Bimodal Voter Accreditation System (BVAS) and INEC Result Viewing (IReV) and Ballot Papers: Suggested Iterative Improvements and Real Size Testing

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ABSTRACT

We proposed iterative improvements to the Bimodal Voter Accreditation System (BVAS) and INEC Result Viewing (IReV) platform used in elections in Nigeria. The suggested improvements include additional hardware and software upgrades and improved ballot paper with anonymised, barcoded identifiers to guarantee authenticity. Our recommendations include a partial facial recognition addition during voter registration to avoid duplication, an AI-assisted camera for cleaner image capture of election documents, and resizing captured images for faster and cheaper transmission to IReV. Furthermore, we proposed using an off-the-shelf lighted document bed to help illuminate documents during capture and satellite internet connectivity to help in areas with GSM blindspots. Our improvements have ensured voter privacy by employing transitive anonymisation of ballot papers to achieve a closed system. We also addressed concerns regarding transmitting sensitive election electronic documents over out-country satellite internet providers. We suggested best practices to stress test electronic equipment in a simulated fashion to envisage how election systems and devices will perform on election day while preserving the privacy and security of electronic devices.

Keywords: Elections, BVAS, Transitive anonymisation, Voter accreditation, GSM, Registration, Systems, Security

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1. INTRODUCTION

The Bimodal Voter Accreditation System (BVAS), alongside INEC Result Viewing (IReV) platform, are an ingenious solution for conducting the general elections in Nigeria [1]. Like all technological advancements, the BVAS needs improvements to forestall glitches within the target operational environment: elections around Nigeria. The suggested improvements are iterative, which all software and hardware systems require to keep up with their operating environment or respond to challenges that only become known in the field.

In this paper, we focus solely on improving the technological and technologically operational side of election software, hardware and materials. This work is non-partisan and will not discuss political parties and other political entities associated with the election process. For ethical reasons, it will also not discuss the election processes or election electronic devices more than it is necessary to describe the environment for our suggested iterations [1]. Our work only describes BVAS and IReV on a higher level because both systems are proprietary to INEC. Our interaction and experience of BVAS and IReV were from a user and operational perspective.

Therefore, our suggestions will only focus on improved operationality and user experience. Our improvements to already excellent features of BVAS and IReV do not require explicit knowledge of the inner workings of both systems because they are practical solutions already available or in use on other deployed systems.

2. RELATED ARTICLES ON ELECTION

To our knowledge, no paper addresses the challenges of using BVAS and IReV, and ballot papers in the Nigerian electoral process like our proposed system. Many studies examined election systems, particularly elections in Nigeria, but no analysis exists on improving BVAS, IReV and ballot papers. It is pertinent to note that we found a study that questioned if BVAS and IReV overpromised and underdelivered, our article coincidentally provides the natural response to the paper [1]. Most studies available target e-voting or voting administration software [2] [3] [4]. Many studies also focussed on different approaches for ensuring privacy during the election process. All our technical suggestions have been thoroughly investigated with mature technologies already deployed technologies [5], [6], [6]–[15].

2.1 BVAS, IReV, Ballot Papers, Forms, and the Election Process

For brevity, in our description of the election process, we avoid discussing the types of documents used in the election process and their utility. We only describe forms at a higher level about how they interact with the electronic devices from an operational standpoint. The election process starts with registering qualified voters according to extant rules. During voter registration, critical information that aids with voter identification during the election process is collected. This information includes biodata, facial image and fingerprints. The collected data tie each voter to a specific polling unit and, eventually, a voter card. A voter card is the means of voter identification and accreditation on election day [16].

On election day, voters, election officials, observers, and party agents gather at the designated polling units for vote casting and monitoring. Party agents are the primary representative of political parties, and they serve as ground truth for occurrences during the election process from the perspective of parties. The process is started with authenticating voters in an accreditation process using BVAS either through fingerprint identification or facial recognition when fingerprint identification is not possible due to damaged fingerprints, etc. After accreditation, voters receive stamped and signed ballot papers from election officials. These ballot papers contain the participating parties' respective candidates. The vote-casting process is a secret ballot system. Voting happens by thumbprinting in the space that identifies the person/party in the open seat (s). Vote casting happens by placing marked ballot papers in designated boxes classified by available seats on that election day. The ballot boxes are then later counted according to parties/candidates after sorting according to extant rules to sift our invalid votes.

2.2 Relevant Rule for Vote Counting: Overvoting

Concisely, in this section, we highlight the rule relevant to vote counting for total valid votes that our improvement seeks to address. We propose a way to avoid overvoting. Overvoting happens when the number of ballot papers issued by election officials is smaller than that found in the designated ballot boxes. Overvoting can only occur because there is no way of authenticating each ballot paper for each polling unit [17]. Since the voting process is a secret ballot system, it is impossible to track the ballot papers sufficiently with serial numbers attached to every ballot paper. Serial numbers on ballot papers deanonymise the identity of ballot boxes. Therefore, the serialisation of ballot papers must happen via a different process that preserves privacy. We discuss our approach in the solution section in detail [18].

3. OPERATIONAL CHALLENGES IN BVAS, IREV DEPLOYMENT AND BALLOT CASTING

This section details the electoral process stages concerning voters' interaction with the BVAS, IReV and ballot papers and accompanying operation challenges. This section aims to elucidate the operation challenges solved in the solution section.

Registration

The user's biodata is collected and stored in a register during registration. A current anomaly is that voters or registrars can circumvent the deduplication process of the central repository and facial recognition system by submitting perturbed textual and facial image data during the capturing process—the perturbed facial image results from angulating faces differently during the face-capturing sessions [19] [18]. However, the Independent National Electoral Commission (INEC) devised an ingenious open solution whereby voters in every polling unit are available and accessible online. INEC, The Nigerian public, Civil Society Organisations (CSOs) and any well-meaning entity can comb the register to find duplicates of names [16], [18]. The only challenge with this approach is that there is no automated way of cleaning the data, and the cleaning process depends on the trust of external or internal parties [18]. At the end of the registration process, users receive a voter card.

Accreditation and Issuance of Ballot Papers

The accreditation process is simple. On voting day, voters are screened based on the information on the voter cards issued at the end of the registration. Screening of users primarily happens through crossmatching data held by INEC as fingerprints or facial images when fingerprint identification is not accessible due to unclear fingerprints in users. Sometimes exposure to chemicals, hot surfaces, or other occurrences damages fingerprints in voters and makes fingerprint identification impossible [1]. Once a voter has undergone the accreditation process, the voter receives ballot papers for the designated seats in the particular election. Voters move ahead to thumbprinting and placing their votes in provided ballot boxes. Because there is no system to tie voters to ballot papers, there is no way of completely controlling the over-collection of ballot papers by voters. Overvoting occurs when more than expected ballot papers make it to the ballot box, i.e., more votes are cast than the total accredited voters. The process is called overvoting by INEC. They are overvoting leads to cancellations in affected polling units [17] [1].

Lack of GSM Coverage and Collation of Results

By their very nature, GSM networks have weak and blindspots for different reasons ranging from obstruction by physical objects to interference by other frequencies. Weak GSM internet complicates the process for collation of results by relevant officials at the ward level because BVAS and IReV depend on the GSM internet. Before the collation of results at the ward level begins, officials must log into BVAS and look at relevant accreditation data: the number of registered and accredited voters [1]. The BVAS system holds ground truth for the accurate number of registered and certified voters per polling unit. By design, the electoral process doesn't tolerate computational errors, and election officials can't progress with computational mistakes at any stage of the election process. Access to the number of registered and accredited voters at a polling unit from BVAS is necessary for the collation of results to continue. Therefore, alternative internet access methods without GSM network coverage are pertinent.

Poor Lighting, Camera Quality and Image Size

When elections at polling units conclude at night in remote areas, proper lighting for recording and collating votes becomes a challenge, even more so in capturing election results for transmission to the IReV portal through BVAS. Furthermore, image sizes are more significant than necessary because of captured images. Coupled with the above internet bandwidth, communication over the GSM network is complex. Other ingenious ways of communicating with the IReV server must be explored, even with reduced image sizes [1].

4. SOLUTIONS TO CHALLENGES

In this section, we suggest improvements to the BVAS System. We term it iBVAS meaning improved BVAS.

Registration
Since the BVAS is capable of facial recognition, an extension to partial facial recognition capability is pertinent to avoid deceiving the registration database with perturbed images. It will be fine whether the voter changes their angle while facing the camera, as seen in the published uncleaned voter register from INEC [13].
Furthermore, during registration, the image capture process should limit the capturing of images to a passport posture, or the registration becomes unsuccessful. This BVAS enforced this described posture during login-in to the image capture process.

Accreditation and Issuance of Ballot Papers
The accreditation system is perfect. The only enhancement needed is to tie released ballot papers to a polling unit and those given to voters at the polling unit. By doing this, no herculean complexity affects the current logistic process. Already, each polling unit has its dedicated BVAS. It means there is already a sorting mechanism to restrict material to polling units. There is also an opportunity for recording ballot papers to voters in an anonymisation approach that hides the identity of voters. We suggest adding barcodes on ballot papers that identify ballot papers as belonging to a specific polling unit [20]. We also recommend a new feature on BVAS to allow registering ballot papers to voter cards using encrypted anonymisation that doesn't identify voters.

During the issuing of ballot papers, The immediate concern is preserving voters' privacy since the ballot system used is the secret ballot system. At the moment, the only way of knowing what Voters voted for is by crossmatching their fingerprints on the ballot papers to the register of fingerprints held by INEC. Adding QCR codes or barcodes on the ballot papers will also serve as a digital fingerprint that makes it impossible to identify voters [20].

Lack of GSM Coverage and Collation of Results
Satellite technology mitigates the lack of proper internet accessibility for areas without decent access to GSM networks. Many of these systems are common in the marine and remote exploration space, and they have been well tested, confirming their ruggedness and effectiveness. Some come in the form of pocket devices [21]. Not all iBVAS systems should contain satellite add-ons or built-in systems to reduce cost. But only those iBVAS planned for deployment to blindspots.

Using satellite technology doesn't increase security or ethical risk because service providers are out-country. Already a lot of the equipment used in the election is provided by out-country vendors. Therefore, our suggestions don't introduce any new ethical or security risk that the available mitigations can't handle. In essence, current security mitigations will suffice for our suggested improvements [5][10]. Furthermore, encryption algorithms protect data sent over satellites. Therefore, if malicious entities intercept the data, it will be useless to them.

Poor Lighting, Camera Quality and Image Quality and Size
Using AI-assisted document capture solves the image quality problem due to poor lighting or focal difficulties with the camera. These solutions are easily integrable into BVAS [22] [23]. AI-assisted cameras not only help with clear images but also help in making sure captured images are minimal in size. In addition, an off-the-shelf or customised lighted document further solves the problem of poor lighting and out-of-focus results caught on IReV [24]. The lighted bed ensures that images are at an optimal distance for capturing with the BVAS camera and with adequate lighting.

It will also give the captured images a more professional look. We show the off-the-shelf version in Figure 1 below. INEC can also decide to commission a customised lighted camera bed.

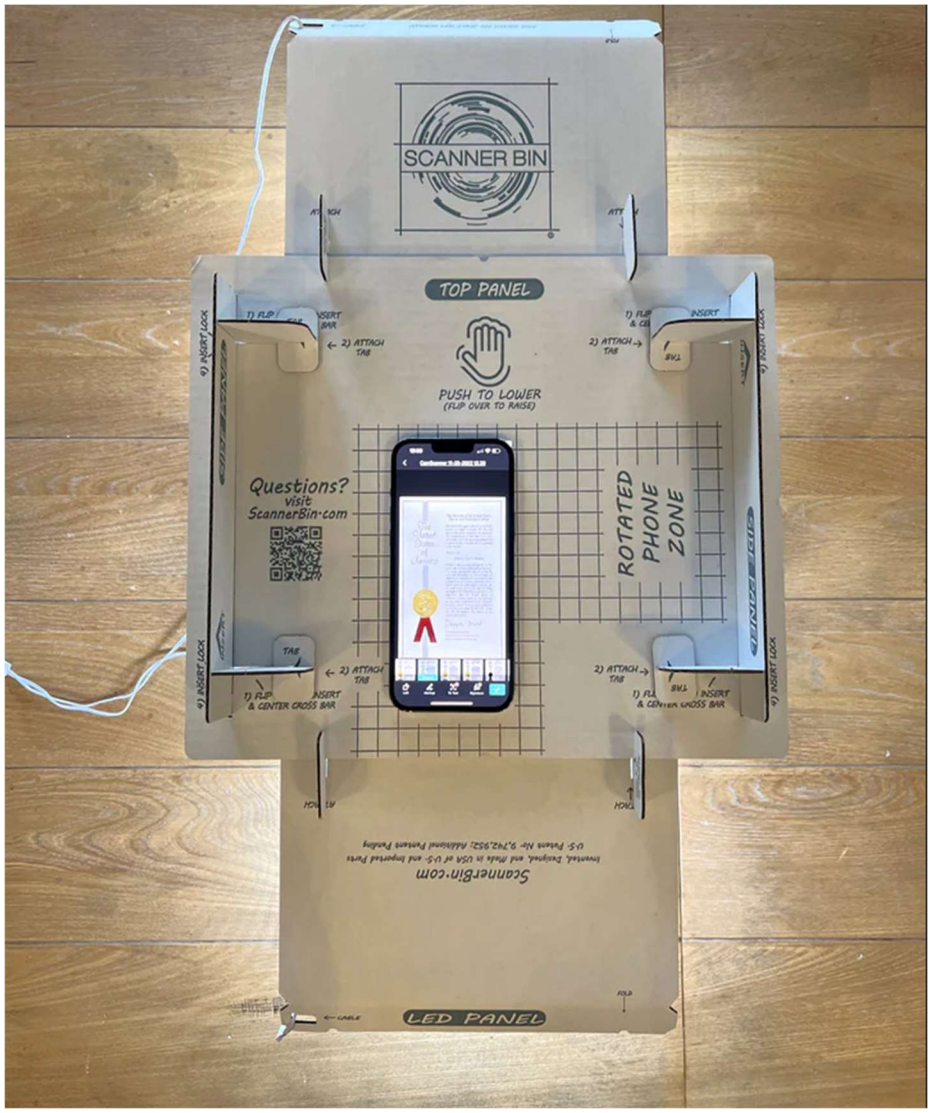

Figure 1: Scanner Bin Pro

5. ALTERNATIVE TRANSMISSION OF RESULTS

An alternative way of transmitting results to election stakeholders from the BVAS is over encrypted, open-source, audited email protocols [25]. Sending emails over BVAS doesn't require an INEC server. Secure email protocols help to achieve two things: masking for destination repository and circumventing denial of service attacks and other attacks that target the INEC. Circumventing Denial of service attacks on the destination repository is possible because one can disrupt transmission over secure email protocol from BVAS systems. One must attack all BVAS systems at the same time.

5.1 Propositions

We propose a novel way to stress test election devices using already present INEC computers to service as testbeds. INEC already has an office in every local government equipped with at least one computer. From these local governments, we can disregard virtual machines that will help stress test the performance of IReV systems during elections. We will discuss all the I implementations in detail [26] [26], [27].

6. CONCLUSION

BVAS and IReV have achieved their intended functions with high significance. Most importantly, they have imposed strict compliance with the verification of voters. We have demonstrated that BVAS and IReV faced limitations due to operational and environmental factors. We suggested mitigations to these limitations.

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