VIETNAMESE-GERMAN UNIVERSITY

PROJECT

Voting System in Corporate Governance

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February 27, 2025

VIETNAMESE-GERMAN UNIVERSITY

Abstract

Faculty Name
Department of Computer Science and Engineering

Bachelor of Computer Science

Voting System in Corporate Governance

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This project presents the design and implementation of a blockchain-based voting system aimed at enhancing corporate governance processes. The system focuses on two primary use cases: board member elections and executive compensation approvals, addressing critical challenges such as transparency, voter anonymity, and security. By integrating blockchain technology, the proposed system ensures the immutability of voting records and provides a decentralized, verifiable audit trail.

The on-chain component captures essential voting data in a compact and cryptographically secure structure, while the off-chain component supports auxiliary functionalities like detailed voter and result management. Key advantages of this system include cost efficiency, scalability, and enhanced transparency, making it a viable solution for modern corporate governance.

Challenges such as voter accessibility and blockchain scalability are acknowledged, with potential mitigations explored. The project concludes that blockchain technology offers a transformative approach to secure and transparent voting, setting a foundation for future research and implementation in governance systems.

Contents

Abstract i

1 Introduction 1
- 1.1 Overview . . . 1
- 1.2 Topic Introduction . . . 1
  - 1.2.1 Shareholder Voting Process for Board Elections . . . 1
  - 1.2.2 Shareholder Voting Process for Salary Approval . . . 1
- 1.3 Purpose . . . 1

2 High-level Design 3
- 2.1 Shareholder Voting Process for Board Elections . . . 3
- 2.2 Shareholder Voting Process for Executive Pay Approval . . . 4

3 On-chain Design 6
- 3.1 Block Store Structure . . . 6
- 3.2 Design Advantages . . . 6

4 Off-chain Design 7
- 4.1 ER diagram . . . 7
- 4.2 Database Diagram . . . 8

5 Conclusion 9
- 5.1 Summary of the System Design . . . 9
- 5.2 Advantages of the Blockchain-Based System . . . 9
- 5.3 Key Findings . . . 10
- 5.4 Final Remarks . . . 10

Chapter 1

Introduction

1.1 Overview

The purpose of this project is to design a voting system for corporate governance. By incorporating blockchain into the system, we can ensure confidentiality for the voters and organizers alike, while making sure that the votes maintain their full integrity throughout the entire process. Through research, we have designed a system in which votes are received and stored through cryptographic measures and produced accompanying diagrams to explain. This project was started in response to concerns regarding voters' privacy and the potential for voting fraud on a non-trivial scale by malicious parties.

1.2 Topic Introduction

1.2.1 Shareholder Voting Process for Board Elections

Our first process concerns the process in which shareholders vote for leadership positions within the company, whose decisions directly impact the company's strategic direction and governance. It focuses on how shareholders cast their votes through a cryptographic system, where their votes becomes secured by means of the blockchain's inherent immutable properties, and remains that way by utilizing smart contracts. This ensures that the votes are verifiably fair and no person or organization can interfere with the process. The added security is of high importance as leadership positions can very strongly decide the trajectory of a company, so any move must be as concrete as possible.

1.2.2 Shareholder Voting Process for Salary Approval

The second process also focuses on the company's leadership, however this time the votes are reserved for the purpose of salary approval and verification. Proposed salaries for the executives are submitted to the blockchain, and through a slightly similar voting process, is determined whether it's appropriate given regulations and performance. This ensures that the executives aren't being paid more than they are supposed to or other abnormal amounts.

1.3 Purpose

The implementation of the blockchain in this process holds rather paramount importance. Traditionally, voting have always been a very sensitive topic where the trust falls solely on one or a few select individuals to accurately count and represents the

vote received. While this is not a flaw in of its own, this does mean the person counting the votes can choose to report false results or change them as they have access to the total count, with little to no built-in countermeasures. Additionally voter fraud from influence from other sources can happen, further endangering integrity. And the only way to make sure votes stay in order would be to attach a person's identity to their vote, which makes them open for targeting for a hypothetical proposition, should they have access to the votes.
The blockchain technology and its implementation would heavily lessens all of the mentioned downsides while still keeping the process relatively the same. It offers strong security with a decentralized system where no one person can control and modify what data that's already on there, while offering human anonymity that can still be verified by machines for checking purposes. It pushes the simple concept of voting into a relatively simple yet still secure version.

Chapter 2

High-level Design

2.1 Shareholder Voting Process for Board Elections

As discussed, the first process focuses on how shareholders vote to elect or re-elect board members using a blockchain system to ensure transparency, security, and immutability. We'll briefly go over the structure and how each component works together.

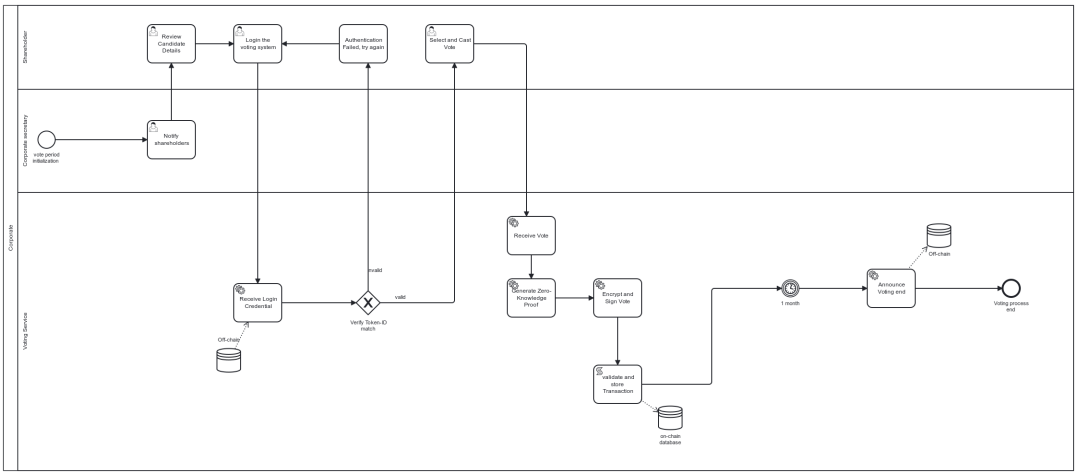

FIGURE 2.1: A BPMN diagram for the process

- **Initiate Voting Process:** The corporate secretary initiates the voting process and sets certain voting parameters such as the candidate list, the period, allowed amounts of vote casts per person and so on. This sets up a list for selection, as well as constraints that the system will do its best to follow.
- **Notification to Shareholders:** The shareholders who are expected to vote will then be notified about the vote happening and being set up. This fills them in on details of the election such as the candidates list and its running period, and give them a brief rundown on how to access the voting system in case they were unfamiliar.
- **Authentication and Voting:** Shareholders log into the system, which then verify their presence and authority through a series of checks against their own personal tokens. The token was generated when they become associated with the company, and is expected to remain only accessible to them at all times. Then as they cast their votes, the votes in of its own also become a token that's

permanently associated with their own, meaning where there is no direct association we can rest assured that each vote still belongs exclusively to that person as far as the machine is considered.

- **Vote Recording:** Votes now become immutable, meaning they are unable to be changed at any point in time or the process so long as they are still within the blockchain. Any changes or access that do happen are also kept in check by peer systems, ensuring maximum integrity
- **Voting Period Closure:** Once the voting period ends, the blockchain system automatically closes the voting process. No further votes are to be accepted, in or out.
- **Vote Tallying:** The blockchain uses automated ledgers and smart contract to tally the votes, ensuring accuracy and transparency. Each transactional computation made are also recorded and acknowledged, available for checking wheter there's issues.
- **Results Announcement:** Results are published on the blockchain, making them publicly verifiable by all stakeholders.

2.2 Shareholder Voting Process for Executive Pay Approval

The second process focuses on how shareholders vote to decide whether or not the seniors or executives of the company be offered with the new pay, bonuses, and benefits. The following is the structure and how each component works together.

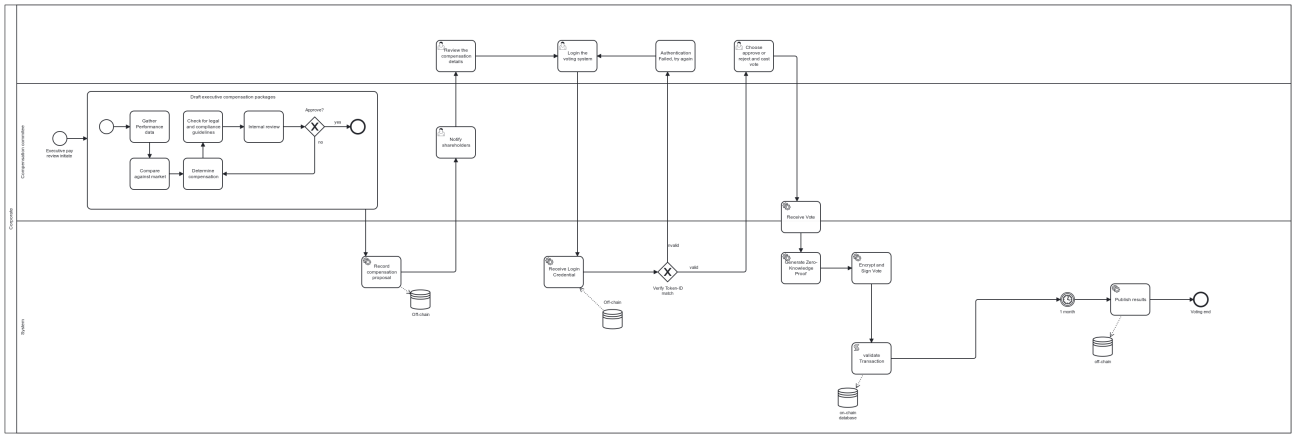

FIGURE 2.2: BPMN diagram for the process

- **Review initiate** After a certain amount of time, the committee will initiate a performance review of the executive and start drafting the compensation package.
- **Subprocess: draft executive compensation package**
  - Gather Performance data: the committee start collecting data of the target executive. This includes the performance of said executive, positive and negative impacts brought by him/her to the company.
  - Compare against market: the committee will then check with the current job market to have an idea of the draft compensation

  - Determine compensation: After gathering all the factors, the committee will determine the new salary level, bonuses and benefits.
  - Check for legal and compliance guidelines: They then align the compensation with legal laws and guidelines
  - Internal review: Once the draft has been made, it will be reviewed by other committees to determine if it is appropriate for the current stage of the corporate.
  - Approval gateway: If the draft is approved, the vote process will continue. If it is not approved, the committee need to again draft another compensation package.

- **Record compensation proposal:** After the drafting process, the proposal will be recorded in the system.
- **Notify shareholder:** The shareholders are then notified by the committee about the start of the voting process
- **Review the compensation details:** The shareholders reviews the details of the proposal, biography, and performance report of the said executive.
- **Authentication and Voting:** Shareholders log in to the system, which checks who they are using their personal tokens. These tokens are made when they join the company and must stay private. When they vote, their votes are linked to their tokens. This makes sure that each vote is connected only to the right person.
- **Vote Validation and Recording:** Vote transaction are validated and saved on the blockchain. This makes them permanent and impossible to change.
- **Voting Period Closure:** When the voting time is over, the blockchain system automatically stops the voting.
- **Vote Tallying:** The blockchain counts the votes using a smart program to make sure everything is correct and clear.
- **Results Announcement:** The results are shared on the blockchain and save in the off-chain database so everyone can see and check them.

Chapter 3

On-chain Design

3.1 Block Store Structure

- **TransactionID: Hash** A unique cryptographic hash generated for each validated vote. Ensures traceability and immutability.
- **ShareholderID: Hash** Uniquely identifies the shareholder, ensuring only authorized individuals can vote.
- **VoteType: String** use to specify the purpose of the vote. It can either be "Election" or "Proposal". If it is a "Proposal", the system can mark the vote to be a "Reject" vote or "Approve" vote behind the "Proposal" (e.g. Proposal Approve).
- **EntityID: Hash** use to hold the id of the entity the vote cast for. Combine with the vote type to determine whether this id represents the elections or the proposal.
- **PersonID: Hash** use to hold the id of the person targeted for the vote. Combine with the vote type to determine whether this id represents the candidate in an election or the executive and its compensation package being vote for.

3.2 Design Advantages

- **Immutability:** The blockchain ensures that once a block is created, the voting record cannot be altered or deleted, providing a reliable audit trail.
- **Transparency:** Shareholders and regulators can independently verify vote counts and results without compromising privacy.
- **Cost Efficiency:** By consolidating all votes into a single block after validation, the design minimizes transaction costs and optimizes resource usage.

This on-chain block store design provides a secure, transparent, and cost-efficient voting mechanism for shareholder governance. Key advantages include immutability, scalability, transparency, and low transaction costs. The system's flexible structure ensures robust performance across diverse voting scenarios.

Chapter 4

Off-chain Design

4.1 ER diagram

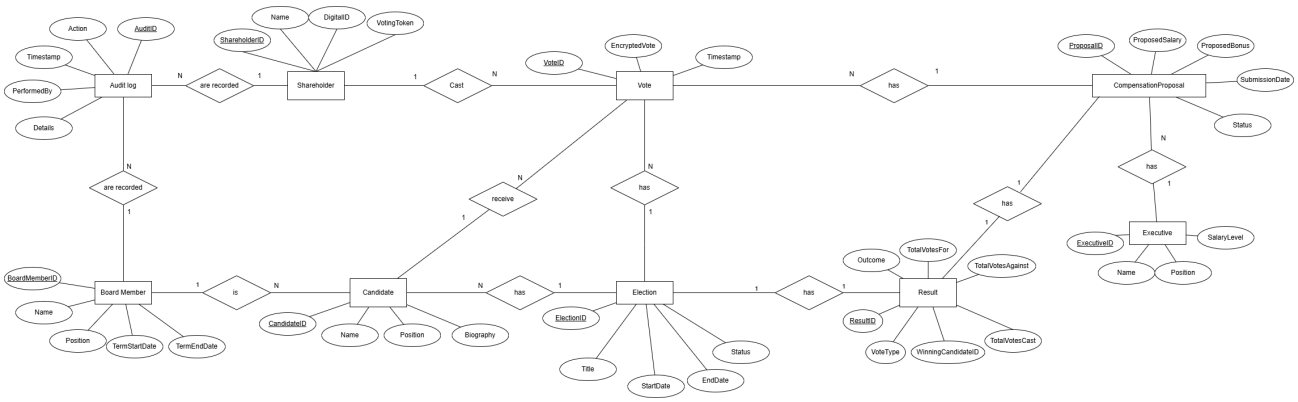

FIGURE 4.1: ER Diagram

In our ER diagram there are 9 entities: Shareholder, Board Member, Candidate, Election, Vote, CompensationProposal, Executive, Result, and Audit Log. Attributes represent the properties or details of entities in the system. The primary key of a Shareholder is ShareholderID and this entity is used to identify shareholders who have the right to vote and with attributes: Name, DigitalID, VotingToken. Board Member represents candidate serving on the board of directors after successful voting with the primary key being BoardMemberID. Attributes of this entity include: Name of the elected person, Position, TermStartDate and TermEndDate. Next, Candidate represents individuals who are candidates in the election process. Attributes with primary keys CandidateID, Name, Position, Biography. In addition, Election with ElectionID as primary key will contain election details like Title, StartDate, EndDate, and Status. Vote captures voting details include VoteID (Primary Key), EncryptedVote, Timestamp. Furthermore, The primary key of a CompensationProposal is ProposalID and this entity is used to represent proposals for executives and with attributes: ProposedSalary, ProposedBonus, SubmissionDate and Status. Executive contains details of company executives with the primary key being ExecutiveID. Attributes of this entity include: Name, Position and SalaryLevel. And, Result tracks election results and voting outcomes include ResultID (Primary Key), Outcome, VoteType, TotalVotesFor, TotalVotesAgainst, TotalVotesCast, and

WinningCandidateID. Finally, Audit Log maintains a log of all system actions. Attributes with primary keys AuditId, Action, Timestamp, PerformedBy, Details. Foreign Keys: CandidateID, ExecutiveID, VoteID, and ShareholderID in the relationship of Election-Result, Compensation Proposal-Executive, Vote-Election and Vote-Shareholder, respectively. The relationship between Shareholder and Vote represents a shareholder can cast multiple votes. Next, Vote and Election determine each election can receive multiple votes. Each election has multiple candidates belonging to the Election and Candidate. Election and Result represent each election has a single result. Furthermore, the relationship between Compensation Proposal and Executive represent a single executive can have multiple proposals. Last, Audit Log records actions of Shareholder and Board Member.

4.2 Database Diagram

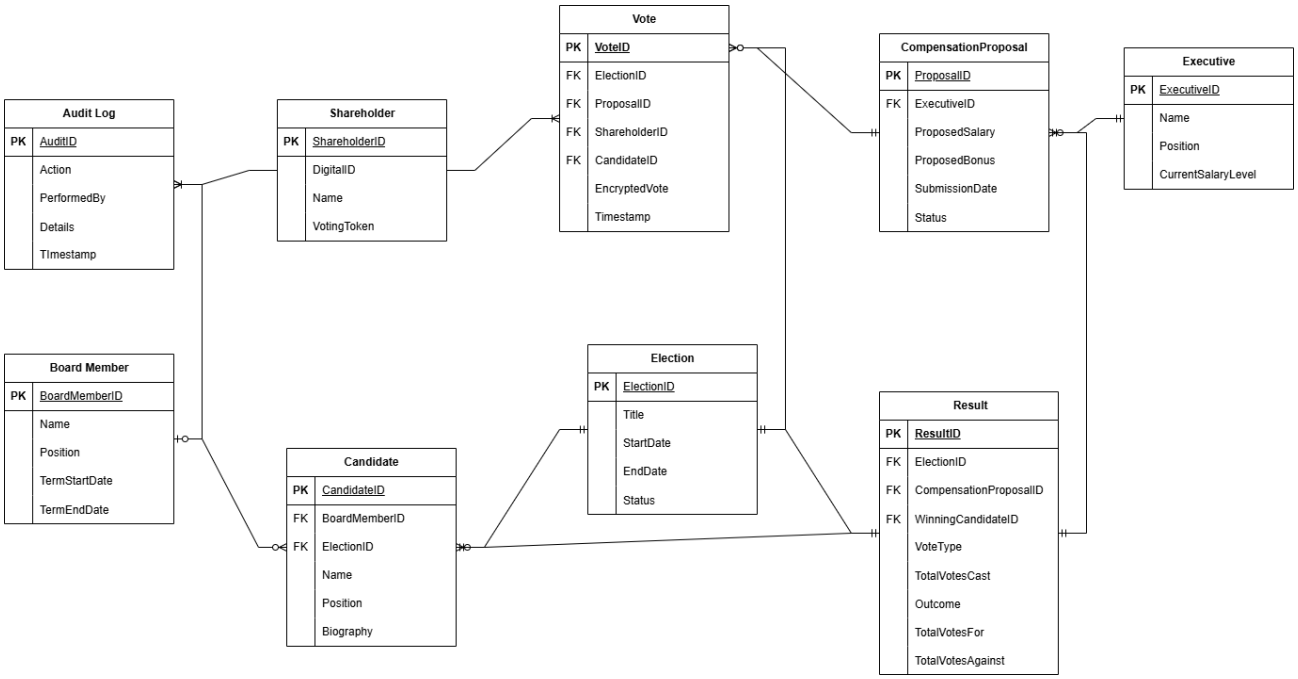

FIGURE 4.2: Database Diagram

Chapter 5

Conclusion

5.1 Summary of the System Design

This project developed a blockchain-based voting system tailored to the requirements of corporate governance, specifically focusing on two key processes: **elections of board members** and **approval of executive compensation packages**. The system's design combines on-chain and off-chain components to ensure transparency, integrity, scalability, and privacy.

On-Chain Design: The on-chain system provides immutability and transparency by recording votes in blocks. Using cryptographic measures and smart contracts, it prevents tampering and ensures that shareholder rights are protected.

- The *block store structure* is minimal yet robust, including fields like TransactionID, VoteType, EntityID, PeopleID, and ShareholderID to provide detailed yet secure voting records.
- Advantages of this system include cost efficiency, traceability, and decentralized verification.

Off-Chain Design: Complementing the on-chain components, the off-chain system manages additional data through an ER model and database schema. These components handle metadata such as voter details, audit logs, and election outcomes to ensure efficient management of data not suited for the blockchain.

5.2 Advantages of the Blockchain-Based System

The blockchain-based system addresses critical challenges associated with traditional voting systems, such as lack of transparency, voter fraud, and scalability limitations. Its advantages include:

1. **Immutability:** Votes and records stored on the blockchain are tamper-proof, providing an auditable trail that stakeholders can independently verify.
2. **Transparency:** The system makes results publicly verifiable while maintaining voter anonymity, fostering trust among stakeholders.
3. **Cost Efficiency:** By consolidating all validated votes into a single block, transaction costs are minimized without compromising the system's effectiveness.
4. **Scalability:** The design supports diverse voting scenarios, such as weighted voting or simultaneous elections, and can accommodate future extensions.
5. **Privacy and Security:** Cryptographic techniques ensure voter identities remain confidential, mitigating risks of coercion or data exposure.

5.3 Key Findings

The project demonstrated how blockchain technology could revolutionize corporate governance voting by enhancing trust and efficiency. The following are key findings from this research and development process:

- Smart contracts are critical for automating vote validation and tallying, ensuring consistent application of rules.
- Cryptographic measures can balance the dual needs for transparency and privacy, a longstanding challenge in voting systems.
- Hybrid on-chain and off-chain designs optimize the use of blockchain by offloading non-essential data while retaining the integrity of critical voting records.

5.4 Final Remarks

This blockchain-based voting system marks a significant step forward in corporate governance by addressing the fundamental issues of transparency, security, and scalability. By leveraging the unique properties of blockchain, the system ensures fairness and integrity while reducing costs and enhancing accessibility. With further development and adoption, this approach has the potential to become a standard in corporate governance, fostering trust and accountability in decision-making processes.