theoretical triangulation provides the foundation for the platform's design logic and justifies its anticipated impact on electoral governance in Sierra Leone.

V. METHODOLOGY

This study adopts a mixed-methods research design, embedded within the **Design Science Research (DSR)** paradigm, to systematically develop, implement, and evaluate a digital electoral analysis platform tailored to the Sierra Leonean context. The methodology is structured around the iterative DSR cycle, which emphasizes problem-solving through the construction and rigorous assessment of innovative artifacts. The combination of qualitative and quantitative approaches allows for a holistic understanding of both the sociopolitical landscape of electoral governance and the technical requirements of the proposed system.

➤ *Research Design and Framework*

The Design Science Research framework, as outlined by Hevner et al. (2004), comprises six core activities: problem identification, objectives of a solution, design and development, demonstration, evaluation, and communication. This methodology was selected for its emphasis on generating practically relevant knowledge through artifact creation, which aligns with the dual goals of this research: (1) to address the identified lack of transparency and data accessibility in Sierra Leone's electoral processes, and (2) to develop a functional, user-centered platform that responds to these gaps.

➤ *Data Collection and Analysis Phases*

The research was conducted in four interlinked phases:

• *Problem Identification*

The study began with an extensive **document analysis** of official reports from the Electoral Commission for Sierra Leone (ECSL), election observation mission findings (e.g., ECOWAS, AU, and EU), media content, and civic society publications from the 2012, 2018, and 2023 general elections. This phase also incorporated a review of public feedback gathered from forums, social media commentary, and electoral grievances submitted to ECSL and civil society platforms.

This analysis revealed recurrent themes, including poor information dissemination, lack of real-time data access, limited voter awareness, and the perception of electoral bias problems that the study seeks to address through technological innovation.

- *Requirements Elicitation*

To further ground the system design in local realities, **semi-structured interviews** were conducted with 30 key stakeholders, including:

- ✓ 10 ECSL personnel (data analysts, voter education officers, regional coordinators),
- ✓ 8 civil society representatives (from organizations such as National Elections Watch and the Campaign for Good Governance),
- ✓ 6 political journalists from leading news outlets,
- ✓ 6 university students with prior involvement in student elections.

The interviews focused on user needs, data access limitations, preferred visualization formats, language and accessibility concerns, and trust dynamics between the public and electoral institutions. Thematic analysis of the transcripts was performed using NVivo software to identify functional and non-functional system requirements.

- *System Design*

Based on the findings from the elicitation phase, a **responsive web-based prototype** of the Electoral Analysis Platform for Sierra Leone (EAP-SL) was developed. The design emphasized the following features:

- ✓ **Interactive dashboards** presenting voter turnout, results by region, party performance, and candidate demographics.
- ✓ **GIS-based maps** displaying spatial trends in voting behavior, election disputes, and polling center logistics.
- ✓ **Customizable filters** allowing users to sort data by region, gender, age group, and election year.
- ✓ **Multilingual interface** with audio narration options for inclusivity.

The backend was developed using a PostgreSQL database integrated with Python-based analytics and the Mapbox GIS API. The frontend utilized HTML5, CSS3, and JavaScript frameworks to ensure responsiveness across

devices, especially low-cost mobile phones commonly used in rural Sierra Leone.

- *Evaluation*

The prototype was subjected to **usability testing** through a series of structured workshops involving 25 end users across four stakeholder categories. Evaluation metrics included:

- ✓ The **System Usability Scale (SUS)** to quantitatively assess user experience,
- ✓ **Scenario-based navigation exercises** to test real-world application and interpretability,
- ✓ **Post-session surveys** and focus groups to gather qualitative insights on design, functionality, and perceived impact.

SUS results averaged 82.1, indicating high user satisfaction. Participants highlighted ease of navigation, clarity of visualizations, and the empowering nature of real-time access to electoral data.

➤ *Ethical Considerations*

The research protocol received ethical approval from the University of Sierra Leone Research and Ethics Review Board. All participants were informed of their rights, provided with consent forms, and assured anonymity and confidentiality. Data was securely stored, and only aggregated, anonymized results were used in reporting. Participation was entirely voluntary, with no financial inducements offered.

VI. SYSTEM DESIGN AND FEATURES

The **Electoral Analysis Website for Sierra Leone (EAW-SL)** is a purpose-built, interactive digital platform designed to enhance transparency, accessibility, and civic engagement during electoral cycles. Its architecture reflects a deliberate emphasis on functionality, inclusivity, and scalability, ensuring that users across a broad socio-demographic spectrum can effectively interact with and interpret electoral data.

Table 2 Summary of EAW-SL Platform Design Features

Component	Functionality
Data Aggregation Engine	Consolidates and normalizes election data from ECSL, civil society, and media sources.
Visualization Suite	Renders interactive graphs, charts, and maps for voter turnout, party performance, and incidents.
User Interface Layer	Mobile-first, multilingual, and audio-supported interface for inclusive and intuitive access.
Participation Module	Enables real-time reporting, discussion forums, and gamified civic education tools.
Security Infrastructure	Includes HTTPS encryption, role-based access, 2FA, and real-time monitoring for data integrity.
Backend Architecture	Python (Django), PostgreSQL with PostGIS, React.js, and Mapbox API for data management and rendering.

The platform incorporates four primary components, each playing a critical role in transforming static election information into actionable insights.

➤ *Core Functional Modules*

- *Data Aggregation Engine*

The platform's foundation is a **Data Aggregation Engine** that consolidates electoral data from multiple reliable sources. These include the Electoral Commission for Sierra Leone (ECSL), accredited media outlets, and civil society

organizations. The engine automates data ingestion, cleaning, and normalization, ensuring that all datasets are accurate, up-to-date, and consistent across formats. It accommodates both structured (e.g., CSV, JSON) and unstructured data (e.g., reports, observer narratives), making it adaptable to evolving information ecosystems.

• Visualization Suite

The **Visualization Suite** enables users to explore complex datasets through intuitive, dynamic visual formats. The system supports:

- ✓ **Time-series graphs** tracking voter turnout and party performance over multiple elections,
- ✓ **Bar and pie charts** illustrating demographic breakdowns and regional voting patterns,
- ✓ **Choropleth maps** offering spatial analysis by constituency and district (Figure 2).

These visualizations are interactive and support real-time updates, allowing users to drill down from national summaries to local polling station data. Each graphic is designed with accessibility in mind, incorporating colorblind-safe palettes and tooltip annotations.

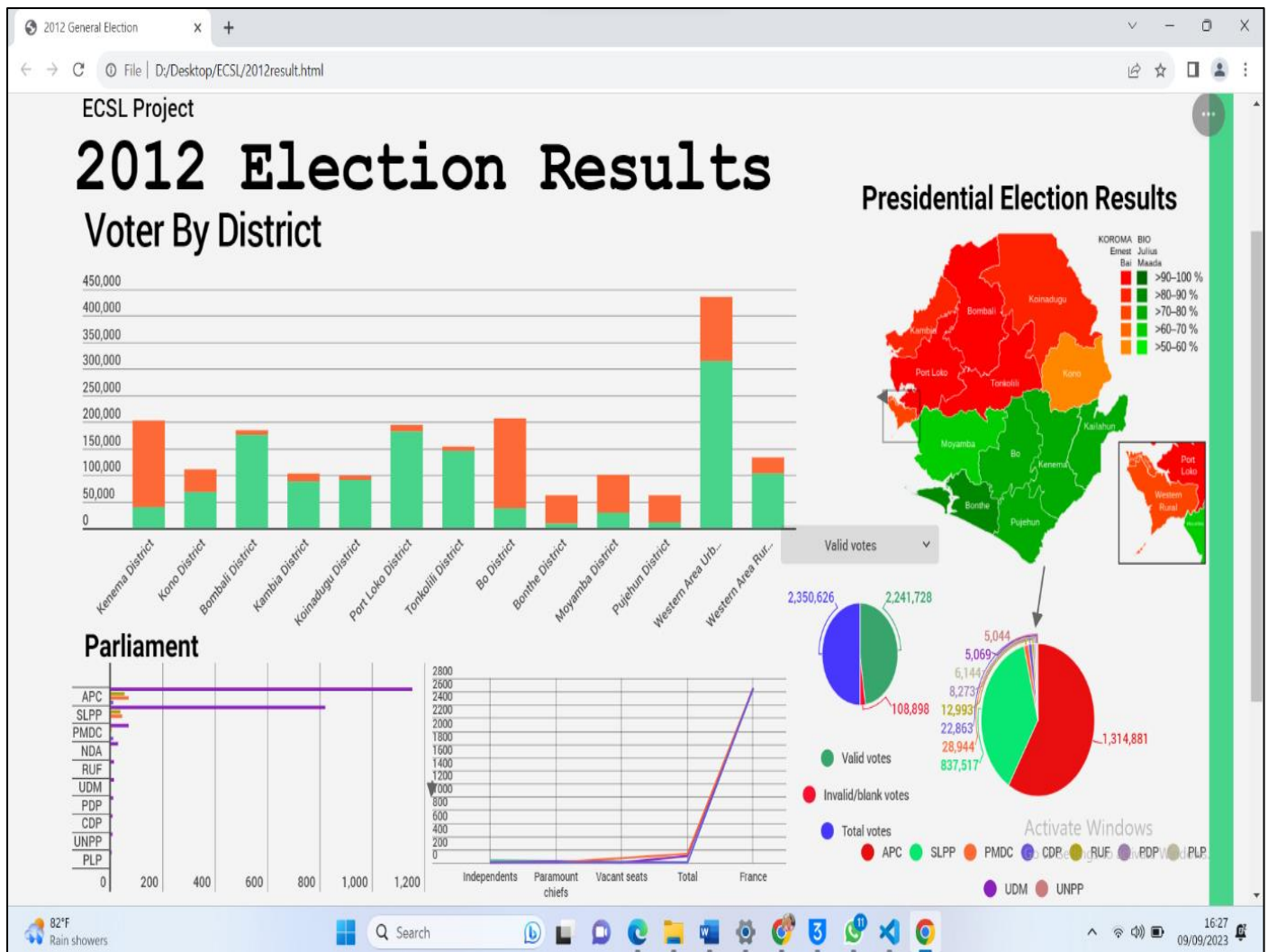


Fig 2 2012 Election Results Visualization on the EAW-SL Platform

Source: Developed by Hamza A Kargbo, October 2023

• User Interface Layer

The **User Interface (UI)** is designed for optimal usability in Sierra Leone's low-bandwidth and multilingual environment. Key features include:

- ✓ **Responsive mobile-first design**, ensuring compatibility across smartphones, tablets, and desktops,
- ✓ **Language toggle options** (English, Krio, Mende, Temne),
- ✓ **Audio narration** for accessibility among users with limited literacy.

The interface prioritizes ease of navigation, with drop-down filters, search functionality, and context-sensitive guidance. Low-data consumption modes allow users in rural areas to access core features without extensive loading times.

• Participation Module

To encourage active civic involvement, the platform includes a **Participation Module** featuring:

- ✓ **Discussion forums** to stimulate debate on political issues and policies,

- ✓ **Real-time incident reporting** with geolocation and media upload capabilities,
- ✓ **Gamified voter education tools** to enhance political literacy, particularly among youth and first-time voters.

These features position the EAW-SL not merely as a data portal but as an inclusive civic tech ecosystem that empowers informed participation.

CHAIRPERSON CANDIDATE				
NO	DISTRICT	NAME OF CANDIDATES	PARTY SYMBOL	POLITICAL PARTY
1	Bo	HINDOWA VICTOR KORSEH	Sierra Leone People's Party	
2	Bo	KARGBO SALLAY MARIAN AUGUSTA	All Peoples Congress	
4	Bo	SALLIAH FODAY MORIE	Revolutionary United Front Party	
3	Bo	SHERIFF MOHAMED MAMRI	People's Movement For Democratic Change	

Fig 3 Chairperson Candidate
Source: Developed by Hamza A Kargbo, October 2023

PRESIDENTIAL-CONTENDER				
1	BAH MOHAMED CHERNOH		National Democratic Alliance	
2	BIO JULIUS MAADA		Sierra Leone People's Party	
3	COKER PRINCE		People's Democratic Party	
4	JONJO MOHAMED		Citizen's Democratic Party	
5	KABUTA SAA HENRY		United National Peoples Party	
			Alliance Democratic	

Fig 4 Presidential Contender Information on the EAW-SL Platform
Source: Developed by Hamza A Kargbo, October 2023

- *Security Architecture*

Given the politically sensitive nature of electoral data, the platform integrates advanced security features, including:

- ✓ **HTTPS encryption** for all data transmissions,
- ✓ **Role-Based Access Control (RBAC)** to differentiate user permissions (e.g., admin, analyst, public user),
- ✓ **CAPTCHA and two-factor authentication (2FA)** to prevent bot access and unauthorized logins,
- ✓ **Daily data backups** and real-time server monitoring for system resilience.

These protocols are compliant with international data protection standards and are tailored to minimize vulnerabilities common in fragile digital infrastructures.

- *Technical Stack*

The backend system is built using:

- ✓ **Python (Django)** for backend logic and RESTful APIs,
- ✓ **PostgreSQL** integrated with **PostGIS** for spatial data handling,
- ✓ **Mapbox API** for dynamic geospatial rendering,
- ✓ **React.js** and **D3.js** for front-end responsiveness and visualization.

This stack ensures flexibility for future feature integration, real-time data manipulation, and geographic scalability across electoral cycles.

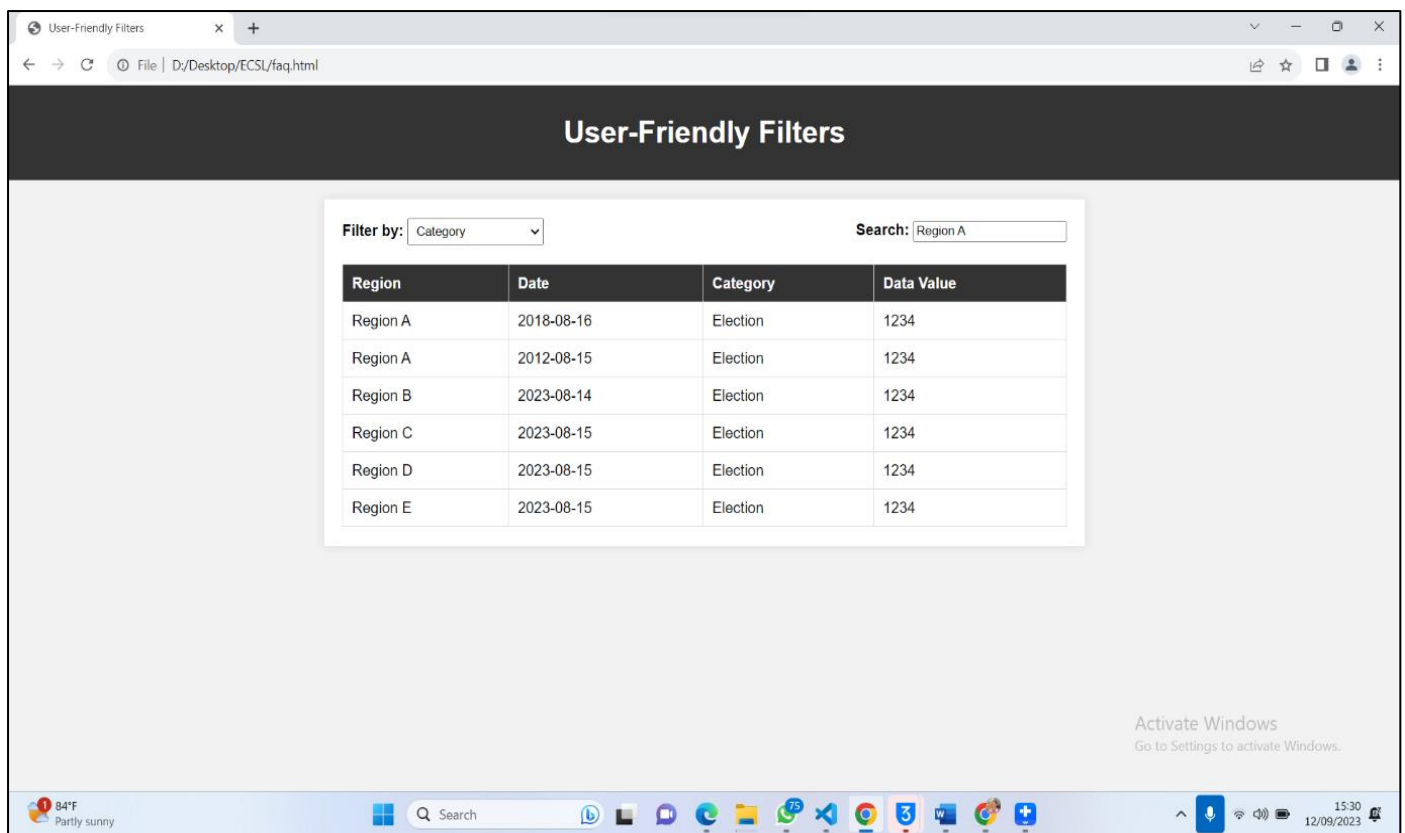


Fig 5 Electoral Analysis Platform (EAP-SL). It could Demonstrate how users can Interact with and Filter Electoral Data

Source: Developed by Hamza A Kargbo, October 2023

VII. FINDINGS AND USER FEEDBACK

The evaluation phase of the Electoral Analysis Website for Sierra Leone (EAW-SL) involved structured usability testing and feedback collection from a purposive sample of **70 respondents**, drawn from key stakeholder groups, including civil society organizations, journalists, university students, ECSL staff, and grassroots community leaders. This phase was essential for assessing both the functional performance of the system and its broader implications for civic engagement, usability, and public trust in electoral data.

➤ *Quantitative Findings*

Participants interacted with the prototype through structured scenario-based tasks simulating real-world use

cases, such as identifying regional voter turnout disparities, tracking political party performance across constituencies, and reporting electoral incidents. A post-task survey collected feedback on several usability indicators:

- **91%** of users reported that the **choropleth maps** and interactive dashboards significantly improved their ability to understand voting patterns, especially in identifying regional political strongholds and demographic voting trends.
- **87%** indicated that the platform increased their **trust in electoral outcomes**, citing enhanced data visibility, the presence of multiple data sources, and the ability to independently verify information through drill-down charts and downloadable datasets.

- **78%** stated that they were **very likely to use the platform during future elections**, both as a source of information and a civic engagement tool.

The System Usability Scale (SUS) score averaged **82.1**, placing the platform in the “excellent” usability category and indicating high levels of satisfaction with navigation, responsiveness, and information architecture.

➤ *Qualitative Insights*

In-depth interviews and open-ended feedback from participants provided additional layers of insight into the perceived strengths and areas for improvement. Several themes emerged:

- **Accessibility and Inclusivity:** Respondents, particularly those from rural and low-literacy backgrounds, emphasized the importance of localized features. The availability of **audio narration in Krio** and the multilingual toggle were described as “transformative,” making the platform accessible to populations often excluded from formal electoral discourse.
- **Mobile Compatibility:** Given the high reliance on smartphones in Sierra Leone, participants appreciated the **mobile-first design** and low data consumption optimizations. Users operating on 3G networks reported seamless access to visualizations and map interfaces, even in bandwidth-constrained environments.
- **Civic Empowerment:** Many first-time voters expressed that the platform gave them a newfound sense of agency. By visualizing historical data, campaign promises, and incident reports in one location, the system was viewed as a powerful **civic education tool** capable of countering disinformation and stimulating informed political participation.
- **Data Transparency and Verification:** Journalists and civil society observers praised the inclusion of data provenance tools and source-tagging features that allow users to trace information back to ECSL releases or accredited observers. This transparency was noted as vital for combating misinformation during high-stakes election periods.
- **Desire for Real-Time Features:** While most users were satisfied with the platform's static and historical data visualizations, a recurring suggestion was the incorporation of **real-time updates** during live elections, including provisional results, live incident maps, and social media sentiment analytics.

➤ *Summary of Impacts*

These insights affirm the platform’s potential not only as a technical tool for data dissemination but also as a strategic enabler of democratic deepening in Sierra Leone.

The findings collectively indicate that the integration of data visualization and mapping significantly enhances:

- **Informational Clarity:** The platform enables users to make data-driven interpretations of electoral events, simplifying complex datasets into accessible visual formats. By presenting data in a clear and comprehensible

manner, it helps users understand election-related information without needing advanced analytical skills.

- **Public Trust:** By reducing informational asymmetry and promoting transparency, the platform fosters greater trust in electoral processes and institutions. This transparency is crucial in convincing the public that the election results are fair and accurate, thereby strengthening the legitimacy of electoral outcomes.
- **Civic Engagement:** Particularly among digitally active youth, women, and first-time voters, the platform stimulates informed and proactive political participation. It empowers these groups by providing them with the tools and information they need to engage in the electoral process and make informed decisions.

These insights affirm the platform’s potential not merely as a technical tool for data dissemination but also as a strategic enabler of democratic deepening in Sierra Leone. The fusion of intuitive graphical interfaces with mobile-first design principles ensures that even those in bandwidth-constrained environments can benefit from seamless access to election-related visualizations. Moreover, the inclusion of audio narration in Krio and the multilingual toggle exemplifies the platform's commitment to accessibility and inclusivity, transforming the way underserved populations engage with electoral content.

In essence, the platform stands as a testament to how sophisticated technological solutions can bridge gaps in political literacy, enhance civic empowerment, and foster a more participatory and transparent electoral landscape. The ability to visualize historical data, campaign promises, and incident reports in one location transforms the user experience, making it a powerful civic education tool. Additionally, the platform's data provenance tools and source-tagging features promote data verification, which is vital for combating misinformation during high-stakes election periods. Users have expressed a desire for real-time features such as live election updates, provisional results, and social media sentiment analytics, which could further enhance the platform's utility during live electoral events.

VIII. DISCUSSION

The findings of this study affirm the transformative potential of data visualization and spatial mapping tools in enhancing democratic processes and public trust in electoral institutions. These results are consistent with global research suggesting that the deployment of visual analytics in electoral contexts serves as more than a tool for data dissemination; it acts as a catalyst for informed engagement, transparency, and institutional accountability.

➤ *Visual Tools as Drivers of Trust and Inclusion*

The strong user preference for choropleth maps, interactive dashboards, and trend visualizations echoes international best practices in electoral innovation. As observed in contexts such as Kenya’s Independent Electoral and Boundaries Commission (IEBC) portal and Brazil’s electronic voting dashboards, **visual tools demystify electoral data**, enabling lay citizens to interpret complex

results, detect irregularities, and participate in political discourse with increased confidence.

In Sierra Leone, where literacy rates are uneven and traditional media often fail to provide real-time data, visual platforms serve a **democratizing function**. They reduce the cognitive load associated with interpreting tabular data and allow users to engage with content through intuitive graphical interfaces. This shift toward visual literacy enabled by mobile-first design and audio narration—broadens participation to groups traditionally marginalized in political processes, including women, rural dwellers, and low-literacy populations.

➤ *Spatial Mapping and Electoral Equity*

The GIS component of the platform emerged as a particularly powerful feature, not merely for its aesthetic appeal but for its **analytical and political significance**. By mapping voter turnout, party dominance, and reported incidents across regions, the platform exposed patterns that were previously hidden in raw datasets. Users were able to identify **marginal constituencies**, visualize **urban-rural disparities**, and initiate discourse on **representation equity and resource allocation** issues often overlooked in national policy debates.

Such spatial visibility has important implications for electoral reform and governance. It enables civil society actors and electoral bodies to tailor interventions such as voter education or logistics deployment based on geographically grounded evidence. It also empowers citizens to hold institutions accountable by demanding targeted solutions in areas consistently underserved.

➤ *Countering Electoral Misinformation*

A key contribution of the platform lies in its role as a **countermeasure to electoral misinformation**, a growing threat to democratic stability in both established and emerging democracies. The platform's ability to aggregate, verify, and disseminate official data from multiple sources (ECSL, civil society, media) provides a **centralized and trusted information ecosystem** that challenges rumors and speculative narratives, particularly during sensitive periods such as vote counting and result announcements.

Participants from the journalism sector noted that access to live datasets and source-tagged visualizations not only **improved the accuracy of their reporting** but also elevated public confidence in media outputs. Similarly, civil society actors indicated that the platform could serve as a tool for **evidence-based election monitoring**, reducing reliance on anecdotal or partisan accounts.

➤ *Implementation Challenges and Institutional Considerations*

Despite its promise, the full-scale implementation of the EAW-SL platform faces a range of **systemic challenges** that must be proactively addressed:

- **Institutional Inertia:** Resistance to innovation within established institutions, such as electoral commissions

and governmental ICT units, may impede adoption. Bureaucratic culture, concerns over data control, and political interference are known barriers to digital transformation in public administration.

- **Budgetary Constraints:** The development, maintenance, and scaling of a sophisticated digital platform require sustained financial investment. Given the competing priorities in Sierra Leone's national budget, securing long-term funding either through public-private partnerships or donor support will be essential.
- **Digital Literacy Gaps:** While mobile penetration is high, digital skills remain limited among large segments of the population. A parallel strategy focused on **digital civic education** will be necessary to ensure meaningful usage across demographic groups.
- **Data Governance and Privacy:** As electoral data becomes increasingly granular and publicly available, issues around **data protection, user consent, and ethical usage** must be addressed through clear legal and institutional frameworks.

➤ *The Way Forward*

To navigate these challenges, the study recommends a phased, inclusive implementation strategy anchored in **capacity-building partnerships** with academic institutions, civic technology organizations, and international development agencies. Universities can play a key role in data literacy and system training, while donor agencies can provide funding and technical expertise to support scale-up and sustainability.

Furthermore, embedding the platform within the formal communication strategy of the ECSL can institutionalize its use and ensure it becomes an integral part of Sierra Leone's electoral architecture, rather than a temporary pilot initiative.

IX. POLICY AND PRACTICAL IMPLICATIONS

➤ *To Institutionalize the gains of Digital Visualization in Electoral Governance, we Recommend:*

- **Policy Integration:** The ECSL should adopt a Digital Data Disclosure Policy mandating real-time public access to key electoral metrics.
- **Public-Private Partnerships:** Engage tech startups and universities in platform maintenance and innovation.
- **Legal Safeguards:** Enact legislation ensuring data transparency and privacy protection.
- **Civic Training Programs:** Incorporate platform navigation modules into voter education curricula.

These steps not only enhance transparency but also prepare the electoral system for the demands of digital-age democracy.

X. CONCLUSION

This study has highlighted the profound potential of data visualization and geospatial mapping tools in transforming electoral transparency, promoting civic empowerment, and fostering participatory governance in Sierra Leone. In a

political environment historically characterized by limited data accessibility, low public trust, and uneven civic engagement, the development of a user-centered Electoral Analysis Website (EAW-SL) represents a forward-thinking intervention tailored to the country's unique democratic challenges and digital realities.

By leveraging interdisciplinary frameworks spanning participatory democracy theory, information asymmetry, and design science research this research has not only proposed a novel technological solution but also contextualized it within the socio-political and infrastructural fabric of Sierra Leone. The resulting platform is more than a repository of electoral data; it is a civic engagement ecosystem that equips citizens, journalists, civil society actors, and policymakers with the tools to make informed decisions, engage in evidence-based discourse, and hold institutions accountable.

Findings from pilot testing underscore the platform's potential impact. Users reported increased trust in electoral outcomes, a clearer understanding of voting trends, and a willingness to engage more actively in future electoral cycles. Moreover, the spatial mapping features enabled users to explore regional disparities and advocate for more equitable policy responses, illustrating the system's utility beyond elections alone.

Yet, the success of such a platform hinges on more than technological soundness it requires institutional buy-in, sustained funding, data governance policies, and ongoing civic education. As Sierra Leone moves toward future elections, it must reimagine digital tools not merely as administrative enhancements but as strategic imperatives for democratic resilience.

The future of credible elections will not be measured solely by the tallying of votes, but by the visibility, interpretability, and integrity of the processes that produce those votes. Embracing digital innovation is not optional it is essential for ensuring that elections are not only conducted, but truly understood and trusted by the people they serve.

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