



# Liquid Voting System Application with Dynamic Category-Based Presets on Blockchain

Batuhan Aydın Deniz Eylül Parlak Denizcan Boyraz

Faculty of Engineering and Natural Sciences  
Istanbul Bilgi University

December 19, 2024



## Introduction

Problem & Solution

Project Aim

Literature Review

Methodology

System Design

Implementation

Evaluation

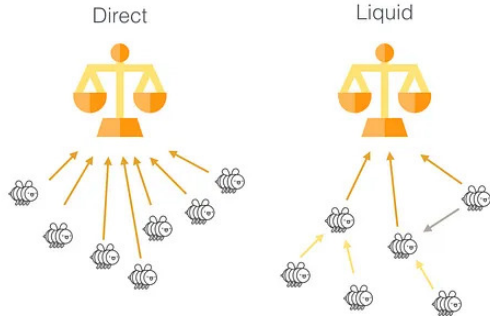
Tools

Roadmap

Conclusion



*Liquid Democracy* is a voting system that utilizes delegated voting, giving individuals the freedom to vote directly or delegate their votes to a trusted person. This form of proxy voting dates back to the 19th century, but has gained attention with blockchain technologies recently.





Introduction

Problem & Solution

Project Aim

Literature Review

Methodology

System Design

Implementation

Evaluation

Tools

Roadmap

Conclusion



## Problem

Implementing a Liquid Voting system on blockchain faces challenges such as gas fees. Each time someone delegates their vote, it will use gas to send the transaction. This can be expensive and inefficient for large scale systems.

## Solution

Our project introduces a category mechanism for efficiency. Any user can create a dynamic category preset to automatically delegate their vote, or use an existing preset. Therefore, the user will not need to delegate their vote each time.



Introduction

Problem & Solution

Project Aim

Literature Review

Methodology

System Design

Implementation

Evaluation

Tools

Roadmap

Conclusion



The main aim of this project is to implement the Flash algorithm from the paper titled “A Fast Algorithm for Liquid Voting on Blockchain” and introduce a dynamic category preset mechanism to boost efficiency on the blockchain.

### Objectives:

- ▶ Enhance efficiency with categories.
- ▶ Reduce blockchain gas costs.
- ▶ Ensure transparency and decentralization.



Introduction

Problem & Solution

Project Aim

**Literature Review**

Methodology

System Design

Implementation

Evaluation

Tools

Roadmap

Conclusion





- ▶ **A Fast Algorithm for Liquid Voting on Blockchain, Zhou et al (2021)**  
Introduces "Flash" algorithm via utilizing Merkle tree structure.
- ▶ **Google Votes: A Liquid Democracy Experiment on a Corporate Social Network, Hardt & Lopes (2015)**  
Reports on a practical experiment deploying liquid democracy principles within a corporate social network at Google.
- ▶ **DAOs, DACs, DAs and More: An Incomplete Terminology Guide, Buterin (2014)**  
Clarifies terminology and conceptual differences between DAOs, DACs, and other decentralized organizational structures.



Introduction

Problem & Solution

Project Aim

Literature Review

**Methodology**

System Design

Implementation

Evaluation

Tools

Roadmap

Conclusion



Our methodology is structured into three key phases: System Design, Implementation, and Evaluation. We make sure that both the theoretical ideas behind Liquid Democracy and the practical material that end users need to know are covered.





- ▶ **Smart Contracts:** Implement functions for creating, managing categories, and applying presets.
- ▶ **Merkle Tree:** Utilize Merkle tree structure to maintain a verifiable, tamper resistant record of voter data and delegation states, enabling efficient proof of membership and quick validation.
- ▶ **Category Presets:** Introduce a second layer for category management, stored as smart contract metadata.
- ▶ **Graph Based Model:** Use a directed graph to represent voters and delegation chains.



- ▶ **Front End Interface:** A user friendly Web3 app for creating categories, assigning delegates, and viewing proposals.
- ▶ **Off-Chain Support:** Indexing and caching for faster UI response.
- ▶ **Security & Testing:** Extensive testing, audits, and potential formal verification.



- ▶ **Stress Testing:** Simulate complex delegation scenarios to measure performance.
- ▶ **User Studies:** Assess ease of use and clarity of category-based presets.
- ▶ **Comparative Analysis:** Compare performance, scalability, and UX against baseline systems and Zhou et al.'s approach.



Introduction

Problem & Solution

Project Aim

Literature Review

Methodology

System Design

Implementation

Evaluation

Tools

Roadmap

Conclusion

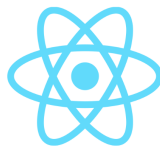


Figure: C++, Solidity, Truffle Suite, React





Introduction

Problem & Solution

Project Aim

Literature Review

Methodology

System Design

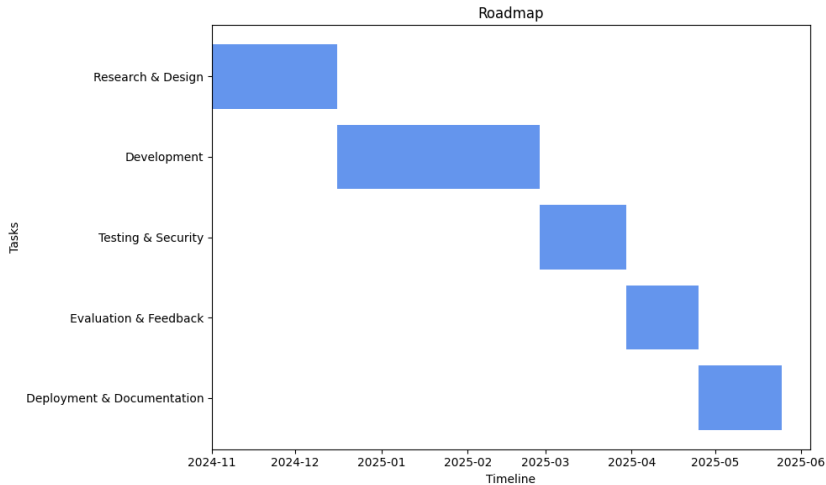
Implementation

Evaluation

Tools

Roadmap

Conclusion





Introduction

Problem & Solution

Project Aim

Literature Review

Methodology

System Design

Implementation

Evaluation

Tools

Roadmap

Conclusion



With the use of dynamic category-based presets, our project seeks to combine blockchain technology with the concepts of Liquid Voting. We hope to increase efficiency, lower gas costs, and maintain voting process transparency by leveraging the Flash algorithm and category mechanisms.