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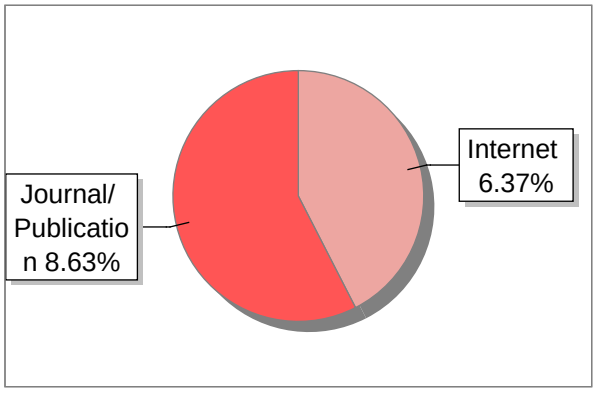

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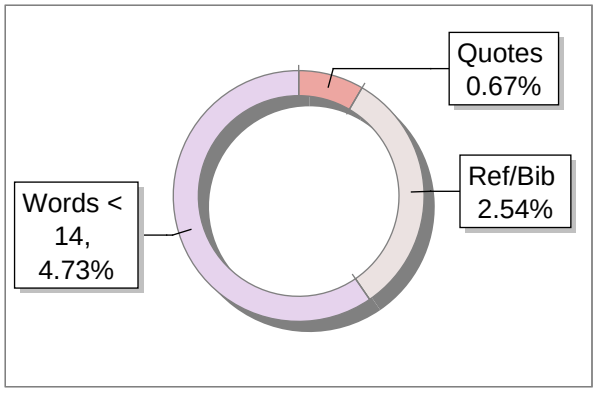

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VISVESVARAYA TECHNOLOGICAL UNIVERSITY

Jnana Sangama, Belgaum-590018

A PROJECT REPORT **(18CSP83)** ON

"DApp for Consensus Protocols in Public Interest Litigations"

Submitted in Partial fulfillment of the Requirements for the Degree of

Bachelor of Engineering in Computer Science & Engineering

By

SHANU KUMAR (1CR19CS153)

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Under the Guidance of,

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that the project work entitled "**DApp for Consensus Protocols in Public Interest Litigations**" has been carried out by **Ms. Shraddha Sahay**(1CR19CS156) and **Mr.Shanu Kumar** (1CR19CS153) bonafide students of CMR Institute of Technology in partial fulfillment for the award of **Bachelor of Engineering** in Computer Science and Engineering of the Visvesvaraya Technological University, Belgaum during the year 2022-2023. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the departmental library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree

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Name of the Examiners	Signature with Date
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DECLARATION

We, the students of Computer Science and Engineering, CMR Institute of Technology, Bangalore declare that the work entitled "**DApp for Consensus Protocols in Public Interest Litigations**" has been successfully completed under the guidance of Dr. M Raja, Computer Science and Engineering Department, CMR Institute of technology, Bangalore. This dissertation work is submitted in partial fulfillment of the requirements for the award of Degree of Bachelor of Engineering in Computer Science and Engineering during the academic year 2022 - 2023. Further the matter embodied in the project report has not been submitted previously by anybody for the award of any degree or diploma to any university.

Place:

Date:

Team members: **Signature**

SHANU KUMAR (1CR19CS153) _____

SHRADDHA SAHAY (1CR19CS156) _____

ABSTRACT

Our project aims to establish a working DAO(Decentralized Autonomous Organizations) that implements the voting system for passing of legal bills in the network. The on paper way of passing a legal bill is through majority of votes but there may be factors of influence and other parameters that are overlooked. Our Project aims is to establish consensus protocol in the organisation which allows a network of nodes to reach a conclusion on the given proposal. In our project we have discussed about the various challenges faced in the creation and deployment of Decentralization System and various legalities in DAO. Our aim is to create a decentralised system which uses Smart contract for automatic rule enforcement.

ACKNOWLEDGEMENT

The knowledge & satisfaction that accompany the successful completion of any task would be incomplete without mention of people who made it possible, whose guidance and encouragement crowned my effort with success. We would like to thank all and acknowledge the help we received to carry out this phase of the project.

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CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

LIST OF ABBREVIATION

DApp	**Decentralized Application**
DAO	**Decentralized Autonomous Organization**
PIL	**Public Interest Litigation**
NFT	**Non-Fungible Tokens**
PoW	**Proof Of Work**
PoS	**Proof Of Stake**
PoA	**Proof of Authority**
PBFT	**Practical Byzantine Fault Tolerance**
DPoS	**Delegated Proof of Stake**

Chapter 1

INTRODUCTION

1.1 Introduction

The advent in the commerce on the internet has been revolutionized with the blockchain industry. The initial third party middle men are now removed and the trust models are being replaced by proof of work concept[1]. The technology came with its own problems such as fraudulent transactions and double spending. The first whitepaper of Satoshi Nakamoto[1] presented the world with solution to a far more secured peer-to-peer transaction system over a network. It had the concepts of cryptographic proof rather than trust, allowing two willing parties to transact directly with each other. Each transaction is added as a block and has its own set of digital signatures and cryptographic hashes which are later mapped to Merkle tree for optimised disk space usage and payment verification methods.[1]

The use of the peer-to-peer chain as a tool for distributed consensus diversifies the possibilities for blockchain, which was even more amplified with the onset of smart-contracts[3]. The smart contracts are pieces of code that digitally move assets from peer to peer, based on some predefined rules[3]. The earlier proposals of Satoshi Nakamoto[1] had various limitations such as Lack of Turing-completeness, Value blindness and Lack of state.

The advent of Ethereum[2] was with the aim to overcome these challenges and to create consensus based applications having scalability, standardisation, feature-completeness, ease of development and interoperability through concepts of scripting, altcoins ,on-chain meta-protocols and smart contracts .[2]

The first instance of a decentralised organisation is described as a virtual entity with a set of shareholders or members[2]. These members have the right to spend the entity's funds and modify its code. Major decisions for the organisation takes place through multiple voting mechanisms. The simplest mechanism takes place with only 2/3rd of the majority votes and also allows for liquid democracy-style vote delegation. The assests were transferred from large number of voters towards a common fund, and major decisions on them were made through voting. The execution of which were then done through a capitalist model of a decentralized corporation[2].With the automation of rule enforcement mechanisms came the era of the DAOs referred to a decentralised autonomous organisation. The difference between a decentralised

organisation and decentralised autonomous organisation lies in the process of governance, either through political methods or through an automatic process. The contracts embedded with DAO's may become the future of organizational structure .

The term contract is seen differently by the computer scientists and the lawyers. The contract to be enforceable in the blockchain system must satisfy the traditional elements of a common law contract[4]. With the advent of smart contracts there is also an upscaling in the dispute resolution mechanisms through electoral voting.

The concepts of smart contracts enabled blockchains have entered various industries such as Supply Chain Management, Property Ownership, Retail ,Digital identity , Insurance sector and voting in elections. These concepts are also applied to the well known industry of NFTs (Non Fungible Tokens).

We plan to propose a solution to the use case of India's PIL (Public Interest Litigation) proceedings.[5][6] The proposed solution offers a system to efficiently process the pile stack of PIL with no entertainment to frivolous PILs.

1.11 Relevance of the Project

The System that we propose aims for broader spectrum of freedom[7] and equality in terms of voting power in decision making bodies. The decentralized nature of the system allows for remote and anonymous voting thereby eliminating the chances of influence on individual. Blockchain-based E-Voting System,proposes a secure and transparent system for electronic voting that uses blockchain technology and smart contracts to prevent fraud and ensure the accuracy of the voting process. The use of biometric hashing (Biohash) further enhances the security and integrity of the system by verifying the identity of the voter without storing any personally identifiable information . It also helps in improving the electoral process by providing a more secure and transparent voting system that can increase public trust and confidence in the democratic process. It has the potential to reduce instances of electoral fraud and to make the voting process more accessible, efficient, and accurate. Furthermore, the use of blockchain technology ensures that the voting data is tamper-proof and the smart contracts enable automation of the voting process, reducing the need for human intervention and minimizing errors. The use of blockchain technology in the context of legal bills can have several potential benefits. By using a blockchain-based voting system, legal bills can be

submitted and processed in a transparent and secure manner, with all transactions recorded on a tamper-proof ledger. One of the main benefits of using blockchain-based voting for legal bills is that it can increase transparency and accountability in the billing process. This can help to prevent overbilling and ensure that legal fees are accurately and fairly allocated. The use of smart contracts can also automate many aspects of the billing process, reducing the need for human intervention and minimizing errors.

Furthermore, blockchain-based voting can help to streamline the billing process by providing a secure and efficient method for submitting and approving legal bills. This can help to reduce administrative costs and improve the overall efficiency of the legal system.

Overall, the use of blockchain-based voting for legal bills has significant potential for improving transparency, accountability, and efficiency in the legal system. It has the potential to reduce instances of overbilling and increase public trust and confidence in the legal system.

1.12 Objectives

Our project aims to achieve to follow goals:

- Bring in transparency in governance systems.
- Automate rule enforcement.
- Equal opportunity to vote,
- To help in large scale decision making and rule enforcement domains, where meeting a consensus is important

1.2 Problem Statement

To design a system which enables token-holders of the network to participate and vote anonymously for multiple proposals. It will help in reaching a consensus in the Legal Framework for the case study of Public Interest Litigations in India.

1.3 Scope of the Project

Decentralized application (DApp) that utilizes blockchain technology to streamline the legal bill processing system. The project would aim to create a user-friendly interface that enables lawyers, clients, and law firms to submit and track their legal bills, as well as view the status of their submissions.

The project would also involve utilizing smart contracts to automate the legal billing process, including invoice generation, payment processing, and fee allocation. The use of smart contracts can reduce the need for intermediaries and human intervention, thereby increasing the efficiency of the billing process.

The scope of the project would also involve addressing challenges related to implementing blockchain-based DApps for legal bill processing. These challenges include ensuring data privacy and security, managing scalability, and complying with legal and regulatory requirements. Moreover, it involves integrating the DApp with other blockchain-based solutions in the legal industry, such as electronic signatures, identity verification systems, and document management systems. This integration can further enhance the security and efficiency of the legal billing process.

The project would involve designing and implementing a user-friendly interface that enables users to submit and track their legal bills, as well as view the status of their submissions. The DApp would also incorporate as a future endeavour smart contract technology to automate many aspects of the billing process, such as invoice generation, payment processing, and fee allocation involve exploring the potential use of other emerging technologies such as artificial intelligence and machine learning to enhance the efficiency and accuracy of legal billing processing.

Overall, our project is to develop a practical and efficient DApp that leverages blockchain technology to improve the legal bill processing system's transparency, security, and efficiency. The project has the potential to significantly impact the legal industry by providing a more secure, efficient, and transparent way to process legal bills.

1.4 Software Engineering Methodology

Our Project uses agile development methodology for cyclic development and improvement(reviews). The major stages of our software cycle are:

- Problem Identification and Ideation
- Discussions and Review of problem
- Development of solution
- Testing and Comparison of solution
- User Interactions

- Operations

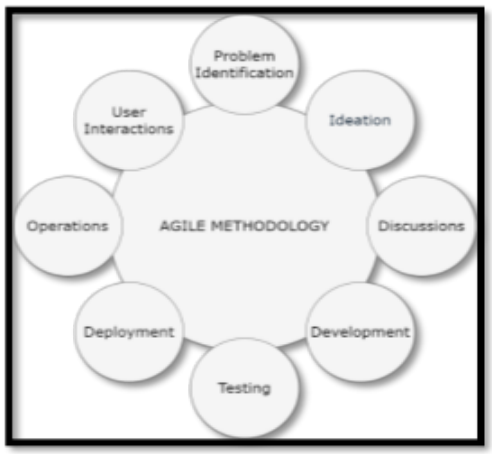

Figure 1.1 Software Engineering Cycle

1.4 Tools and Technologies

SOFTWARE COMPONENTS

Table 1-1 Software Requirements

NAME OF THE COMPONENT	SPECIFICATION
Operating System	Windows 11 and above versions
Language	Solidity, TypeScript
Database	Decentralized Public Ledger
Browser	Locally Hosted
Software Development kit	Visual Studio, Hardhat, OpenZeplin, Truffle, Ganache

HARDWARE REQUIREMENTS

Table 1-2 Hardware Requirements

NAME OF THE COMPONENT	SPECIFICATION
Processor	Intel i5 or above processor with 1.60 GHz Clock speed

RAM	Minimum 4GB
Hard Disk	Minimum 250GB
Monitor	14” color monitor
Keyboard	104 keys

1.5 Approaches

Table 1-3 DAO Deployments

DAO-As-A-Service	Aragon DAO, DAOhaus, DAOStack
DAO from scratch	The DAO architecture
Open-Source DAO development	Hyper Ledger platform, Hardhat

Table 1-4 Voting Methodologies

Holographic Consensus	DAO Stack	the quorum required to approve a proposal can be reduced from absolute majority to relative majority if some conditions are met
Permissioned Relative Majority	Moloch DAO	There is no minimum quorum requirement and each member of the DAO has immense power.
Quadratic Voting		Makes proof of identity necessary , cost of vote is related to the square of number of votes a member wishes to acquire.
Liquid Democracy		Delegates votes to trusted experts who are prepared to make decisions and casters can change vote anytime.
Multisig Voting		Brings the perfect balance between centralized and decentralization concepts. Fast and urgent actions.
Conviction Voting		Community’s aggregated preference and time as

		utility, longer a member remains in the organization stronger the vote becomes.

1.6 Schedule

This is the Gantt chart designed for our project. We did the planning, Research and Literature review in the first phase from September to November. We started with the design of models in December and implemented the models, executed during March and April. Follow up was done during every stage of the project.

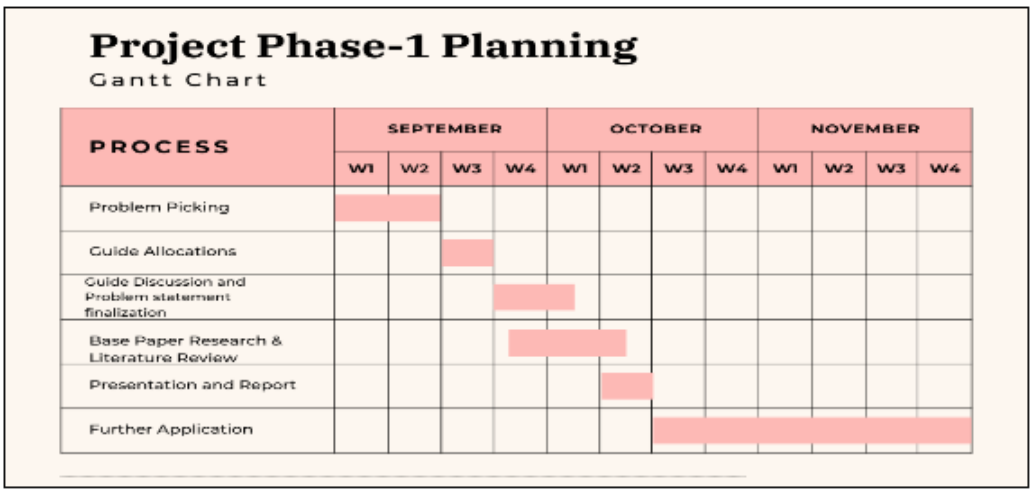

Figure 1.2 Timeline for the project

1.7 Chapter Wise Summary

The entirety of this piece of writing is organized in the following manner:

- Chapter 2 gives a brief comparison on the survey done on various research papers related to the problem statement.
- Chapter 3 gives details about the proposed models.
- Chapter 4 gives the Implementation of our project.
- Chapter 5 gives details about the desired results obtained.
- Chapter 6 gives the conclusion, contribution and the future scope.

Chapter 2

LITERATURE SURVEY

2.1 OVERVIEW

Blockchain as a technology has ruled over the last decade and has shown continuous growth despite the challenges of being decentralized. Researches have led to an open discussion on the applicability, challenges and future scope of blockchain and related domains.

Substantial research can be found on this topic with the keywords as 'Decentralized', 'Autonomous', 'Distributed Organization', 'Consensus Protocol', 'E-Governance'. We have surveyed over major papers in this domain from reputed journals such as IEEE and Internet Serv Appl 12. A major chunk of data can be found from online blogs and technical articles, which provide new insights on the current discussion.

The literature survey that was carried out for this project scope broadly classifies the papers reviewed under five major classes.

2.1.1 Decentralized autonomous organizations on the blockchain

Title: An overview of decentralized autonomous organizations on the blockchain **Author:** Y El Faqir, J Arroyo, S Hassan

Publisher: Proceedings of the 35th Annual ACM Symposium on Applied Computing (SAC '20)

Year of Publication: 2020

Discussions: The authors also discuss different types of DAOs, such as member-managed DAOs, investor-managed DAOs, and hybrid DAOs, and provide examples of successful DAOs that have been implemented on various blockchain platforms. The paper discusses various successful DAOs that have been implemented on different blockchain platforms. One example is MakerDAO, a decentralized credit platform that allows users to borrow and lend cryptocurrencies using stablecoins backed by collateral. Another example is MolochDAO, a grant-giving DAO that supports projects related to Ethereum development and community building. The authors also discuss DAOstack, a platform for creating and managing DAOs that

provides a range of tools and features for governance, decision-making, and collaboration. The paper highlights the potential of DAOs to enable new forms of collective action and value creation, and to empower communities and individuals to participate in decision-making and resource allocation in a more decentralized and transparent way.

	Release	DAOs	Key features
Aragon	Oct. 2018	1459	* Modularity * Permissions
DAOstack	Apr. 2019	22	* Holographic consensus improving scalability.
DAOhaus	Aug. 2019	127	* Rage quitting * Simple decision system
Colony	Feb. 2020	-	* Work driven (meritocracy) * DAOs split into domains.

Figure 2.1 Summary of DAO platforms

Major Conclusions: DAOs represent a promising new paradigm for organizing and coordinating human activity in a decentralized and transparent way. The authors argue that DAOs have the potential to enable greater participation and collaboration among stakeholders, to reduce transaction costs and increase efficiency, and to foster innovation and experimentation. However, they also emphasize the challenges and risks associated with DAOs, such as security vulnerabilities, governance challenges, and regulatory uncertainty. The paper calls for further research and development in this area, including the exploration of new governance models and the development of better tools and frameworks for designing and managing DAOs

Limitations: The paper brings to light the significant technical, legal and social challenges that are to be addressed. The major limitations of the technology is scalability and regulatory challenges associated with DAOs.

2.1.2 Smart Contracts in Decentralized Systems

Title: Blockchain Technology and Smart Contracts in Decentralized Governance Systems
Author: A. P. Balcerzak, E. Nica, E. Rogalska, M. Poliak, T. Klieštik, and O.-M. Sabie.

Publisher: MDPI (Multidisciplinary Digital Publishing Institute)

Year of Publication: 2022

Approach: The paper discusses the potential of blockchain technology and smart contracts in developing secure and transparent voting systems and decentralized identity management systems. In the case of voting systems, blockchain technology can be used to create a tamper-proof and transparent system that ensures the accuracy of election results. Blockchain-based voting systems can provide a higher level of security, transparency, and efficiency compared to traditional voting systems, which can help prevent fraud and ensure the integrity of the democratic process. Similarly, blockchain technology can be used to develop decentralized identity management systems that allow individuals to control their personal data and protect their privacy. Decentralized identity management systems can provide a more secure and transparent way of verifying identities, which can help prevent identity theft and fraud. Overall, the paper highlights the potential of blockchain technology and smart contracts in enabling more secure and transparent voting systems and identity management systems, which can bring many benefits to governance.

Major Conclusions: The authors argue that the adoption of blockchain technology and smart contracts in governance can bring many benefits, such as increased transparency, reduced transaction costs, and greater efficiency. However, the paper also highlights the challenges and limitations of these technologies, such as scalability issues, regulatory challenges, and the need for further research and development. Overall, the paper provides a comprehensive overview of the role of blockchain technology and smart contracts in enabling more inclusive and participatory forms of governance, and highlights the need for further exploration of these technologies in the context of governance.

Limitations: The limitations include scalability, regulatory challenges, interoperability, and governance challenges. These limitations can hinder the potential of blockchain technology and smart contracts in governance, and there is a need for further research and development to address these issues. The paper highlights the importance of developing governance frameworks that ensure the transparency, accountability, and inclusivity of these technologies in governance.

2.1.3 Blockchain and E-governance applications

Title: A Survey of Blockchain and E-governance applications: Security and Privacy issues

Author: Ohood M. AlMendah, Mohammed A. AlZain, Mehedi Masud, NZ Jhanjhi, Jehad Al-Amri, and Mohammed Baz

Publisher: Journal of Cybersecurity and Information Management

Year of Publication: 2021

Discussions: The case study focuses on the Ministry of Communications and Information Technology's (MCIT) initiative to use blockchain to secure and streamline government transactions. The MCIT's blockchain-based system is designed to enable secure and transparent transactions between government entities, citizens, and businesses, while also reducing transaction costs and processing times.

Major Conclusions: It draws several important conclusions about the use of blockchain in e-governance. First, the paper highlights the potential benefits of blockchain in improving transparency, accountability, and efficiency in government transactions. Second, the paper discusses the major security and privacy challenges associated with the use of blockchain in e-governance and identifies several mechanisms that can be used to mitigate these challenges. Third, the paper provides a case study of the use of blockchain in e-governance in Saudi Arabia, which highlights both the potential benefits and challenges associated with the technology. Finally, the paper emphasizes the need for careful planning and implementation of blockchain-based e-governance systems to ensure compliance with relevant regulations and adequate cybersecurity measures to protect against potential cyber threats.

Limitations: The adoption of blockchain-based e-governance systems requires significant investment in technology infrastructure and human resources. This can be a barrier to adoption, particularly in resource-constrained environments. Another limitation is the potential for cybersecurity threats and attacks on blockchain-based e-governance systems. Blockchain systems are not immune to cyber threats, and any vulnerabilities in the system can be exploited by attackers. Therefore, adequate cybersecurity measures must be in place to protect against potential attacks and ensure the integrity and confidentiality of government transactions.

2.1.4 A new form of corporate governance

Title: The DAO Controversy: The Case for a New Species of Corporate Governance

Author: Robbie Morrison, Natasha Mazey, and Stephen Wingreen

Publisher: Frontiers in Blockchain

Year of Publication: 2020

Discussion: The DAO was a decentralized investment platform that operated on the Ethereum blockchain, and it was designed to be governed by its community of token holders through a system of smart contracts. However, in 2016, the DAO was hacked, resulting in the theft of over $50 million worth of Ether. This led to a debate about the legal and regulatory status of DAOs and whether they could be considered as a new form of corporate entity. The paper argues that the traditional legal frameworks for corporate governance may not be suitable for DAOs and that new forms of governance may need to be developed to ensure their effective operation and regulation.

Major Conclusions: The limitations of current corporate governance structures and the need for a new species of governance that is more decentralized, transparent, and inclusive. The authors argue that blockchain technology and smart contracts can be used to create new types of organizations that are more democratic and responsive to the needs of their members. They propose a new model of governance based on a hybrid structure that combines the best features of traditional corporations and DAOs, and they suggest that this model could be used to solve some of the problems that have arisen in the wake of the DAO controversy..

Limitations: The authors do acknowledge that the regulatory and legal frameworks surrounding DAOs are still evolving and that there may be challenges in defining the responsibilities and obligations of various stakeholders in a DAO. Additionally, the authors note that there may be challenges in ensuring that DAOs are accountable to their members and that their decision-making processes are transparent and fair.

2.1.5 eGov-DAO

Title: eGov-DAO: a Better Government using Blockchain based Decentralized Autonomous Organization

Author: N. Diallo, M. Ouoba, A. L. Traore, and A. S. Ouedraogo

Publisher: IEEE

Year of Publication: 2018

Approach: The paper proposes the eGov-DAO system, which is a decentralized governance framework for e-government services. The architecture consists of three main layers: the

presentation layer, the service layer, and the blockchain layer. The presentation layer provides a user interface for citizens to interact with e-government services. The service layer contains the application logic and interfaces with the blockchain layer to perform transactions. The blockchain layer is the backbone of the system and provides the necessary security and transparency through distributed ledger technology. The proposed architecture uses smart contracts to automate processes and enforce rules, such as ensuring that only eligible citizens can participate in voting processes. The eGov-DAO system aims to provide a more efficient, transparent, and accountable e-government service to citizens by leveraging the benefits of blockchain technology.

Major Conclusions: The paper proposes a new model of governance called eGov-DAO that is based on blockchain technology and a decentralized autonomous organization. This model is expected to improve the efficiency and transparency of government operations, reduce corruption, and increase citizen participation in decision-making. The authors conclude that eGov-DAO has the potential to transform the way governments operate and to create a more democratic and responsive system of governance.

Limitations: The paper highlights a few limitations of the proposed eGov-DAO approach. Firstly, the proposed system relies heavily on the participation of stakeholders, and the effectiveness of the system may be compromised if there is a lack of participation or cooperation from them. Additionally, the implementation of the proposed approach requires significant investment in terms of time and resources, which may be a challenge for some governments. The paper also notes that the use of blockchain technology and smart contracts in e-governance is still relatively new, and there are ongoing concerns regarding the security, scalability, and interoperability of these systems that need to be addressed.

2.1.6 Blockchain Solutions for E-Voting

Title: Analysis of Blockchain Solutions for E-Voting: A Systematic Literature Review

Author: Ali Benabdallah, Antoine Audras, Louis Coudert, Nour El Madhoun, and Mohamad Badra

Publisher: IEEE

Year of Publication: 2020

Approach: The paper discusses various blockchain-based e-voting systems proposed in the literature. Some of the systems discussed include "Decentralized Voting System" that uses Ethereum blockchain to conduct voting, "Blockchain Voting with Untrusted Networks" that uses a two-layer blockchain-based system to ensure vote integrity, "Decentralized E-Voting System based on Smart Contract by using Blockchain Technology" that proposes a decentralized e-voting system based on smart contracts, and "A Blockchain-Based E-Voting System with Smart Contracts" that proposes a voting system that uses smart contracts to ensure transparency and fairness in the voting process.

Major Conclusions: blockchain technology has the potential to enhance the security, transparency, and efficiency of e-voting systems. However, there is still a need for more research and development in the field to overcome the challenges associated with blockchain-based e-voting, such as scalability and usability issues. The paper also suggests that a hybrid approach combining blockchain with other technologies, such as homomorphic encryption and biometrics, can be a promising solution for building more secure and user-friendly e-voting systems.

Limitations: The paper identifies several limitations of blockchain-based e-voting systems, including the lack of a universally recognized identity management system, concerns about the accuracy and security of the voting process, and the potential for privacy breaches. The authors also note that blockchain technology is still relatively new and untested in large-scale, high-stakes applications such as national elections, and that more research and development is needed to address these limitations before widespread adoption of blockchain-based e-voting systems can become a reality. Additionally, regulatory and legal frameworks need to be developed to ensure the integrity, transparency, and accountability of such systems.

2.1.7 Blockchain Solutions for E-Voting

Title: Blockchain-Based E-Voting System

Authors: Friðrik Þ. Hjálmarsson, Gunnlaugur K. Hreiðarsson, Mohammad Hamdaqa, and Gísli Hjálmtýsson

Publisher: IEEE

Year of Publication: 2018

Approach: The authors propose the use of a "blockchain as a service" (BaaS) approach as a core concept for their e-voting system. BaaS allows the development of blockchain-based applications without requiring the developers to set up and manage the entire blockchain infrastructure themselves. Instead, they can use an existing blockchain platform that provides the necessary services and infrastructure for their application.

The authors used Microsoft's Azure Blockchain Service as their BaaS provider, which allowed them to easily create and deploy a permissioned blockchain network with minimal effort. The network consisted of a set of nodes distributed among several entities, such as universities and government agencies, which ensured the integrity and security of the voting system.The BaaS approach also allowed the authors to use smart contracts to manage the voting process, which are self-executing contracts that automatically enforce the rules and regulations of the voting system. The smart contracts used in this e-voting system were designed to ensure transparency, security, and auditability, which are essential features for any e-voting system.

Major Conclusions: They concluded that their system overcomes the limitations of traditional e-voting systems by providing secure and transparent voting, eliminating the need for a central authority, and preventing fraud and manipulation. They also argued that their system could be easily integrated into existing e-voting systems and that the use of blockchain as a service could reduce the costs associated with maintaining and updating the system. The authors suggested that the use of blockchain technology in e-voting has the potential to revolutionize the electoral process and make it more democratic and transparent.

Limitations: The authors point out that BaaS is not a decentralized solution, as the blockchain network is managed by a single entity. This could lead to concerns around centralization and security, as the system would be vulnerable to attacks or manipulation by the entity managing the network. Additionally, BaaS may not be cost-effective for small-scale e-voting systems, as it requires payment for the services provided by the network. The authors suggest that these limitations could be overcome by developing a custom blockchain network specifically for e-voting, but note that this would require significant resources and expertise.

2.1.8 Biohash and Smart Contracts

Title: Digital Voting: A Blockchain-based E-Voting System using Biohash and Smart Contract
Authors: Syada Tasmia Alvi, Mohammed Nasir Uddin, and Linta Islam
Publisher: IEEE, ICSSIT 2020
Year of Publication: 2020
Approach: Biohash is used for biometric authentication of voters to ensure that only authorized individuals are allowed to vote. Smart contracts are used to enforce the rules and regulations of the voting process and to ensure the transparency and fairness of the system.

Biohash is a biometric security mechanism that allows for the storage and comparison of biometric data in a secure manner without actually storing the raw biometric data. Instead, a one-way hash function is used to create a unique digital signature for the biometric data, which is then stored on the blockchain. During the voting process, voters provide their biometric data, which is converted into a biohash and compared with the stored biohashes to ensure that the voter is authorized to vote.

Smart contracts are used to enforce the rules and regulations of the voting process, such as eligibility criteria for voters, the number of votes per person, and the time period for voting. These contracts are self-executing and self-enforcing, meaning that they automatically execute the terms of the contract when certain conditions are met. This ensures that the voting process is fair, transparent, and tamper-proof, as the rules are enforced without the need for human intervention.

Major Conclusions: The biohash technique provides an added layer of security by using biometric features to generate a unique hash for each voter, which is then used to authenticate their vote. The use of smart contracts on the blockchain allows for transparency in the voting process and ensures that the voting rules are enforced without the need for a central authority. The authors conclude that their proposed system can address the issues of transparency and security in traditional voting systems and provide a feasible solution for a secure and trustworthy e-voting system.
Limitations: Like any biometric-based authentication system, there could be potential limitations related to accuracy and security. For example, there is a possibility of false positives and false negatives in the biometric recognition process, and there is also a risk of biometric

data being compromised or stolen. Additionally, there may be challenges in ensuring that the biometric data is stored securely and not vulnerable to hacks or breaches.

2.1.9 Decentraland DAO

Application: Decentraland DAO is a Decentralized Autonomous Organization (DAO) that governs the Decentraland virtual world

Developers: Esteban Ordano and Ari Meilich

Maintained by: Decentraland Foundation

Year of Development: 2017

Functionality: Its main functionality is to allow community members to participate in the governance of the Decentraland ecosystem. This includes making decisions on important issues such as platform development, allocation of resources, and the distribution of the MANA cryptocurrency, which is used as the in-world currency. The DAO operates on a blockchain-based governance system, which allows for transparency and decentralization in decision-making. Members of the Decentraland community can participate in the DAO by holding a minimum amount of MANA tokens and staking them to vote on proposals. In Decentraland DAO, identities are represented as non-fungible tokens (NFTs) that are minted by members. These NFTs serve as a representation of a member's stake and voting power within the DAO. Members can use their NFTs to participate in the DAO's decision-making process, such as proposing and voting on proposals. The number of NFTs a member holds determines their voting power and influence within the DAO. The DAO also has a reputation system where members can earn reputation points by actively participating in the decision-making process and contributing to the development of the Decentraland ecosystem. Reputation points can increase a member's voting power and access to certain privileges within the DAO.

Major Conclusions: Decentraland DAO represents an innovative approach to decentralized governance and community involvement in the development and management of a virtual world. The Decentraland DAO uses a voting technique based on the Ethereum network, which employs a proof-of-stake consensus algorithm to secure its blockchain.

Drawbacks: The drawbacks of the Decentraland DAO include the fact that it is still relatively new and untested, so there may be unforeseen issues that arise as it is used more extensively.

2.1.10 Aragon DAO

Application: Aragon is a DAO platform that allows the creation and management of decentralized organizations on the Ethereum blockchain.

Developers: Luis Cuende and Jorge Izquierdo

Community: Aragon Network

Year of Development: 2016

Approach: The Aragon network uses its native cryptocurrency token, ANT, which is used for governance and decision-making within the network. With Aragon, individuals and groups can easily create decentralized autonomous organizations (DAOs) without needing technical expertise. The platform provides a range of tools and features for managing the DAO, including voting mechanisms, fundraising and budget management tools, and dispute resolution systems. Aragon has been used for a variety of decentralized applications, including decentralized finance (DeFi) platforms, governance mechanisms for other blockchain projects, and even community-owned media platforms..

Major Conclusions: Aragon uses a liquid democracy voting mechanism, which combines both direct and representative voting. In this mechanism, token holders can either vote directly on proposals or delegate their voting power to a third party, who can then vote on their behalf. This allows for more flexibility in decision-making and encourages participation from a wider range of stakeholders. Additionally, Aragon allows for quadratic voting, which gives more weight to the votes of those who are most affected by the outcome of the proposal. This helps to ensure that the interests of the community are properly represented in the decision-making process.

Limitations: There are some drawbacks to the Aragon platform, including the potential for centralization through large token holders, the difficulty of modifying the underlying smart contracts, and the limited ability to handle complex decision-making processes. Additionally, the token-weighted voting system may not always result in a fair or democratic outcome, as those with more tokens will have more voting power, potentially leading to vote manipulation and governance by a small group of individuals.

2.1.11 Comparison

Various consensus mechanism are compared in the following table.

Table 2-1 Comparison of protocols-1a

Consensus Mechanism	Algorithm	Energy Consumption	Speed	Security
Proof of Work (PoW)	SHA-256	High	Slow	High
Proof of Stake (PoS)	Variants including Casper, Tendermint, Algorand, and more	Low to Medium	Fast	High
Delegated Proof of Stake (DPoS)	EOSIO, Lisk, Steem, and more	Low to Medium	Fast	Medium to High
Practical Byzantine Fault Tolerance (PBFT)	Hyperledger Fabric, Ripple, and more	Low to Medium	Fast	High
Federated Byzantine Agreement (FBA)	Stellar	Low	Fast	High

Table 2-2 Comparison of protocols-1b

Consensus Mechanism	Example Use Cases	Advantages	Disadvantages
Proof of Work (PoW)	Bitcoin, Ethereum	- Proven security - Simple to implement	- High energy consumption -Limited transaction throughput - Centralization of mining power
Proof of Stake (PoS)	Cardano, Tezos	- Energy-efficient - More equitable distribution of rewards -Higher transaction throughput	- Vulnerability to attacks by majority holders - Potential for centralization
Delegated Proof of Stake (DPoS)	EOS, Tron	- High transaction throughput - Less energy consumption than PoW - More democratic voting system	- Vulnerability to attacks by majority holders - Centralization of power in the hands of block producers
Proof of Authority (PoA)	Kovan, POA Network	- High transaction throughput - Low energy consumption - Sybil-resistant	- Centralization of power in the hands of validators - Potential for censorship and corruption

Consensus Mechanism	Example Use Cases	Advantages	Disadvantages
		- Simple governance structure	
Practical Byzantine Fault Tolerance (PBFT)	Hyperledger Fabric	- High transaction throughput - Low latency - Guaranteed finality of transactions	- Requires a fixed set of nodes - Vulnerability to attacks by a minority of malicious nodes - Limited scalability
Raft	Ethereum 2.0	- Fast transaction finality - Simple implementation	- Requires a fixed set of nodes - Limited scalability
Tendermint	Cosmos	- High transaction throughput - Low latency - Byzantine fault tolerance	- Requires a fixed set of nodes - Limited scalability

2.2 RESEARCH GAP

As blockchain technology continues to mature, there is an increasing interest in exploring its potential for e-voting. However, despite the numerous proposed solutions, there is still a research gap in the development of a blockchain-based e-voting DApp that can be used in real-world scenarios. One of the major challenges is ensuring the privacy and security of the voting process while also maintaining transparency and auditability. There is a need for a DApp that can provide end-to-end verifiability of the voting process, while also ensuring the anonymity of voters. Additionally, scalability is another important factor that needs to be considered, especially for large-scale elections. Another research gap is the lack of standardization in the development of blockchain-based e-voting systems, which makes it difficult to compare different solutions and identify best practices. Overall, there is a need for further research and development in blockchain-based e-voting DApps to address these challenges and ensure the adoption of secure and trustworthy e-voting systems.

Chapter 3

PROBLEM FORMULATION

With recent advent of technology, the process of decision making has to be made available at grass root levels to make democracy inclusive. The cases of publicly raised concerns has ever since been taken with a lot more gravity.

PIL's -Public Interest Litigations form a fair share of the legal society. The concept was introduced to protect the fundamental rights of people who are poor, ignorant or in socially/economically disadvantaged position. The process of PIL's though noble but lacked the sincerity from the public to make it a success. People took hatred and revenge as the core for filing petitions , and upturned justice in the most brutal ways. The courts later revised the core principles and policies to file a PIL and levied lump-sump charges on those filed with a negative intention. These cut down the number of PIL's received without a strong base but with the rise in social crimes the numbers never actually reduced and the court hearings got extended.

Our system takes birth from this crevice. The need of a better system to tackle the timelines and prioritizing the cases has never been as prominent as it has been now. The pandemic changed the course of due nature and even took justice online, so the possibility of a well-maintained network for judicial matters is not a far-off dream. A system with the vision of distributed democracy and weighted opinions can ensure a better priority order for the scheduling of hearings in the court.

The effectiveness of a good consensus protocol for weighted decision making and holding a trial to publicly available facts, with the individuals with protected identity will lead to a better space for freedom and also lessen the burden from the traditional legal structure.

The stakeholders of this permissioned system would be the litigants, the law professionals and other trusted parties who have authorized access to the organization and holds true voting power.

3.1 TIME CONCEPTS

The entire system internally relies on 3 major time concepts:

Table 3-3 Time based terms in Voting

VOTING DELAY (votingDelay)	(Governor Contract) Time interval in terms of number of blocks between submitting a proposal and when **voting power is fixed**. This can be used to enforce a delay after a proposal is published for users to unstake tokens, or delegate their votes.
VOTING PERIOD (votingPeriod)	(Governor Contract) The time window that starts after votingDelay, in number of blocks, as to till when **voting is open**.
DELAY TIME (minDelay)	(Time Lock Contract) delay period before a passed proposal is executed. The **proposal is "queued"**. It provides opportunity for users to exit DAO if they disagree.

3.2 WORK-FLOW

The system was designed by keeping the stakeholders in mind. We identified the various stakeholders for our system as shown in the figure 3.1. The system can be used for the use for the purpose of proposing a bill to the network which can be scanned and read by multiple users. This allows easy access of information to all the nodes and makes the system transparent to the citizens. The vote weightage of each party of the legal body can be determined depending on the track of the bill and the context it has been proposed for. Users can also engage with the platform for passive income generation through active participation and staking mechanisms.

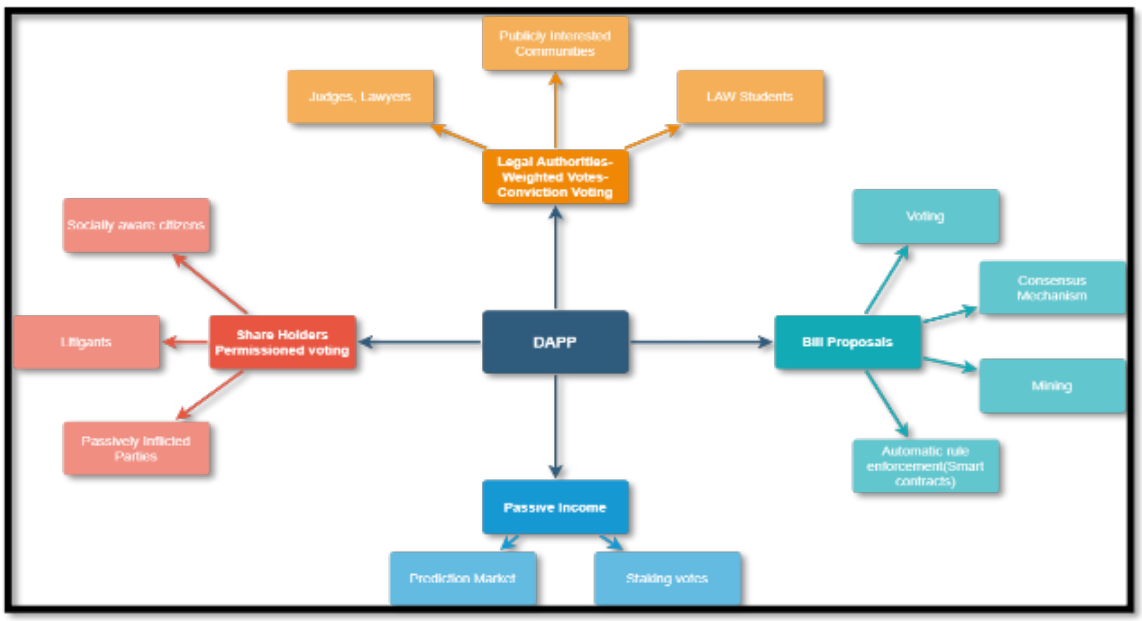

Figure 3.1 System Components Design

The System workflow can be seen in figure 3.2. The box contract proposal is introduced to the network and undergoes a phase of voting delay. After finishing which it goes through the voting period where the users can cast their votes for or against the proposed bill. The voting tally or the consensus is met based on weightage calculation of votes and consensus protocols. If the result turns out as positive it is put in the delay queue for before it is enforced on the network. It allows users to take a stand for their stakes invested. The final execution of contract ends with mining the result on the chain and wait for the new proposals to drop in.

If the proposal is rejected, it is treated as it never existed.

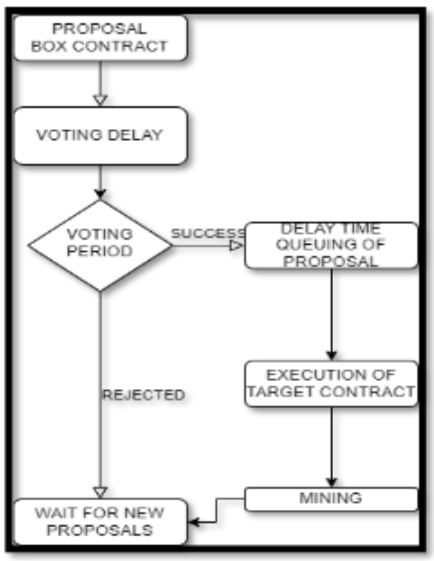

Figure 3.2 System workflow design

3.3 DESIGN AND ARCHITECTURE

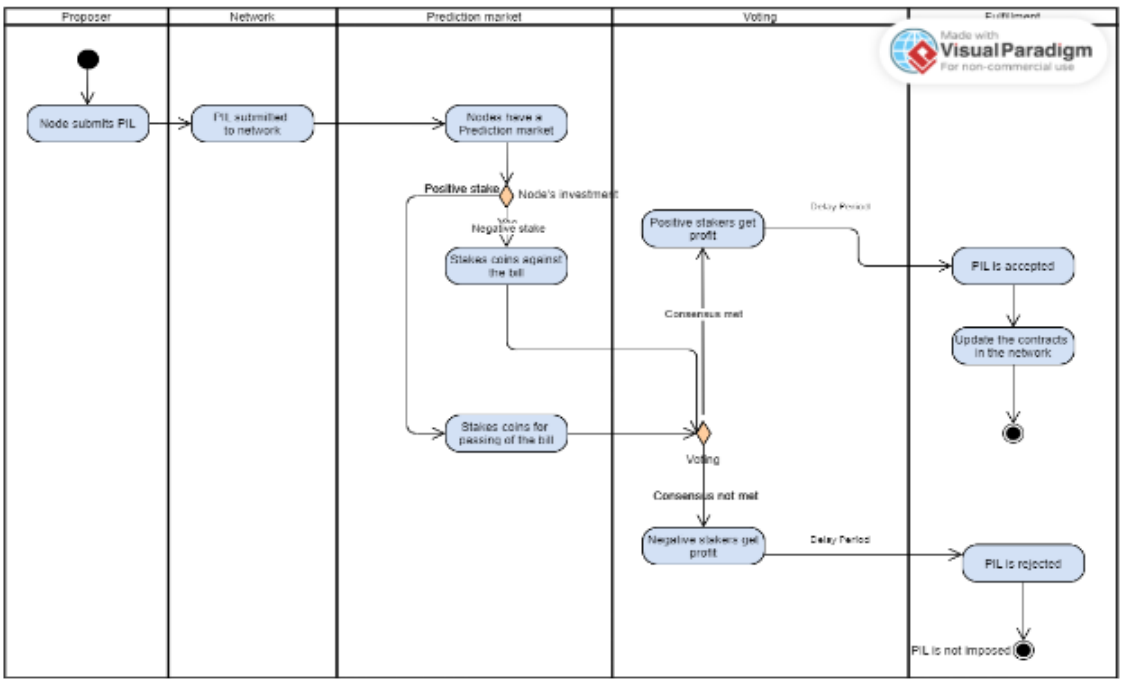

Figure 3.3 System Design

The design of the proposed system figure 3.3 was made keeping the problem statement in mind. The main functionality of the project is to create a Dapp for voting for PILs. This system allows users to participate in the voting process by being a shareholder of the network. There are various stages involved in the process:

- Proposer: The current system allows only for the admin to be a proposer of the bill in the network. They introduce a bill through the backend and add a voting period to it, till which the voting on the proposal would be accepted.
- Network: The bill is introduced to the network. Every user is able to see the proposal on their dashboard with details such as days left to vote, description of proposal , owner of contract and even a button for exercising voting power.
- Prediction Market: The users can stake tokens for the outcome of the proposal in the network. It allows for users to earn some extra tokens from the network.
- Voting : The actual voting starts during this stage, where users can cast their votes through the interface.
- Fulfillment : Based on the voting outcome, the proposal is implemented in the network or discarded. It also furbishes to the tokens used in the prediction market.

Chapter 4

IMPLEMENTATION

4.1 ROADMAP FOR PROJECT

The system is under continuous development and has a defined timeline as shown in figure 4.1. We had a thorough research done for the decentralized and web3 implementations. It brought to light the drawbacks and the perks of the technology. This lead to making a decisive stand on why decentralization was the need of the hour. We then worked to build our smart contracts and wrote various scripts to locally test and deploy it on a dummy network. Our last stage process was to implement a front-end for the project so as to show user interaction while the backend remained shelled from the users.

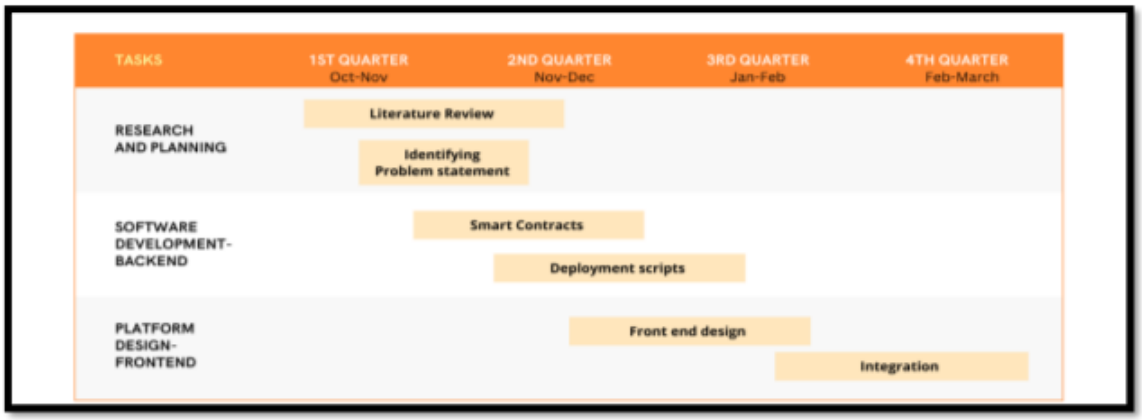

Figure 4.1 Project Roadmap

4.2 SMART CONTRACTS – IMPLEMENTATION

Smart contracts are the code version of formalizing and securing relationships on a public network[8]. There are 4 major smart contracts that form the basis of our project:

- GovernorContract
- Box Contract
- TimeLock Contract
- GovernanceToken Contract

4.2.1 GOVERNOR CONTRACT

This contract forms the base of logic and mechanics of the entire system[9]. It helps to propose proposals, cast votes and execute the proposals based on the voting outcome. It is the administration base of the system.

```
constructor(IVotes _token, TimelockController _timelock, uint256 _votingDelay,uint256 _votingPeriod, uint256 _quorumPercentage)
    Governor("GovernorContract")
    GovernorSettings(
        _votingDelay /* 1 block Voting delay */,
        _votingPeriod /*Voting period 1 week */,
        0/*Proposal threshold */)
    GovernorVotes( token)
    GovernorVotesQuorumFraction( quorumPercentage) //i.e. 4% quorum percentage
    GovernorTimelockControl(_timelock)
{}
```

Figure4.2 Constructor

```
function state(uint256 proposalId)
    public
    view
    override(Governor, GovernorTimelockControl)
    returns (ProposalState)
{
    return super.state(proposalId);
}

function propose(address[] memory targets, uint256[] memory values, bytes[] memory calldatas, string memory description)
    public
    override(Governor, IGovernor)
    returns (uint256)
{
    return super.propose(targets, values, calldatas, description);
}

function proposalThreshold()
    public
    view
    override(Governor, GovernorSettings)
    returns (uint256)
{
    return super.proposalThreshold();
}

function _execute(uint256 proposalId, address[] memory targets, uint256[] memory values, bytes[] memory calldatas, bytes32 descriptionHash)
    internal
    override(Governor, GovernorTimelockControl)
{
    super._execute(proposalId, targets, values, calldatas, descriptionHash);
}
```

Figure 4.3 Functions of Governor

4.2.2TARGET-BOX CONTRACT

This smart contract is the target contract or the proposal on which votes are drawn on. The state of this contract changes after voting. For our system we have taken a sample target contract of updating the value of a value of a variable “value” to a new value based on the voting consensus outcome. This is the contract that is executed after the Time Lock period gets over.

```
contract Box is Ownable{
    uint256 private value;

    event ValueChanged(uint256 newValue);

    function store(uint256 newValue) public onlyOwner{
        value=newValue;
        emit ValueChanged(newValue);

    }

    function retrieve() public view returns(uint256){
        return value;
    }
}
```

Figure 4.4 Target Contract

4.2.3TIME-LOCK CONTRACT

This smart contract gives a waited-pause to the execution of successfully passed proposals, so as to allow the unhappy members to leave and not be enforced with the decision. It forms a Queue to enforce the Time gap between proposal passing and execution. It also does access control or allotment of roles such as **administrators, proposers and executors**.

```
contract TimeLock is TimelockController{

    constructor(
        uint256 minDelay ,
        address[] memory proposers,
        address[] memory executors,
        address admin
    )TimelockController(minDelay, proposers, executors,admin){}
}
```

Figure 4.5 TimeLock Contract

4.2.4GOVERNANCE-TOKEN CONTRACT

This smart contract gives every participant a right to vote in the system. It issues the tokens on the chain. It keeps track of the total supply spent and the real world tally for the supply in the test network created. Here, we have generated our own token called the "**Kanoon Token**" for the members participating in this DAO.

```
contract GovernanceToken is ERC20Votes{
    uint256 public s_maxSupply= 1000000000000000000000000;
    constructor()
    ERC20("KanoonToken","KT")  /*governance token */
    ERC20Permit("KanoonToken")
    {
        _mint(msg.sender,s_maxSupply);
    }

    //Function below overrides required by Solidity
    //afterTokenTransfer--->how many tokens are sent, what are the total suppy, update snapshot
    //state changes
    function _afterTokenTransfer(
        address from,
        address to,
        uint256 amount
        ) internal override(ERC20Votes){
            super._afterTokenTransfer(from,to,amount);
    }
    //_mint-->how much we send , add from total supply to real world
    function _mint(address to, uint256 amount) internal override(ERC20Votes){
        super._mint(to,amount);
    }
    //burn--> take them out of total supply
    function _burn(address account, uint256 amount) internal override(ERC20Votes){
        super._burn(account,amount);
    }
}
```

Figure 4.6 Governance Token creation

4.3 FRONT END – IMPLEMENTATION

The front-end of the project is made using html and css. The frontend is equipped with the functionality of fetching data from the backend and displaying it to the user as their dashboards. The user faces a Metamask wallet connection as soon as they enter the dApp[10] for authorization and authentication. After which they are enabled to interact with the application through the voting transactions. On each vote the user is prompted for a transaction from their

Metamask account. The front-end application is made through truffle framework along with a ganache blockchain for a locally hosted chain network[11]. This local chain is connected to Metamask wallet through chain Id.

As for the application to be deployed live, we would have to connect it to an existing chain and incur billing charges, for a proof-of-concept project we have scoped ourselves to create a locally hosted application.

This simple interface is the demo for what our DApp would look like when it is floated as an application on the main network. We have used locally hosted networks and dummy wallets for this front-end implementation.

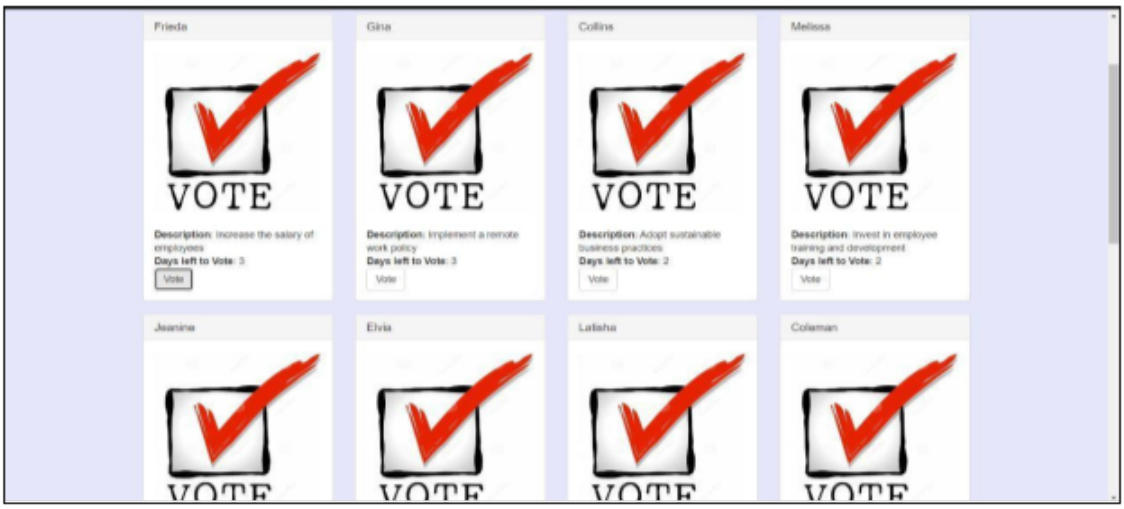

Figure 4.7 Front-end

Chapter 5

RESULTS

The application brings in a more democratic form of governance for the people by introducing a voting system that has:

1. Increased transparency and efficiency: A consensus protocol helps to ensure that all participants in a network are in agreement about the current state of the system. By building a dapp with a consensus protocol, you can increase transparency and efficiency, since everyone can see and agree on the same information.
2. Decentralization: Many consensus protocols are designed to be decentralized, meaning that no single entity has complete control over the system. This can help to prevent corruption and abuse of power, as well as increase trust in the system.
3. Lower costs: Some consensus protocols, such as Proof of Stake (PoS), are designed to be more energy-efficient and cost-effective than older protocols like Proof of Work (PoW). By using a dapp with a consensus protocol, you could potentially save on costs associated with running the system.
4. Improved security: Consensus protocols help to prevent attacks and ensure that the system is secure. By building a dapp with a consensus protocol, you can increase the security of the system and reduce the risk of hacks or other security breaches.
5. User Interface: User interface allows for the users to easily interact with the blockchain system and cast vote easily and transparently.
6. User Interactivity: Users of the system were able to cast vote for the proposals and engage with the system through their crypto-wallets.

We could create a demo working front-end along with a working consensus algorithm for the PIL voting use case. We developed the smart contract for the voting to happen on multiple parameters , which could be changed by the client based on the requirements. Currently our system administers to only admin generated proposals but as a future scope we would include all token holders to propose a bill.

Chapter 6
CONCLUSION & FUTURE SCOPE

Blockchain technology is used to develop a decentralized application that streamlines the proposal acceptance process in the legal industry. The project seeks to address the challenges[12] and issues associated with traditional proposal acceptance processes, such as lack of transparency, inefficiency, and security risks.

The initial proof of concept will involve the development of a DApp that associates an Ethereum address with a proposal to be accepted. The team will write the smart contract and front-end logic for the DApp, which will include features such as user-friendly interface, voter eligibility verification, and automated vote tallying.

The future scope of this project is vast, as it has the potential to revolutionize the legal industry. In the long term, the project can expand to include more complex and advanced features, such as the integration of artificial intelligence and machine learning algorithms to analyze proposals and make informed decisions. The DApp can also be expanded to include other functions related to legal bill processing, such as billing and invoicing, case management, and document management.

The future scope would include expanding along the horizon of allowing every network member to add/propose bill in the network. It would also be available as a SaaS for multiple use case for voting such as BoardRoom meetings where decision making is highly confidential as well as privacy is of major concern.

"DApps for Legal Bill Processing" has significant potential to improve the efficiency, transparency, and security of the proposal acceptance process in the legal industry, and has promising future scope for further development and expansion.

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