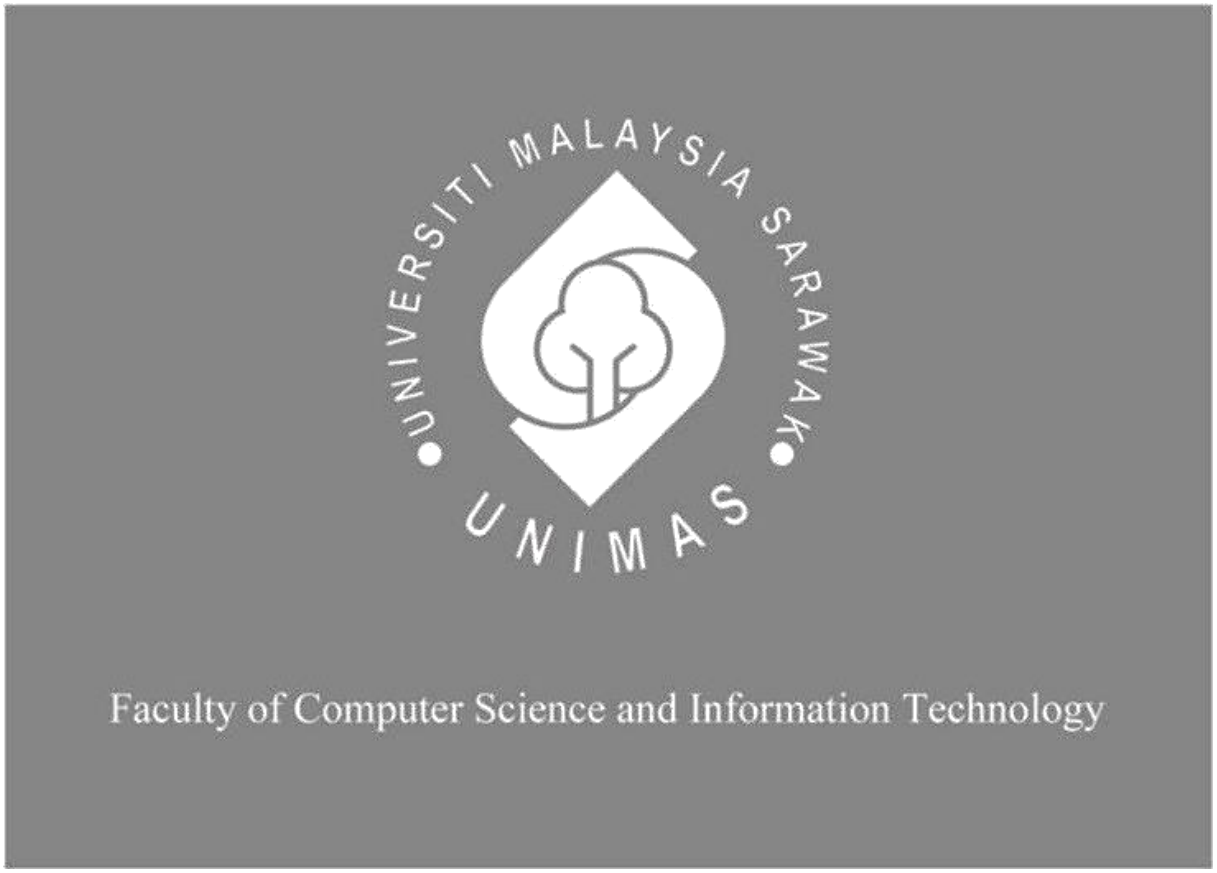

A Scalable college hostel voting system using polygon technology.

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Bachelor of Computer Science with Honors
(Software Engineering)
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ABSTRACT

Voting is important for our democratic society, even in university. Voting in university means students have the equal rights to vote for the candidates who will become their representatives. To vote for the candidates, the students have to access the residential college online voting system. However, using the online voting system is not without drawback, as there are some issues that need to be address. Thus, the blockchain technology exists to overcome these issues. This study is focused on the development of a scalable college hostel voting system using polygon technology.

ABSTRAK

Aktiviti seperti mengundi adalah sangat penting untuk memupukan semangat demokrasi dalam kalangan mahasiswa dan mahasiswi di institusi pengajian tinggi. Pelajar-pelajar di universiti mempunyai hak yang sama rata dalam memilih calon yang akan mewakili mereka untuk menyelesaikan masalah-masalah dihadapi pelajar. Semasa durasi pengundian sedang berjalan pelajar harus mengakseskan sistem mengundi dalam talian kolej kediaman. Walau bagaimanapun, sistem mengundi dalam talian mempunyai kelemahannya yang tersendiri. Oleh itu, teknologi blockchain merupakan solusi untuk kelemahan ini. Kajian ini memfokuskan kepada pembangunan berskala sistem pengundian kolej kediaman menggunakan teknologi poligon.

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1. CHAPTER 1: INTRODUCTION

1.1 Introduction

Universiti Malaysia Sarawak (UNIMAS) consisted of 8 residential colleges in total to accommodate UNIMAS students from across Malaysia as well as international students. Each of these residential colleges has a student committee in which act as a representative to voice students' concerns to the college administration. The process of picking a representative is by having a residential college election. During this covid-19 endemic, voting usually takes place online by using a google form. However, google form is susceptible to information theft during vote casting because it carries sensitive data such as students' matric number, and phone number consequently compromising their private details to malicious third parties. Works have been done to develop blockchain that enabled voting system for residential colleges. However, blockchain is known to have low scalability and subsequently cannot accommodate many students casting votes at the same time. The issue presents itself on how we scale blockchain technology to accommodate a wider range of students to use the voting system more effectively. Scalability is an issue in which rather prevalent within the blockchain environment, such as, throughput which is also known as transaction per second, cost or gas fees, and latency referring to the processing time of a transaction. According to Worley and Skjellum. (2018), even in the limited market that blockchains now have, scalability has emerged as one of the main problems.

To date, Polygon is used as a scalable solution to Ethereum's expensive gas fees, and slow transaction per second while reaping the benefits provided by Ethereum. In conjunction of the high degree of decentralization preserved and the quick block confirmation rates of roughly 2 seconds made possible by this, the network's throughput is exceptional. The network can handle millions of transactions per second thanks to the use of many sidechains. The Polygon network may quickly scale thanks to this method. Furthermore, it makes use of a group of motivated validators running Heimdall and Bor nodes as well as Ethereum's staking management contracts.

Nowadays, blockchain decentralized applications are run under a software platform called Ethereum. Decentralized applications in blockchain are developed using Solidity, and JavaScript programming language. However, Polygon also a platform to build blockchain decentralized application has been garnering attention from Ethereum developers for its fast transactions speed, high user throughput, and inexpensive gas fees which has a few upgrades that was missing from Ethereum. To what extend Polygon can scale up the current voting system is the focus of this research. In this thesis, a scalable college hostel voting system using polygon technology is developed.

1.2 Problem Statement

Scalability is one of the main issues present in blockchain application. A blockchain that enabled a voting system for residential colleges is developed to cast votes by students to choose their student representative on their respective colleges. How do we accommodate more students to use blockchain voting system with minimal cost. Ethereum has a very expensive gas fees in deploying decentralized application in blockchain. Hence, applying the usage of Polygon technology for a scalable residential college voting system is yet to be explored.

1.3 Objectives

- To develop a voting system in blockchain using Polygon.
- To design a voting system in blockchain using Polygon.
- To evaluate Polygon based voting system.

1.4 Procedures/Methodologies

The methodology that is used is Waterfall methodology in developing and designing a scalable residential college voting system using Polygon technology. The Waterfall model is a methodology for managing projects in which each step is completed before moving on to the next. A project management approach called the Waterfall methodology is based on a sequenced design process that closely resembles a waterfall face. Methodology such as these is likely to devote more time to gathering requirements because the waterfall methodology demands that they be thoroughly documented before the start of any other project phase. Gathering requirements typically begins with a notion or an understanding of what the user wants to accomplish. by outlining very clearly customer needs. The physical design determines the components, such as storage and the network architecture, that will make the design phase a reality. The logical design is an abstract representation of how system data flows at the output (Sinha, & Das, 2021). Subsequently, Waterfall methodology focuses on a well-defined project direction and works on a smaller to medium scale of software development. The reason I chose this methodology is to ensure meticulous execution of every phase and prevent the back and forth of phases.

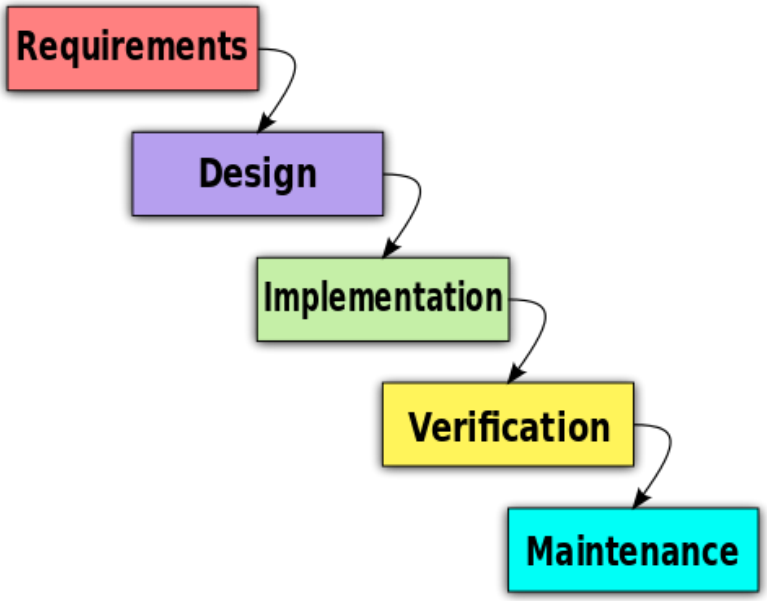

Figure 1.1 Waterfall Methodology

1.4.1 Requirement Analysis Phase

The end users of this project will be UNIMAS students, and Residential College administrators. The current scope of this project will only cater to residential colleges in UNIMAS. The requirement analysis is conducted by one-on-one interviews, questionnaire to intended demographic using Google Form, and the utilization of Use Cases. In addition, multiple collections of books, journals, and research are reviewed to gain more knowledge on the concept of Blockchain, Solidity programming language, and Polygon. The scalability of Polygon on how it can enhance the voting system in blockchain is studied. These requirements are then separated into two categories which are the functional requirement, and non-functional requirement.

1.4.2 System Design Phase

The user interface of the voting system is drafted and designed using Figma. The layout consisted of a login page, candidate overview page, residential college page, casting vote page, homepage, register candidates' details page, voting results overview page, edit voting schedule page, register candidates, and profile page. Human Computer Interaction concepts are taken into consideration for a user friendly and effective voting system. On the other hand, the system design is conducted with the usage of use case, sequence diagram, activity diagram, and ERD. The layout of system architecture is drafted and designed as well as the database needed to store information for the voting system.

1.4.3 Implementation

Implementation involved the usage of Visual Studio Code for scripting JavaScript programming language, while Remix Integrated Development Environment (IDE) for scripting Solidity programming language respectively which is vital in the development of the system in blockchain. Web3.js is used as Ethereum JavaScript API in order to interact with an Ethereum node locally, or remotely through HTTP, IPC, and WebSocket using a collection of libraries. The voting system will then be deployed into the Polygon Network.

1.4.4 Testing Phase

Having a test case on every feature whether it runs as intended. Verifying if the system developed has the necessary requirement. The voting system will be ready to be released after testing.

1.5 Scope

A scalable college voting system using Polygon technology is developed by using Solidity, and JavaScript programming language. It was designed to make a scalable system for accommodating a large number of students at one time.

1.5.1 System Environment

Table 1.1 below shows the hardware and software that was used to design and develop a scalable college voting system using Polygon technology.

Hardware	**Laptop or Desktop** • A platform for developing a secure system voting system.
Software	**Visual Studio Code** • A programming editor for JavaScript **Remix Online IDE** • A programming editor for Solidity programming language **Web3.js** • Ethereum JavaScript API **Polygon Network** • A platform to deploy decentralized applications

Table 1.1 System Environment.

1.6 Significant Project

This project involved enhancing existing voting system in blockchain using Polygon technology. Hence, making the voting system more scalable for UNIMAS students to vote for their representative in residential colleges. In conjunction, students can experience a more secure platform for voting system without worrying if their personal information will be compromised.

1.7 Project Schedule

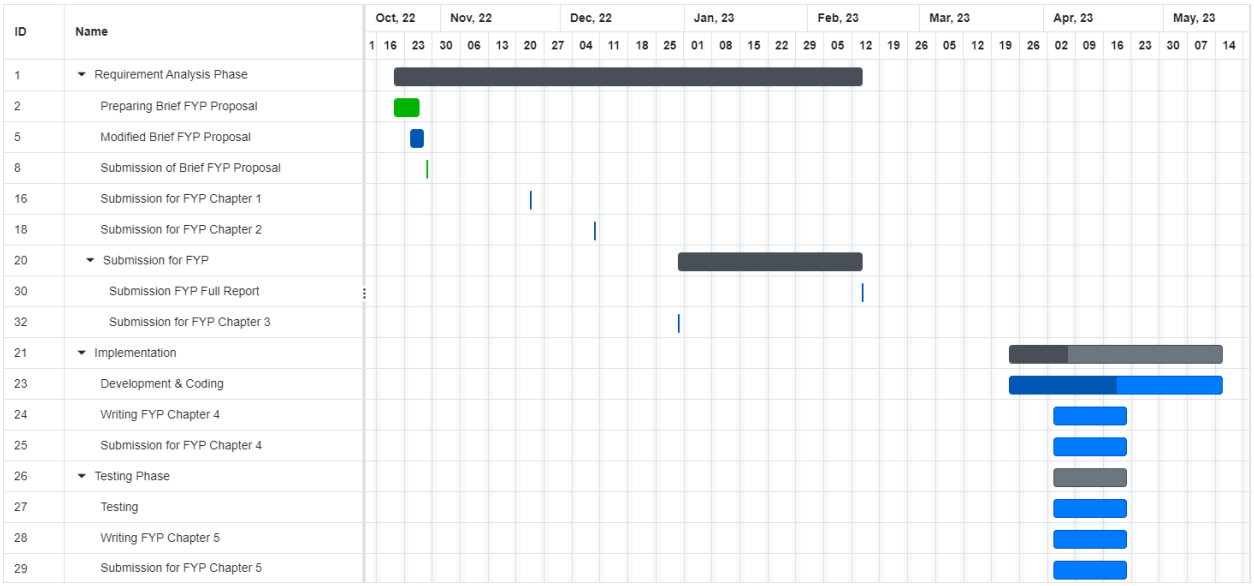

Figure 1.2 Project's Gantt Chart

1.8 Expected Outcome

At the end of this project, a scalable voting system for residential college using Polygon technology is developed.

2. CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter reviews related research on blockchain applications. Section 2 presents the background study on blockchain technology. The background study on online voting system using Blockchain and Ethereum is presented in section 2.3. On the other hand, 2.4 presents the scalability issues for blockchain applications using Ethereum. Section 2.5 discussed approaches on overcoming scalability issues using Polygon technology. In addition, discussion of this chapter is shown in section 2.6. The chapter is concluded in section 2.7.

2.2 Background study on blockchain technology

The concept of cryptocurrency was first proposed by Satoshi Nakamoto a pseudonym who came up with a system where any two willing parties may deal with each other directly using an electronic payment system based on cryptographic proof rather than trust without the assistance of a third party (Satoshi Nakamoto, 2008).

According to Hjálmarsson et al. (2018), blockchain can be visualised as a ledger that cannot be deleted or tampered with. Each block inside the blockchain has a hash which connected to a previous block that function in inserting previous node and providing immutability assurance. The two types of blockchain, public and private network. It is a platform to develop immutable and distributed applications or smart contracts other than cryptocurrencies. Smart contracts are programmed agreements that go into effect automatically when certain criteria are met. Smart contracts are utilised as a legally enforceable agreement between parties, just like traditional written contracts. The advantages, and disadvantages of blockchain is shown in Table 2.1.

Advantages	Disadvantages
Immutability	Performance
Transparency	Speed
Traceability	High implementation costs
Anonymity	Rigid data modification

Table 2.1 Shows the advantages and disadvantages of Blockchain.

According to Bhutta et al. (2021), blockchain that were used for cryptocurrencies are called “Blockchain 1.0”. The information that entered into a list of records, also known as “blocks,” the data structure of Blockchain 1.0. These blocks consisted of a Block Header, and a Block Body as shown in Figure 2.1.

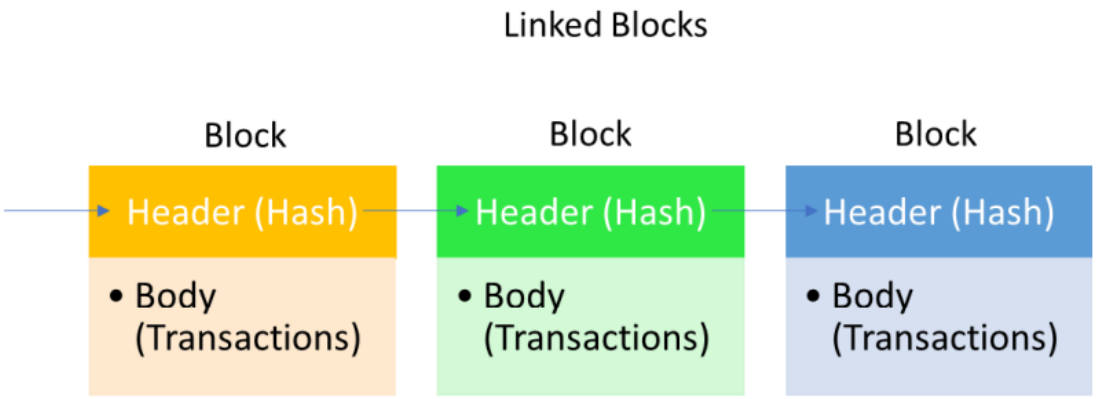

Figure 2.1 the block visualization inside blockchain.

The hash in Figure 2.1, is a unique identifier used for blocks to identify previous blocks. Hashing is the process by which a particular algorithm converts input data of arbitrary length into a sequence of a predetermined length. The Secure Hashing Method 256 bits (SHA-256) is the hashing algorithm used for Bitcoin. In essence, a hashing algorithm uses an infinite number of bits to conduct calculations before returning a specific number of bits.

Blockchain 2.0 refers to Smart Contracts. A smart contract is a computerized transaction protocol that carries out a contract's provisions and is how it is defined. Without the use of a reliable middleman, smart contracts automatically enforce agreements between two or more parties. These smart contracts are embedded as computer programs in Blockchain software's' like Ethereum, and Hyperledge. The same digital currencies are recorded, the history of these transactions is also stored in Blockchain. Similarly, to cryptocurrencies, smart contracts' proper execution does not depend on a reliable third party (Bhutta et al., 2021).

On the other hand, Blockchain 3.0 specifically point out to blockchain applications. For the development of distributed applications, such as games, user-generated content networks, the internet of things (IoT), smart hardware, supply chains, source tracing, and economy sharing credits, blockchain technology has been used by various industries. These distributed applications benefit from many features offered by blockchain technology, such as improved performance in terms of low latency and high throughput, easier identity management, the ability to conduct offline transactions, and flexible maintainability for system upgrades and bug recovery (Bhutta et al., 2021). Figure 2.3 explained by Bhutta et al. (2021), are the layered architecture of blockchain 3.0.