**(Prototype Mid-Defense Report)**

**(Cover Page)**

**Tribhuvan University** **Faculty of Humanities and Social Sciences**

**Online Voting System**

**A Mid-Term Project Report**

**Submitted to** **Department of Computer Application**

**Academia International College**

**In partial fulfillment of the requirements for the Bachelors in Computer Application (CAPJ356: Project II)**

**Submitted by**

Khagendra Malla [6-2-346-15-2021]

Sujal Bajracharya [6-2-346-35-2021]

**(Date: 12th Week of Sixth Semester - April 2025)**

**Under the Supervision of** Ananda Adhikari

**Department of Computer Application**

**Academia International College**

**(Title Page - Same as Cover Page)**

**(Supervisor’s Recommendation)**

**Tribhuvan University** **Faculty of Humanities and Social Sciences** **Academia International College**

**Supervisor’s Recommendation**

I hereby recommend that this mid-term project report prepared under my supervision by **Khagendra Malla & Sujal Bajracharya** entitled **“Online Voting System”** in partial fulfillment of the requirements for the degree of Bachelor of Computer Application (Project II - CAPJ356) is recommended for the mid-term evaluation.

<<Signature of the Supervisor>> **SIGNATURE** Ananda Adhikari **SUPERVISOR** **<<Academic Designation>>** **Department of Computer Application** **Academia International College, Gwarko, Lalitpur**

**(Letter of Approval - Placeholder for Mid-Term Evaluation)** *(Note: The standard template is for final approval. This section might be adapted or omitted for mid-term as per college practice.)*

**(Acknowledgements - Placeholder)**

*(Student expresses gratitude to supervisor, HoD/Coordinator, college, friends, family, etc.)*

**(Abstract - Placeholder)**

*(A brief summary of the project: problem, objectives, methodology, progress achieved at mid-term, and expected final outcome. Typically 150-250 words.)*

This project details the development of an Online Voting System aimed at addressing inefficiencies and security concerns in traditional voting. Key objectives include enhancing accessibility, efficiency, accuracy, and security. This mid-term report covers the initial phases, including requirements analysis, feasibility assessment, and system design progress. The system utilizes PHP, MySQL, HTML, CSS, and JavaScript. Initial progress includes user interface mockups and database schema design. The final system is expected to provide a secure, transparent, and cost-effective platform for various election types.

**(Table of Contents - Auto-generated based on final headings and page numbers)**

**(List of Figures - Auto-generated)**

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Table 1: Violations of Arrow's Axioms by Common Voting Methods

**(List of Abbreviations - Placeholder)** *Example:*

* BCA: Bachelor of Computer Application
* CSS: Cascading Style Sheets
* EVM: Electronic Voting Machine
* FPTP: First-Past-The-Post
* HTML: HyperText Markup Language
* IIA: Independence of Irrelevant Alternatives
* IRV: Instant Runoff Voting
* JS: JavaScript
* MySQL: My Structured Query Language
* PHP: PHP: Hypertext Preprocessor
* RCV: Ranked Choice Voting
* SRS: Software Requirements Specification
* STV: Single Transferable Vote
* UI: User Interface

**Chapter 1: Introduction**

**1.1 Background** Traditional voting systems, relying on paper ballots or Electronic Voting Machines (EVMs), often face logistical hurdles, potential for miscounts, security vulnerabilities, and significant administrative costs. These challenges can impact voter turnout and trust in the electoral process. The advancement of digital technology offers an opportunity to modernize elections through online voting systems. Such systems aim to provide a more accessible, efficient, and potentially more secure platform for casting and counting votes. This project undertakes the development of such an online system tailored for academic or organizational elections, focusing on usability and core voting functionalities.

**1.2 Problem Statement** The primary problems with existing traditional voting methods include:

* **Inefficiency:** Manual counting and logistical arrangements are time-consuming and resource-intensive.
* **Accessibility Issues:** Physical presence requirements can disenfranchise voters who are remote, ill, or have mobility issues.
* **Security Concerns:** Paper ballots can be lost or tampered with, while EVMs can face concerns regarding transparency and unauthorized access.
* **High Costs:** Expenses related to ballot printing, polling station setup, and personnel are substantial.
* **Lack of Transparency:** Verifying votes accurately and transparently can be challenging in traditional systems.

This project addresses these issues by proposing a web-based online voting system designed to be secure, efficient, accessible, and transparent.

**1.3 Objectives** The main objective is to develop a functional and secure Online Voting System. Specific objectives include:

* To enhance **accessibility** via a user-friendly web interface for remote voting.
* To improve **efficiency** by automating vote casting and counting.
* To ensure **accuracy** in vote tabulation, minimizing errors and manipulation.
* To implement robust **authentication** mechanisms to prevent fraudulent voting.
* To achieve **cost-effectiveness** by utilizing digital infrastructure.
* To design a **scalable** system adaptable to various election sizes.
* To promote **transparency** through secure vote verification mechanisms.

**1.4 Scope and Limitations**

* **Scope:** The system will facilitate user registration, secure login, ballot presentation based on election type, casting of votes for multiple voting methods (e.g., FPTP, Approval, RCV), secure vote storage, automated counting, and result presentation. It will include administrator functionalities for managing elections, users, and results.
* **Limitations:** This is an academic project; therefore, aspects like large-scale deployment infrastructure, advanced cryptographic techniques beyond standard practices (e.g., homomorphic encryption), and legal compliance for national elections are outside the scope. The focus is on demonstrating core functionalities and addressing security at a level appropriate for organizational/academic use.

**1.5 Report Organization** This mid-term report details the progress made in the first half of the project lifecycle. Chapter 2 discusses the background and literature review. Chapter 3 presents the system analysis and design undertaken so far. Chapter 4 outlines the initial implementation and testing efforts. Chapter 5 concludes with the current status and planned future work. References and appendices follow.

**Chapter 2: Background Study / Literature Review**

**2.1 Existing Voting Systems** Traditional voting relies on paper ballots or EVMs. While widely used, these face challenges like cost, logistics, and potential inaccuracies. Online voting systems have emerged as alternatives, aiming to leverage technology for efficiency and accessibility. Early trials and implementations exist, but concerns regarding security and digital divides remain prominent areas of research.

**2.2 Challenges in Online Voting**

* **Security:** Ensuring voter authentication, preventing coercion, maintaining ballot secrecy, and securing the transmission and storage of votes against tampering or hacking are paramount challenges. Cryptographic techniques are essential but complex to implement correctly.
* **Fairness and Accuracy:** Designing systems that accurately reflect voter intent without bias is complex. Social choice theory highlights inherent difficulties. Arrow's Impossibility Theorem demonstrates that no ranked voting system can simultaneously satisfy a set of desirable fairness criteria (like non-dictatorship, Pareto efficiency, and independence of irrelevant alternatives - IIA) when there are three or more options. Common methods like Plurality, Borda Count, and IRV all violate at least one of these axioms. This implies trade-offs are necessary. The spoiler effect, often linked to IIA violations, where a minor candidate alters the outcome between major ones, is a practical concern.
* **Accessibility and Digital Divide:** While aiming to increase accessibility, online systems might exclude those without internet access or digital literacy.
* **Transparency and Verifiability:** Voters need assurance that their vote was recorded correctly and contributes accurately to the final tally, without compromising anonymity. End-to-end verifiable (E2EV) systems are an active research area but often complex.

**2.3 Relevant Technologies** The proposed system leverages common web technologies:

* **Frontend:** HTML, CSS, JavaScript for user interface and interaction.
* **Backend:** PHP for server-side logic and database interaction.
* **Database:** MySQL for storing user data, election details, and encrypted votes.
* **Security:** Standard practices like HTTPS, password hashing, input validation, and potentially basic encryption for vote data will be employed.

**2.4 Supported Voting Methods** The system aims to support various methods, including:

* First-Past-The-Post (FPTP)
* Approval Voting
* Ranked Choice Voting (RCV) / Instant Runoff Voting (IRV)
* Single Transferable Vote (STV)
* Score Voting
* Condorcet Method The implementation will need to carefully consider the aggregation logic for each method, acknowledging the theoretical limitations discussed (e.g., Arrow's Theorem ).

**Chapter 3: System Analysis and Design (Progress)**

**3.1 Requirement Analysis** *(Based on objectives and scope)*

* **Functional Requirements:**
  + User Registration (Voter, Administrator)
  + Secure User Login/Authentication
  + Election Creation & Management (Admin: setup candidates, dates, voting method)
  + Ballot Presentation (Display candidates/options according to election)
  + Vote Casting (Support for selected methods like FPTP, Approval, RCV etc.)
  + Vote Encryption & Secure Storage
  + Automated Vote Counting/Tallying (per selected method)
  + Result Generation & Display
  + Basic Vote Verification Mechanism (e.g., confirmation code)
* **Non-Functional Requirements:**
  + **Security:** Protect against unauthorized access, data breaches, vote tampering.
  + **Usability:** Intuitive and accessible interface for diverse users.
  + **Reliability:** System should function correctly and consistently.
  + **Scalability:** Ability to handle a moderate number of voters and elections.
  + **Performance:** Responsive interface and timely vote processing.
  + **Maintainability:** Code should be well-structured and documented.

**3.2 Feasibility Study Summary** *(Based on proposal )*

* **Technical Feasibility:** The project utilizes standard, widely available technologies (PHP, MySQL, HTML/CSS/JS) with ample documentation and community support, making it technically feasible.
* **Operational Feasibility:** The system is designed with a simple UI, requiring minimal training for voters and administrators, ensuring operational feasibility.
* **Economic Feasibility:** Development relies on open-source software (PHP, MySQL) and standard hardware, minimizing direct costs and making it economically viable for academic purposes.

**3.3 System Design (Progress)**

* **Architecture:** A standard 3-tier web application architecture (Presentation/UI, Business Logic/Backend, Data/Database) is adopted.
  + *Presentation Tier:* HTML, CSS, JavaScript.
  + *Logic Tier:* PHP handles requests, business rules, and data processing.
  + *Data Tier:* MySQL database stores all persistent data.
* **Database Design (Initial):** Key tables identified include:
  + Users (UserID, Username, HashedPassword, Role, etc.)
  + Elections (ElectionID, Title, StartDate, EndDate, VotingMethod, Status, etc.)
  + Candidates (CandidateID, ElectionID, Name, Details, etc.)
  + Votes (VoteID, ElectionID, VoterID, EncryptedVoteData, Timestamp, ConfirmationCode)
  + *(Relationships and further attributes are being finalized)*
* **Interface Design (Mockups/Wireframes):**
  + *(Include initial sketches or digital mockups for key screens: Login, Voter Dashboard, Ballot Page, Admin Dashboard, Election Setup Page. Describe the basic layout and navigation.)*
* **Core Algorithm Design (Conceptual):**
  + *Vote Casting:*
    1. Authenticate voter.
    2. Fetch relevant election details and candidates.
    3. Present ballot according to the specified voting method (e.g., checkboxes for Approval, ranked list for RCV).
    4. Capture voter input.
    5. Encrypt vote data.
    6. Store encrypted vote with voter/election identifiers and timestamp.
    7. Generate and display a unique confirmation code.
  + *Vote Tallying (Example: FPTP):*
    1. Decrypt votes for the specific election (requires secure key management).
    2. Iterate through votes, incrementing count for the selected candidate.
    3. Determine candidate with the highest count.
* **Security Mechanisms (Planned):**
  + HTTPS for encrypted communication.
  + Password hashing (e.g., bcrypt).
  + Input validation to prevent injection attacks.
  + Role-based access control (Voter vs. Admin).
  + Basic encryption for stored vote data.

**Chapter 4: Implementation and Testing (Progress)**

**4.1 Implementation Status** *(Describe modules/features implemented so far. Be specific.)*

* **Development Environment:** Setup complete (e.g., XAMPP/WAMP/MAMP stack).
* **Database Schema:** Initial schema created in MySQL based on design.
* **User Interface:** Basic HTML/CSS structure for main pages (Login, Dashboard) developed.
* **User Authentication:** Backend logic for user registration and login (with password hashing) implemented in PHP.
* **(Other implemented components...)**

**4.2 Testing Status** *(Describe testing done so far.)*

* **Unit Testing:** Initial tests performed on user authentication module functions.
* **Interface Testing:** Basic checks on page rendering and navigation.
* *(Testing is ongoing and will become more comprehensive as modules are completed.)*

**Chapter 5: Conclusion and Future Work**

**5.1 Progress Summary** Significant progress has been made in the initial phases of the Online Voting System project. Requirements have been thoroughly analyzed, feasibility confirmed, and a foundational system design established. Key database structures are defined, initial UI elements are built, and core functionalities like user authentication are implemented. The theoretical background, including challenges highlighted by social choice theory, has been reviewed to inform design choices.

**5.2 Work Remaining** The focus for the remaining project duration includes:

* Completing the implementation of all functional requirements, particularly the various vote casting and tallying mechanisms.
* Finalizing and refining the database schema and user interfaces.
* Implementing planned security measures robustly.
* Conducting comprehensive testing (unit, integration, system, usability).
* Writing the final project report and preparing for the final defense and demonstration.

**5.3 Updated Timeline / Gantt Chart** *(Refer to the initial Gantt chart from the proposal. Provide an updated version reflecting current progress and projecting remaining tasks within the semester timeframe. Highlight any delays or adjustments.)*

**5.4 Expected Outcomes Review** The project remains on track to deliver the expected outcomes: a functional online voting system, increased efficiency, potential for greater participation, cost reduction compared to manual methods, enhanced confidence through basic transparency, and a scalable platform for academic/organizational use.

**References (IEEE Format)**

*[Note: Combined and formatted references from proposal v2.docx and The Inherent Challenges...docx. Document IDs ([1], [2] etc.) are placeholders as per IEEE style; actual numbering depends on citation order in the full text.]*

* **From proposal v2.docx:**
  + [1] J. Doe, "Digital Voting Systems and Their Impact," *IEEE Transactions*, 2020. [Referenced in proposal v2.docx]
  + [2] A. Smith, "User Authentication in Online Elections," *Cybersecurity Journal*, 2019. [Referenced in proposal v2.docx]
  + [3] M. Kumar, "Cost Analysis of Digital Voting," *Security & Privacy*, 2021. [Referenced in proposal v2.docx]
  + [4] S. Brown, "Approval Voting: A Practical Approach," *Political Science Review*, 2022. [Referenced in proposal v2.docx]
  + [5] T. Green, "Ranked-Choice Voting in Practice," *Democracy Studies*, 2023. [Referenced in proposal v2.docx]
  + [6] L. White, "Scalability and Security in Online Elections," *Computer Science Research Journal*, 2021. [Referenced in proposal v2.docx]
  + [7] B. Hall, "Challenges and Future Directions for Digital Elections," *Journal of Governance*, 2022. [Referenced in proposal v2.docx]
* **From The Inherent Challenges...docx:** *(Selected examples, full list is extensive)*
  + [8] "Voting Protocols and Arrow's Theorem," UCSB Computer Science. [Online]. Available: <https://sites.cs.ucsb.edu/~suri/ccs130a/Voting.pdf>. [Accessed: Apr. 8, 2025].
  + [9] "Arrow's Impossibility Theorem – Math Fun Facts," Harvey Mudd College. [Online]. Available: <https://math.hmc.edu/funfacts/arrows-impossibility-theorem/>. [Accessed: Apr. 8, 2025].
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  + [24] M. A. Satterthwaite, "Strategy-proofness and Arrow's conditions: Existence and correspondence theorems for voting procedures and social welfare functions," *Journal of Economic Theory*, vol. 10, no. 2, pp. 187–217, 1975. *(Relevant via Gibbard-Satterthwaite)* [Referenced in The Inherent Challenges...docx]
  + *(... many more references from "The Inherent Challenges..." document would follow here ...)*

**(Appendices - Placeholder)**

* Appendix A: System Architecture Diagram
* Appendix B: Database Schema (ER Diagram)
* Appendix C: UI Mockups/Screenshots
* Appendix D: Updated Gantt Chart
* *(Other relevant supplementary materials)*