DEVELOPMENT OF DECENTRALIZED APPS USING BLOCKCHAIN TECHNOLOGY TO IMPROVE MALAYSIAN GOVERNMENT SERVICES AT MINISTRY OF HOME AFFAIRS

By

Gunn Wei Teong

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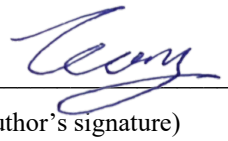

(Author's signature)

(Supervisor's signature)

Address:
E230, Lorong 22, Taman Sejati Indah,
08000 Sungai Petani,
Kedah, Malaysia.

Mr. Su Lee Seng
Supervisor's name

Date: 21 April 2022

Date: 21 April 2022

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

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ABSTRACT

Land registration and land dealing involves lot of middlemen and central authorities in the process which puts trust in the system. Keeping track of who owns which part of land is challenging when there are hundreds or thousands of land records to maintain. The current land registration and land dealing process in Malaysia have some flaws such as increasing number of fraud cases in land registration, restricting land owners' rights in land dealing and time-consuming processes. Therefore, this project aims to improve the government services in Malaysia by developing a Blockchain-based land registration system for the Minister of Home Affairs. Using Blockchain technology, it enables decentralization, transparency, immutability and traceability in the land registration and land dealing process. Middlemen in between processes can be reduced drastically which leads to less corruption and sped up processes. The proposed system is developed using the concept of Ethereum Blockchain network and smart contracts. There are two roles in the system, which is user and government authority. The system allows user to register and store their land details into the Blockchain. The details stored in the Blockchain are immutable thereby preventing forgery of land documents. A government authority who traditionally looks into land registration process is assigned to ensure details given by users are legitimate before entering the Blockchain. Once their land is registered, users have the option to sell their land through the system. Users can just interact with one another as buyer or seller and deal their land without restriction or authorization. There is no worry about any backdoor activities as all transactions are stored in the Blockchain, which enables transparency and traceability of transactions. Other than that, the introduction of smart contracts has fully removed middlemen like brokers and central authorities from the land dealing process. This is because smart contracts have automated the land ownership transfer and fund transfer between buyer and seller.

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LIST OF ABBREVIATIONS

DApp	Decentralized Application
RMP	Royal Malaysian Police
SPA	Sale and Purchase Agreement
IPFS	Interplanetary File System

1 Chapter 1: Introduction

1.1 Problem Statement and Motivation

- The increasing number of fraud cases for land registration in Malaysia

In Malaysia, title registration fraud has increasingly become a primary concern. This has greatly violated the rights of the actual owner of the land. The most common occurrences of land registration fraud are falsification of original issue document of title, signature, transfer form, identification card, court's order, power of attorney and even impersonation as a registered proprietor or estate agent. Based on the statistics published by Royal Malaysian Police (RMP), there was a total of 730 fraud cases reported from the period between 2005 and 2012. In 2015, there was a total of 90 cases reported with losses amounting to RM20 million. Moreover, January to May 2016, the RMP received 151 land fraud reports with losses exceeding RM30 million. The factors that are leading to the increasing land fraud cases are abandoned land, increase in property prices and weaknesses in the land registration system which are easily manipulated by fraudsters [9].

- Land owners' rights to deal with their land are restricted by the restriction of interest

Sale and Purchase Agreement (SPA) requires land owners to compliant with the restriction in interest. During the sale and purchase of land, land owners must carefully examine the document of title and look out for the 'Restriction in Interest'. The restriction in interest limits the right of the land owners to deal with their lands, by requiring them to seek for the consent of the State Authority before any transactions can occur. This restriction will also limit the right of the land owners to request for amalgamation, subdivision and partition of their lands. The following is an example of the restriction in interest, 'This land cannot be leased, transferred or charged without the consent of the State Authority'. The purpose of the restriction in interest is to allow the State Authority to keep track on the types of land dealings and land applications happening around [1].

- Time consuming land registration and land dealing process in Malaysia

Land owners are required to follow the restriction in interest stated in the SPA which brought a downside in time consumption. By following the restriction in interest, the normal completion period of 3+1 months for the land dealing process will be extended by an estimated 3-6 months. Land owners are required to obtain the consent of State Authority for transfer of land to the buyer within a period of 4 months from the signing date of SPA with an additional grace period of 2 months. The payment of the balance purchase is within 4 months of the signing date of SPA. However, everything done by the land owners will not count if the consent of State Authority is not obtained. The SPA will come to an end if consent is not given by the State Authority [1]. Moreover, the involvement of middlemen like brokers and government intermediaries slows down the both processes. Land owners require to go through different intermediaries to prove their ownership of land before registering or dealing the land. The whole process can take months to complete and in between the processes there could be time delay if the intermediaries take a long time to prove the land ownership. For land dealing, land owners also need to find a suitable broker to help them facilitate the process. This process is both time consuming and costly. Brokers require time in order to find a suitable candidate to purchase the owner's land while the brokers' facilitating fee is quite expensive.

1.2 Project Objectives

- To develop a tamper proof land registration system to prevent continuously increase in land registration frauds in Malaysia

There are several methods fraudsters use to conduct their fraudulent activities like changing electronic or paper documents, creating fraudulent documents and altering or deleting information in accounting systems. However, blockchain is immutable, by design. Transactions recorded in the blockchain network are safe because they cannot be changed or deleted. This makes the blockchain tamper proof. Before a block of transactions can be added to the blockchain, the blockchain network participants must agree the transactions are valid, this process is called consensus. The block is then timestamped, secured with cryptography and appended to the previous block in the chain. Although new transaction can be created to change the state of an asset, it will not delete or change the previous related record, it will just be added to the chain. Hence, the original record is still accessible. By utilizing blockchain, we can see the provenance of an asset, which includes the ownership of the asset, the location it came from and been.

- To apply a distributed digital ledger in the land registration system to keep track of all land dealings in Malaysia and allow land owners to deal with their lands without restriction

A distributed digital ledger is possible with the help of blockchain technology. A blockchain is actually a type of distributed digital ledger that contains transaction data which is shared across a peer-to-peer network and is reconciled continuously. Instead of having a central administrator, authorization and management is spread across the network. Hence, land dealing activities can be easily detected. With the introduction of a shared digital ledger, the visibility and transparency of the transactions made are increased. Any participants in the blockchain will be able to see the history and transfer of assets. Hence, if there are any land dealing activities occurring, they will be easily traced and identified. By doing so, land owners do not need to receive the consent from State Authority before dealing with their lands. They are able to deal their lands as they please and the State Authority will have records on each and every transaction made.

- To decrease the government intermediaries required in between land registration process and implement smart contracts in land dealing process to speed up and prevent time delays for both processes

The land registration system allows land owners and government authorities to interact directly. For the land registration process, land owners can just interact with government authorities on the system to prove their land ownership without having to go through multiple government intermediaries. The government authorities on the system will check the legitimacy of the land owners then only register their land to the Blockchain. Smart contracts are able to reduce the time needed in the land dealing process. This is because they assist in getting the confirmation of land ownership. In the traditional system, land owners require to get the land ownership confirmation from government intermediaries before they can sell their lands. This is to make sure that the seller is actually the owner of land but slows down the process tremendously. Sometimes there are even time delays in the process because of late responds from intermediaries. However, blockchain and smart contracts have removed the necessity of this process. All of the land owners' documents that prove their ownership of the land have been kept in the blockchain network. After that, if a land owner decides to sell and transfer the ownership of the land, the smart contract will automatically retrieve the land owner's information from the blockchain and prove his/her ownership of land. Once proven, the smart contract will trigger ledger updates for the land ownership. The buyer will replace the seller as the owner of the particular land. But, if the seller's document cannot be found by the smart contract, the seller could be a fake and not allowed to proceed with the transaction. By automating land ownership proving and land ownership updates, the total time of doing a deal is reduced from several months to few days.

1.3 Project Scope and Direction

With the development of a blockchain-based land registration system, it is able to solve the problems faced by the current land registration system in Malaysia.

One of the problems is the number of fraud cases for land registration is increasing in Malaysia. Nowadays, imposters can forge title documents to fake land ownerships with technology. However, Blockchain land registration system allows land owners to upload their land documentation into the blockchain network where others can verify the document when needed. The records kept in the blockchain network are immutable thereby proving the ownership of each land and preventing forgery of documents. Blockchain is an anti-fraud technology by design. It is a tamper-proof and shared record of transactions that are time-stamped and then verified by a distributed network of computers. This creates a near real-time audit trail of transactions produced.

Other than that, the blockchain-based land registration system also solves the problem of restriction of land owners' rights to deal with their land. The restriction of interest in the Sale and Purchase Agreement does not allow land owners do sell their land as they please. They are required to get consent from the State Authority before the dealing can be proceeded. State Authority needs the restriction in interest within the Sale and Purchase Agreement to allow them to keep track on the types of land dealings and land applications happening around the country. However, with the introduction of blockchain technology, this restriction of interest can be removed. This is because all transactions of land dealings between buyer and seller will be stored in the blockchain network. Transaction like buyer viewing land descriptions, transfer of ownership between seller and buyer or registration of new lands are stored. Therefore, the State Authority are able to keep track of all land dealings without limiting land owners' rights. Land owners are able to deal as they please and the State Authority do not need to worry of any land dealings behind the back as all transactions must go through the blockchain network and they can be easily audited.

Furthermore, the blockchain-based land registration system solves the problem of time consumption in the land registration and land dealing process. Land owners

now do not have to go through many government intermediaries to prove their land ownership, they will just go through one government authority. The land owners and government authorities will be connected through the system. Hence, when land owners register their lands on the system, the government authorities will be able to prove land ownership with the system. With the introduction of smart contracts, the land dealing process has accelerated. Smart contracts are self-executing contracts where the agreement terms between a buyer and a seller are in lines of code. This makes the land dealing process simpler by automating verified transactions. By doing so, ownership transfer has become quicker and seamless than traditional systems. Smart contracts are able to trace back ownership records from the blockchain network and easily proves the seller's ownership of the land. This eliminates the need of government intermediaries for proving land ownership and prevents the time delay caused from them. Smart contracts also eliminate the need of middlemen like brokers as sellers are able to deal their lands on their own. Sellers are able to find buyers through the system and smart contracts trigger the transfer of ownership between them. Moreover, land owners do not require the consent from State Authority before land dealings which saves a lot of time. This is because the smart contracts signed by both parties will be stored in the blockchain network and the State Authority will have the proof of land dealings made.

1.4 Project Contributions

Land registration takes a long time to finish the full process. There may possibly be time span of months between registration and completion. However, a Blockchain land registration system is able to accelerate the land registration process for users and reduce the time span needed drastically. This is achieved by reducing the government intermediaries needed in between the land registration process. Users now just need to go through one government authority to register their land. Moreover, Blockchain land registration system is a web portal that serves as a distributed database where anyone has the rights to store and access information without permission of any centralized authority. With immutable records of transactions maintained, Blockchain is able to prove user's land ownership and prevent any falsify documentation of the land.

Blockchain land registration system will also bring transparency to the land dealings between buyer and seller. All the transactions done between buyer and seller will be store in the Blockchain and displayed to other users. Furthermore, users will save cost on hiring middleman like brokers to facilitate the land dealing process. In this system, buyer and seller can directly communicate with each other and deal their land as they please. As long as both parties give their consensus, the transaction will be a success. Furthermore, the implementation of smart contracts in the system accelerates the land dealing process. This is due to the fact that land ownership verification will be automated and government intermediaries will not be needed in between the land dealing process.

1.5 Report Organization

This report is organized into 7 chapters: Chapter 1 Introduction, Chapter 2 Literature Review, Chapter 3 System Approach, Chapter 4 System Design, Chapter 5 System Implementation, Chapter 6 System Evaluation and Discussion and Chapter 7 Conclusion and Recommendation.

The first chapter is the introduction of this project which includes problem statement and motivation, project objectives, project scope and direction, project contributions and report organization. The second chapter is the literature review carried out on several existing blockchain land registration systems to evaluate the strengths and weaknesses of each system. The third chapter shows the use-case diagram and description of the proposed system. The fourth chapter is discussing the overall system design of this project. The fifth chapter is regarding the details on how to implement the design of the system. Furthermore, the sixth chapter reports the test results of the system. Lastly, the final chapter gives a brief conclusion of the overall report and recommendations for future work.

2 Chapter 2: Literature Review

2.1 Review of the Technologies

2.1.1 Blockchain

Blockchain is a distributed database of records, or in other words digital transactions that have been conducted and shared among participating parties. All of these transactions are verified with the consensus of a majority of the participants in the system before entering the distributed database. Once the transaction is stored in the database, it can never be erased. Blockchain contains verifiable records of each transaction that is produced [6]. Hence, Blockchain produced tamper resistant and tamper evident digital ledgers applied in a distributed fashion that allows for the absent of central repository and central authority like bank [4].

Using the Blockchain technology, decentralized systems can be achieved and use to replace centralized systems. Centralized system means there is a master node responsible to break down tasks or data and distribute them across other nodes. While, decentralized system does not require a master node and it is still able to distribute tasks or data among nodes. Moreover, there are three different perspectives, technical, political and logical, to determine a centralized system or a decentralized system. In the technical perspective, an example is a decentralized system will be able to sustain more node failures before the whole system crashes as it does not have master nodes. In the political perspective, decentralized system has no specific individual or groups who control the system and everyone has the same rights on the system while centralized system is the opposite. In the logical perspective, if computing devices are able to operate as independent units even though half of the service providers and consumers are gone, they are decentralized and centralized otherwise [3].

The main question is why decentralized systems is replacing centralized systems. There are many benefits decentralized systems have over centralized systems. One of the benefits is that decentralized systems do not have a central point of failure and this makes them stable, fault tolerant and attack resistant. A centralized system has a central point of failure, so it is less stable and more vulnerable to attacks. Another benefit of decentralized system is equal authority for all which will have less unethical operations. Unethical operations usually are caused by centralization of power. Other

than that, the scalability of centralized systems is difficult most of the time which prompts the use of decentralized systems [3].

However, blockchain technology is not new and actually has started years ago. Blockchain technology started in the late 1980s and early 1990s. On 1989, Leslie Lamport developed the Paxos Protocal and presented the paper 'The Part-Time Parliament' towards ACM Transactions on Computer Systems in 1990. This paper discussed about a consensus model in order to reach an agreement in a network of computers. In 1991, a signed chain of information was used as an electronic ledger for signing documents digitally so it easily showed none of the signed documents was tampered. These concepts were combined and implemented to electronic cash and a paper 'Bitcoin: A Peer-to-Peer Electronic Cash System' written by Satoshi Nakamoto was published in 2008. The following year, Satoshi
Nakamoto established the Bitcoin cryptocurrency blockchain network [4].

Bitcoin is a decentralized cryptocurrency that supports global currency so it is not limited to any nation. It is decentralized in every perspective like technical, political and logical. Bitcoin was designed to facilitate peer-to-peer monetary transactions without the need of trusted intermediaries. This means physical currency can be transacted without banks or other centralized entities. There is a maximum of 21 million Bitcoin that can be produced. After all the Bitcoins are produced, there will be no more new coins to be mined and only those in circulation would be use [3].

More importantly, how does Bitcoin work? Bitcoin uses cryptographic proof rather than trusting in third-party organizations to execute an online transaction over the Internet for two willing parties. Each of the transactions is protected with a digital signature, which is digitally signed with the private key of the sender. The transaction will be sent to the public key of the receiver and the receiver will verify the sender's digital signature by using the sender's public key on the transaction. The digital signature will prevent the transaction from being tampered once it is issued. Each transaction will be broadcasted to all the nodes in the Bitcoin network and then recorded in the public ledger once the transaction is verified. There are two things to be verified before the transaction is recorded. The first one is the digital signature of the sender and the second one is ensuring there is sufficient balance in sender's account [6].

2.1.2 Ethereum Platform

The blockchain technology has allowed communities and individuals to restructure their interactions in business, society and even politics based on automated and trustless transactions. This process will have quick effect on the tenets and underpin existing political systems and governance models, which raise the question of the traditional role of State and centralized institutions. Therefore, many blockchain advocates said that by replacing the traditional functions of State with decentralization and blockchain-based services, open source platforms like Ethereum will help civil society organize itself and defend its interests more effectively [5].

Ethereum is a blockchain-based platform that wants to provide developers with the ability to develop consensus-based applications that are feature-complete, interoperable, censorship-resistant, self-sustaining, scalable and standardize. The Ethereum platforms' codes and standards were developed by a community of developers and users through crowdsourcing initiative, which is known as the Ethereum network. Upon development, the Ethereum platform was formed by volunteer entities that set up the Ethereum nodes that collaborate with one another and ran the Ethereum code. The participation in extending the Ethereum network is open for anyone. Hence, Ethereum is not controlled by any preeminent entity or company [7].

2.1.3 Solidity Programming Language and Smart Contracts

Ethereum includes a blockchain which has a built-in Turing-complete programming language, called Solidity, that lets anyone to create smart contracts. Smart contracts are computer programs that execute or enforce predefined terms of a contract automatically on the blockchain. The contracts' terms and conditions among parties are written into lines of the program directly. This allows developers to set their own rules of ownership, transaction format and state transition mechanisms for the smart contracts [7].

Smart contracts are used to develop decentralized applications (DApp). DApp are fully open to users and operate automatically without any entity taking control of the applications. The application's data and code are stored securely and managed by a decentralized blockchain to prevent failure in the central point. Since data is stored on the blockchain, it is tamper-free and secure. The smart contract is playing the role of back-end and it is completely decentralized as its code is stored, run and managed within the blockchain. When users want to interact with the smart contract, the users will contact a node in the blockchain network. If the particular node is out of service, there are still other nodes to carry out the task. Moreover, the DApp based on Ethereum has a benefit from a cryptocurrency known as ether. This cryptocurrency can be used to easily include moneyrelated activities in DApp or build financial applications [7].

2.2 Review of Existing Systems

2.2.1 Land Registration System using Blockchain [11]

In this system, users can take up roles as buyer or seller and register themselves on the portal. On the portal, the seller will need to upload all requisite details or documents while the buyer can then purchase the lands that are verified. Other than that, users can get deeds digitally. This system eliminates the involvement of middlemen like brokers while having all transactions directly done between buyer and seller.

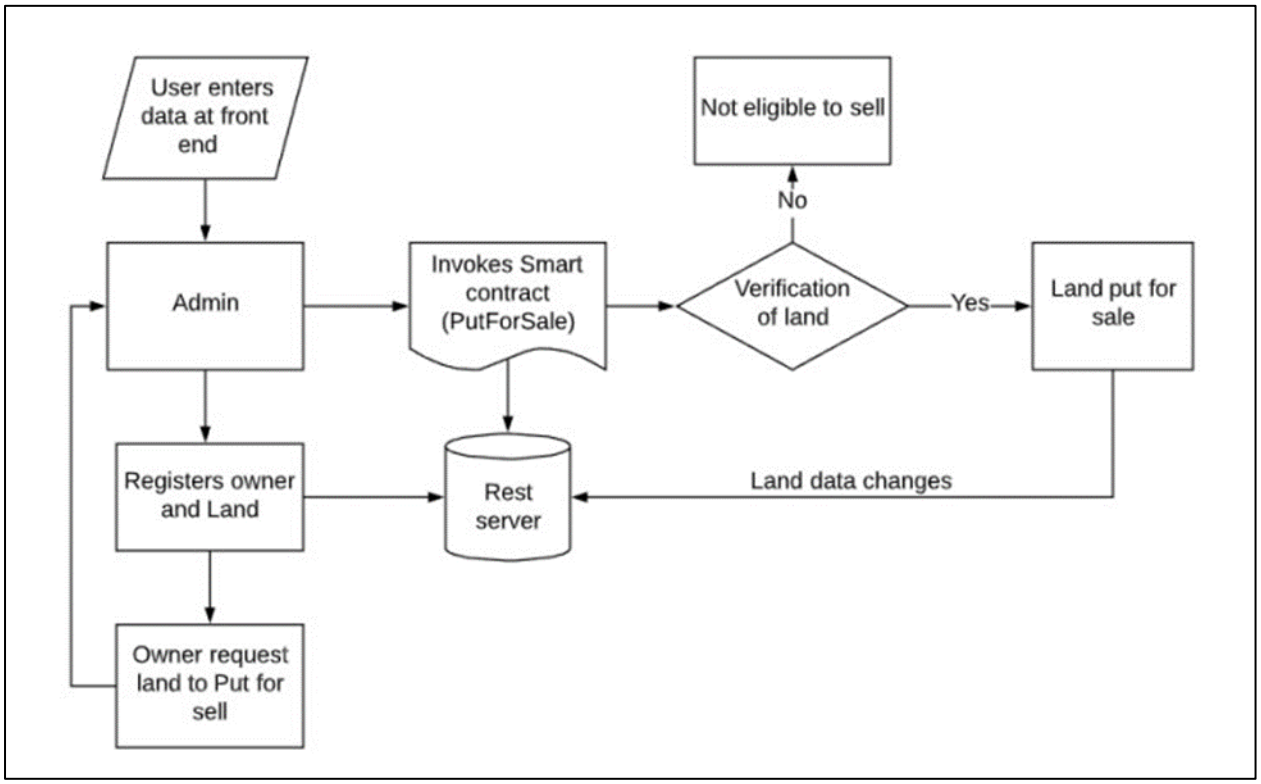


Figure 2.2.1.1: Register users and put land for sale

First of all, users will enter their personal details at the front-end application and submit it. The admin will then receive the users' personal details and register the users to the platform. Land owners will need to give their land information so that the admin is able to add their land asset into the system. When a land owner wishes to put a land for sale, the admin invokes the smart contract PutForSale which publishes the land for sale if necessary conditions are met. The conditions mandatory are government verification, registrar verification and collector verification. The government ensures that the land is within an acceptable price range, the registrar verifies the land

documents, seller identity and criminal records while the collector is only needed for extreme cases which the lands involved are forest, government or religious based. If sellers meet all the following conditions, then their land will be placed on the portal for buyers to view.

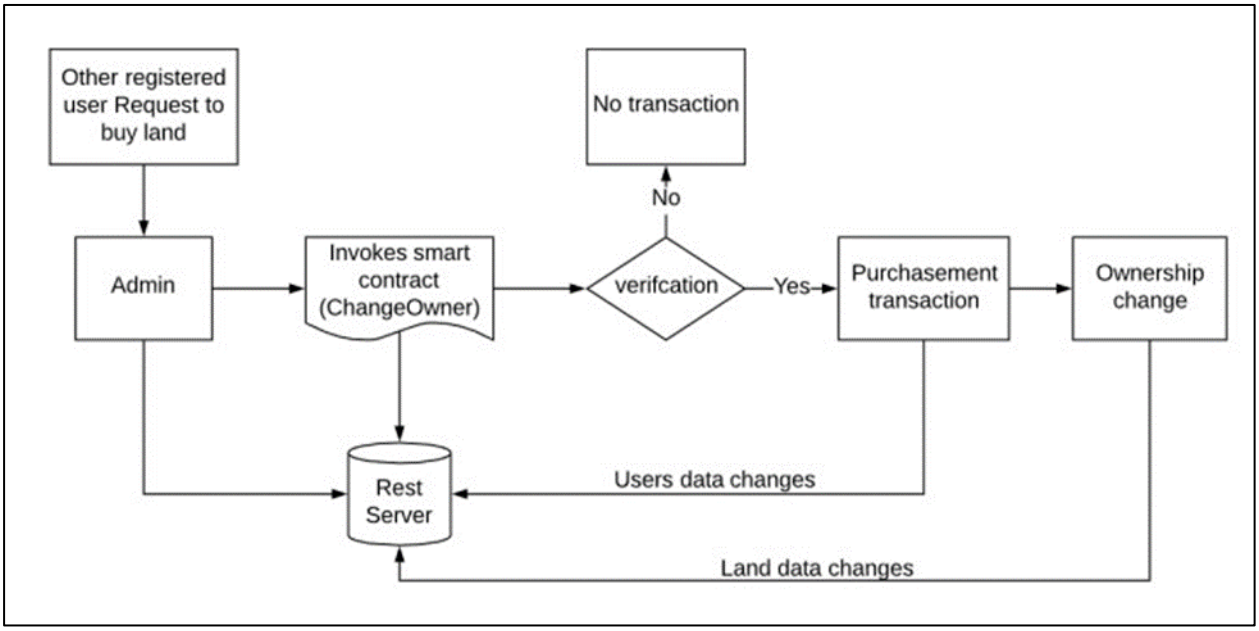


Figure 2.2.1.2: Change owner of land

When a buyer requests to purchase a land asset, changes need to be done for the ownership of the land. The admin will trigger the smart contract ChangeOwner to start the process. However, before buyers are allowed to purchase the land, some conditions have to be cross checked. The buyer must not have any criminal records while having an account balance greater than the cost of the land registration process. One more condition is buyer cannot purchase the land if the seller did not put the land for sale. Once these conditions are verified, the buyer is assigned as the new owner while the seller is assigned as the previous owner. The seller will then receive the amount quoted on the land into his/her account whereas the quoted price is paid by the buyer along with additional charges. Hence, the ownership transfer is completed.

There are many strengths found in this system. First of all, users are able to register accounts and login to the portal. This allows for basic information gathering from users which will determine the person conducting the transactions later on. Other than that, users have the ability to register their land assets on the portal. This is the

main functionality of the system which stores users' land assets in the blockchain and secure their land ownership.

Another strength is the government authority's involvement in the land registration process which ensures that the land registration information from users are legitimate before entering the Blockchain. Following that, users also can purchase and sell land assets on their own. This is huge as it removes middlemen like brokers from the land dealing process. Buyer and seller are not required to spend time searching for a broker to facilitate the process. This saves both time and cost of the middleman. Next, the processes automated through the use of smart contracts are strengths as well. The smart contract in this system automates the transfer of land ownership and funds for the land dealing process. As long as both buyer and seller give their consensus, the smart contract will trigger the transfer.

The weakness found in the above system is the unnecessary involvement of government authority. It is shown that a government authority is needed to start the selling of lands and transferring of ownership. This can actually be avoided by simply modifying the smart contract to start when the users perform a specific action. For example, if a user wishes to sell a land, the user will just need to click on a button on the portal which then automatically invokes the smart contract PutForSale. Contacting a government authority just to invoke the smart contract PutForSale and ChangeOwner are redundant. Another weakness detected is users are not able to view the transactions done in the land registration portal. Since the land registration portal is decentralized, users have the rights to know the kind of transactions occurring. This can be easily solved by retrieving the transactions from the blockchain and displaying them to the users.

2.2.2 A Novel Framework for Implementation of Land Registration and Ownership Management via Blockchain in Bangladesh [8]

This system architecture is a combination of Blockchain and smart contracts. All land-related information and land ownership transactions are stored in the Blockchain.

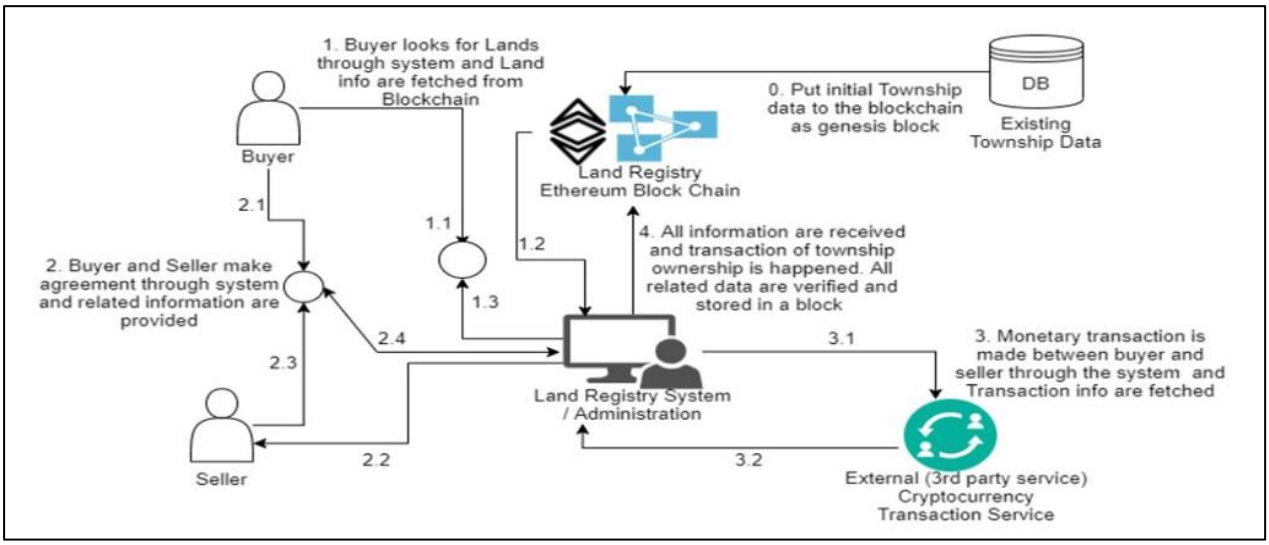


Figure 2.2.2.1: Flow diagram

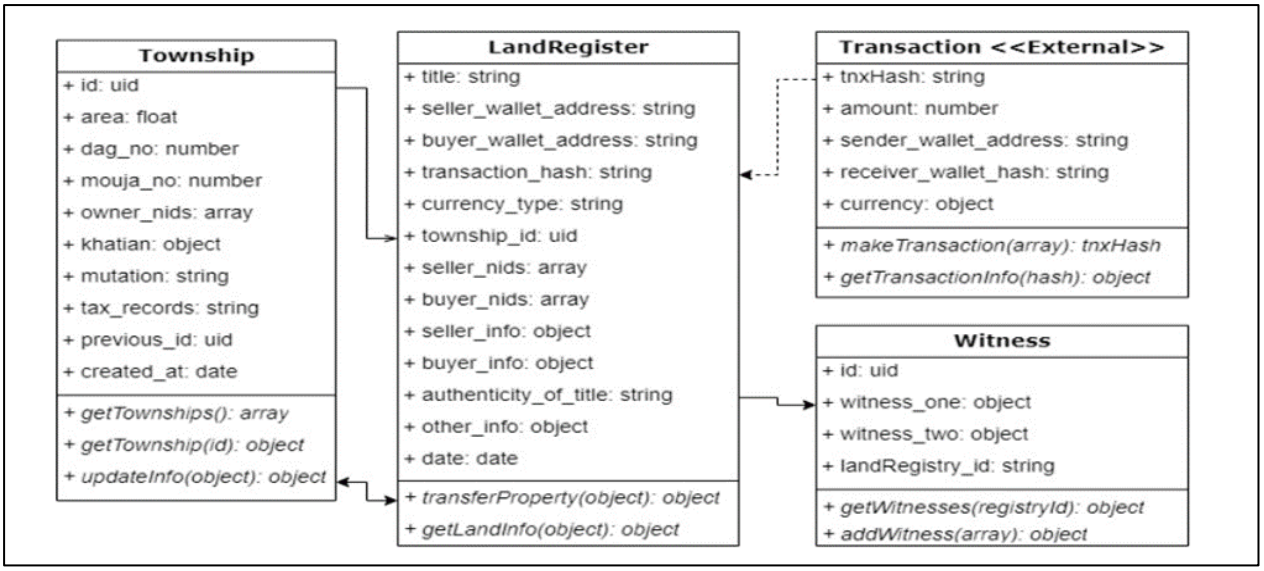


Figure 2.2.2.2: Class diagram

Detailed information of a land is contained in the Township class. Buyers can look for lands on the portal and request for land information. When a buyer requests land information, the method, getTownship(id) of the smart contract is invoked and it fetches a block in the Blockchain. The block contains information that is then

transferred to the land registration system whereas it will process the data and buyer will then be able to view it.

When the buyer decides to purchase a land, the buyer executes a purchase request. The registration system alerts the land owner about the buyer information. A seller is able to receive multiple purchase requests, but the smart contract ensures only one buyer is purchasing the land once an agreement is reached. The buyer and seller will come to an agreement and provide some mandatory information. The mandatory information needed is shown in the LandRegister class. This will become the virtual deed.

This system uses existing Blockchain-based payment service to facilitate monetary exchange between buyer and seller. The system will record down seller's wallet addresses and cryptocurrency can be transferred to the seller through the system. However, buyers will need to authenticate themselves before any fund is charged from their wallet. Once monetary transaction is completed, all related information is forwarded to land registration system.

The land registration system will invoke transferProperty(data) method from the smart contract once it receives all mandatory information and transaction confirmation. This method will store a transaction in the Blockchain and transfer the land ownership from seller to buyer.

There are several strengths found in the above system. The first strength is government authorities are involved in the land registration process. Since the system is running on existing data, government authorities have already gone through the land details to check their legitimacy before entering them into the Blockchain. This is very important for the next process, which is the land dealing process. The second strength is registered lands are viewable by all users. Users will know the owner of each land and be able to find lands for sale using the portal. Moreover, users being able to purchase or sell land without any assistance from middlemen like brokers is another strength. This system allows buyer and seller to communicate directly and deal with lands as they please. There is no need for users to spend time searching for a broker to facilitate the land dealing process. The final strength is process automation with smart contracts. This system uses smart contracts for users to retrieve registered land information, transfer land ownership and transfer funds. When a user requests registered land information, the smart contract will retrieve the information from the Blockchain and display it to the user. When a buyer and seller come to an agreement

on a land deal, the smart contract trigger the transfer of land ownership to buyer while transfer of funds to seller.

However, the weakness shown is the portal does not provide account registration and login. Without account registration and login, user's basic information will be gathered and the transactions carried later on will be anonymous. This can be solved by just adding a registration process so that users will need to login to their accounts before entering the portal. Moreover, the portal does not allow users to register land assets. The portal is currently running on existing data of land assets. Hence, if there were any new land assets, users are not able to register them to the system. The portal should include another registration function that allows users to register their own lands. The final weakness found is users cannot view the transactions occurring in the portal. In a decentralized system, users should be able to view all transactions that are happening in the system. The is solved by retrieving transactions from the blockchain and displaying them in the portal.

2.2.3 Land Registry Management using Blockchain [2]

This application brings transparency and decentralization to land registration and land transaction.

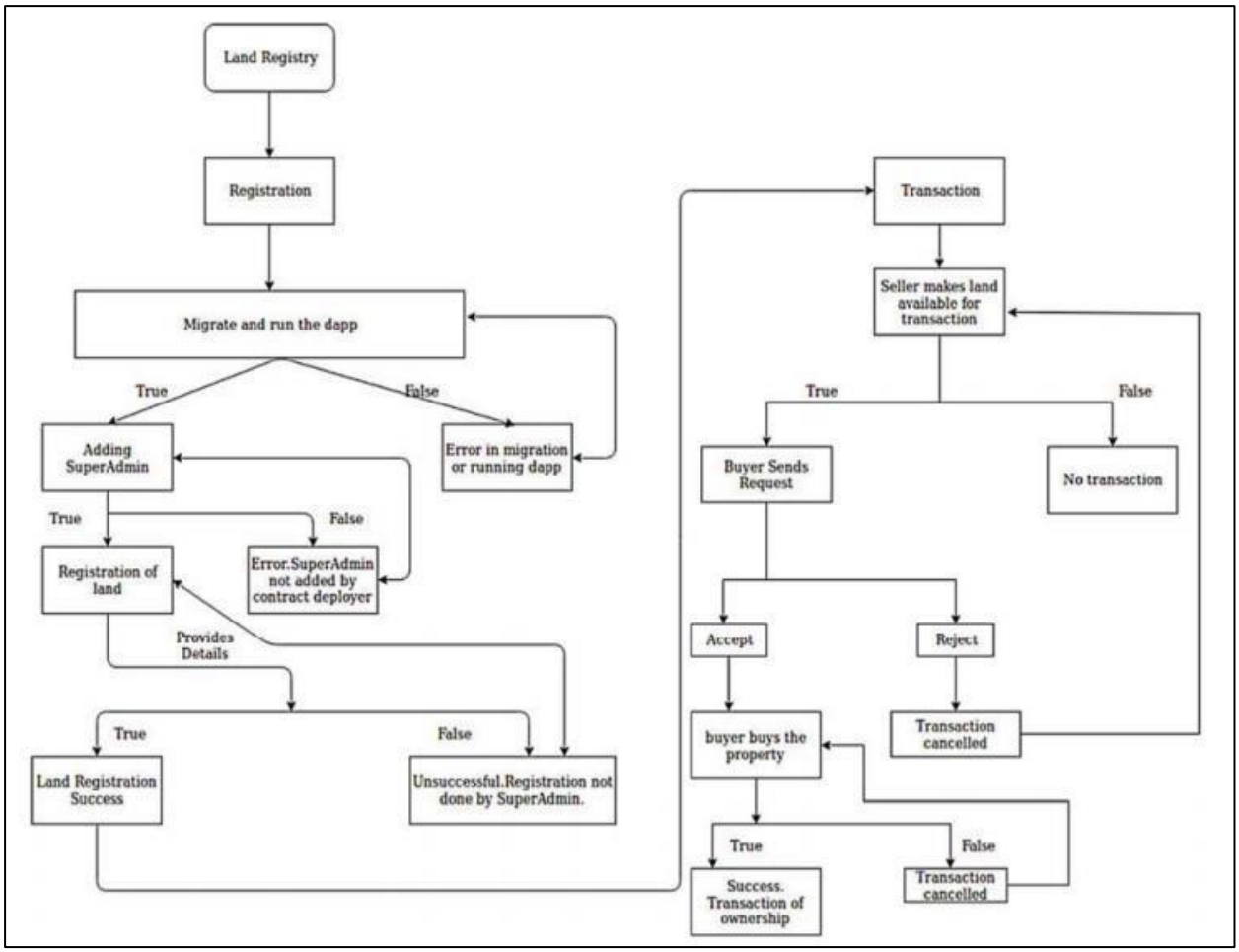


Figure 2.2.3.1: Code flow

First and for most, users will need to provide their land details to the super admin, who is the government authority. A separate admin will be assigned for each village and he/she is responsible for the land details of that village. The land details entered by the admin is the same area where he/she is registered. The super admin verifies the land details and enter them to the chain. The details registered into the decentralized application are market value of land, state, district, village, survey number and owner address.

Once the land is registered into the blockchain, users can sell their land whenever they want. The sellers just need to make the land available for sale from their own login. After that, buyers will be able to view the land for sale on the portal. If buyers are interested in the land, buyers can send request to the land owner to purchase

the land. However, one land can only have one buyer request at a time. This means that if buyer A sends a request to purchase land C, buyer B will not be able to send a request to purchase land C until the land owner rejects buyer A.

Next, the seller will receive the request from the buyer. The seller then will have a choice to either accept or reject the buyer's request. If the seller accepts the request, the buyer can now purchase that particular land. At the buyer's portal, the buyer will now see a button "buy" and when pressed will transact the land ownership to the buyer while the price of the land will be transferred to the seller. However, if the seller chooses to reject the request, then other buyers will be able to send their request to the seller.

There are many strengths found in the above system. Firstly, users need to register an account and login before being able to use the portal. This enables basic information gathering of users for their profile. The user's profile determines the person carrying out the transactions later on. Secondly, users are able to register their land to the Blockchain.

This will secure users' land ownership and prevent fake parties from claiming their land. Thirdly, a government authority must be involved in the land registration process. This is very crucial as the government authority needs to ensure users' land registrations are legit before the details are stored in the Blockchain. If the Blockchain contains false information, frauds can occur in the system. Next, registered lands are open to everyone to view. Users will know the owner of each registered land and they can search for lands for sale. Other than that, users are able to purchase or sell land without the help from middlemen like brokers. In the land dealing process, only buyer and seller will be interacting with each other, no other parties are needed to intervein. Users do no need to waste time searching for a broker to facilitate the land dealing process. The final strength detected is usage of smart contract for process automation. This system uses smart contract to automate the transfer of land ownership and funds. Once buyer and seller both agree on the land transfer, the smart contract will trigger allowing buyer to receive the land ownership and seller to receive the funds. A third-party is not needed for the transfer.

However, there is one weakness in this system. This system does not show the transactions occurring to the users. Blockchain applications are decentralized which makes it transparent. This means users have the rights to know the activities happening in the system. The transactions must be showed to the users so they know no

transactions are being hidden. This is easily fix by retrieving the transactions stored in the Blockchain and displaying them to the users.

2.2.4 Blockchain based Land Registry System using Ethereum Blockchain [10]

The reviewed paper's proposed system consists of three roles, which are buyer, seller and land inspector. The buyers will need to register by providing documents issued by the government and then they can see the available lands. The sellers need to register themselves as sellers and upload photos of the land together with the documents of the land. Lastly, the land inspector, who is an official from the land registration government agency, inspects the documents when a seller approves the buyer's request to purchase the land.

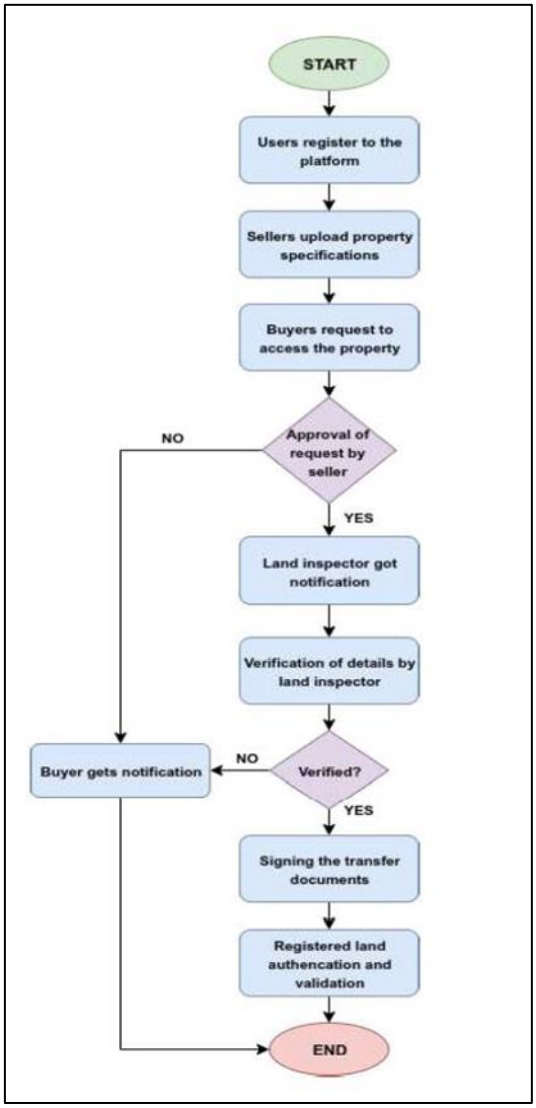


Figure 2.2.4.1: Flow diagram

The following are the steps for the research paper's proposed system. The first step is buyers or sellers need to register on the blockchain land registration platform. They require details like designation, government-issued ID and name in order to

create their profile. The identity information of the users will be hashed and stored into the blockchain. The second step is sellers upload the land specifications like land' images and documents on the platform. The seller's transaction will be stored on the blockchain and buyers who signed up is able to view the properties. The third step is buyers will request access to listed land. When a buyer finds a land of interest, the buyer can request to view the ownership history of the land from the seller and send a request to buy it, then the seller can choose to accept or deny the request based on the buyer's profile. All of these transactions between the buyers and sellers are recorded on the blockchain to make sure they are authentic and traceable.

The fourth step is land inspector gets notification when sellers approve buyer's request. The land inspector receives the notification to initiate the land transfer. Once the land documents are verified by the land inspector, a meeting is scheduled to transfer land ownership between buyer and seller. The record of the meeting will be kept on the blockchain to help solve future land related disputes. The fifth step is verification of transaction and initiation of transfer by land inspector. Sellers and buyers sign the transfer document together with the land inspector. This signed document is saved and the corresponding transactions are stored on blockchain. Then, smart contracts trigger and send funds to seller while ownership of land to buyer.

The last step is the validation and authenticity of the registered land documents. If there are disputes, any authorized party can claim verification by just uploading all documents and an unbiased party will search by passing through hash function. If the hash for the uploaded documents is the same as the hash created during signing of the documents, then the documents are authenticated and this proves they are not tampered with.

There are several strengths found in this system. The first one is users are required to register an account on the platform and login before being able to enter the platform. This allows for some basic information gathering for the user's profile. This system requires the designation, government-issued ID and name of the users for registration. The user's profile is important to know who is conducting the transactions later on. The second strength found is users are able to register their land into the Blockchain. This provides security for land owners as their land ownership details will be stored in the Blockchain and their land will not be compromised by fake documents afterward. Moreover, users being able to view all registered land is another strength.

Users will get to know the owner of each land and find lands for sale by viewing the registered land. The next strength seen is users have the ability to purchase or sell land without the assistance from middlemen like brokers. Users do not have to waste their time searching for a broker to facilitate their land dealing process. This system allows users to deal their land on their own. The last strength for this system is the involvement of smart contracts for process automation. Once the land dealing process receive consensus from both parties, the land ownership will be transferred to the buyer while the funds will be transferred to the seller.

Apart from the strengths, there are weaknesses in this system. The first weakness is there is no government authority involve in the land registration process. Government authorities are required to ensure that the land details given by the users are legitimate before entering the Blockchain. There cannot be false information entering the Blockchain, or else the Blockchain is not able to prove land ownership for users. This can be easily fixed by reverting the user's land registration details to the government authorities before storing in the Blockchain. The second weakness encountered is the system does not provide an option to view all transactions occurring. Users have the rights to know activities happening in a decentralized system. Since all transactions are stored in the Blockchain, the system just needs to retrieve the transactions from the Blockchain and display to the users. Lastly, the involvement of a government authority in the land dealing process is redundant. Smart contracts can already automate this process. As long as both buyer and seller give their consensus for the smart contract, the land ownership transfer will occur. If either one party disagree, the transfer will not occur. The government authority should be present in the land registration process. If all registered lands are legitimate, the land dealing process will not have fake information and users can deal worry free.

2.2.5 Comparison of Reviewed Systems with Proposed System

	2.1.1	2.1.2	2.1.3	2.1.4	Proposed System
Register / Login account to use the system	✓	✗	✓	✓	✓
Register land to Blockchain	✓	✗	✓	✓	✓
Government authority involves in land registration process	✓	✓	✓	✗	✓
View all registered land	✓	✓	✓	✓	✓
View all transactions occurred	✗	✗	✗	✗	✓
Purchase / sell land	✓	✓	✓	✓	✓
Use of smart contracts for process automation	✓	✓	✓	✓	✓
Middlemen like brokers not involve in land dealing process	✓	✓	✓	✓	✓

Table 2.2.5.1: Comparison of reviewed systems with proposed system

3 Chapter 3: System Approach

3.1 Use-Case Diagram and Description

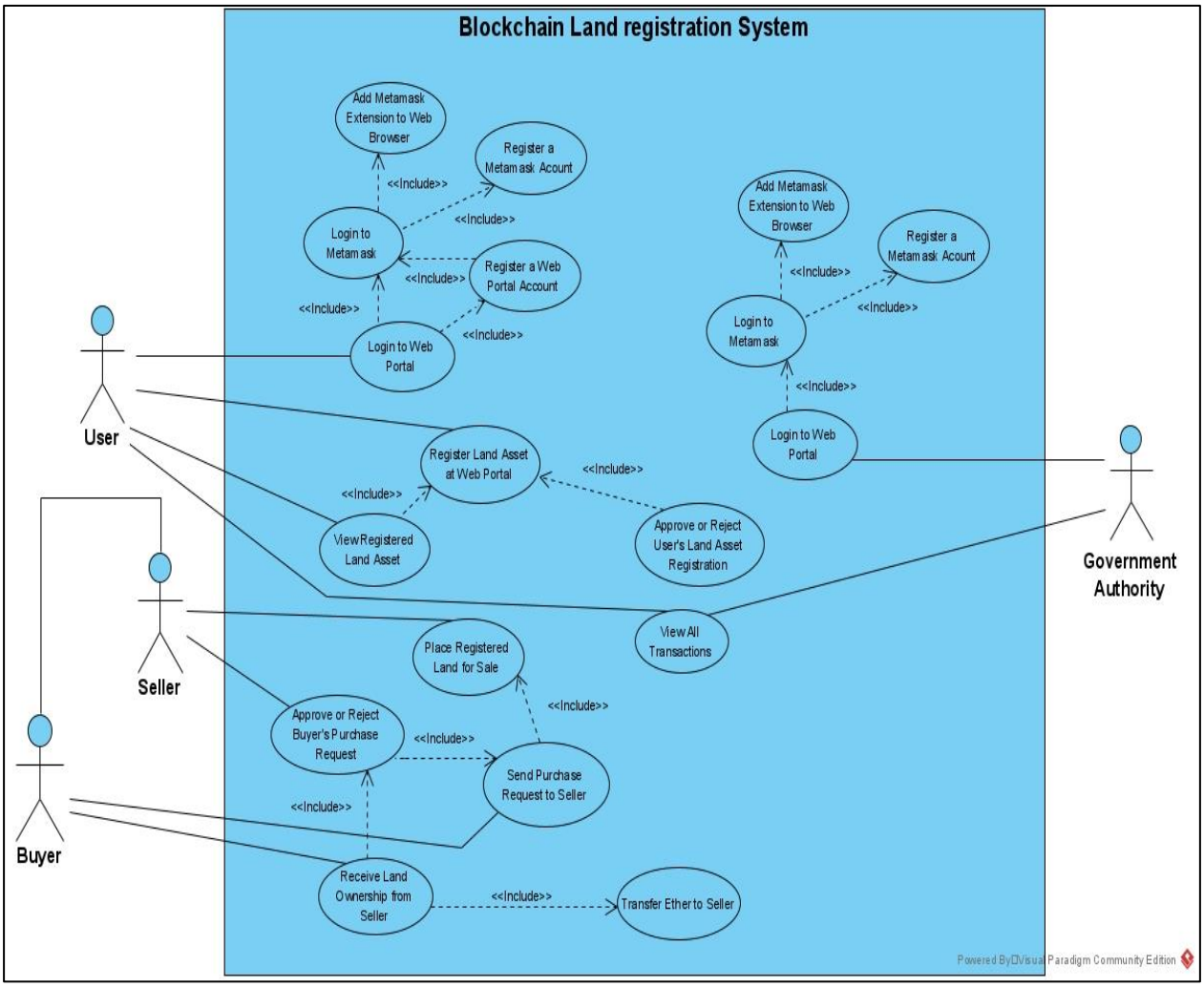


Figure 3.1.1: Use-case diagram of proposed system

Use case	Login to Web Portal
Purpose	Allow access to the web portal.
Actor	User, Government authority
Trigger	When user or government authority keys in the password and click 'Login'.
Main flow	1. For users, they will access the user's home page. 2. For government authorities, they will access the government authorities' home page.
Precondition	1. Users and government authorities must login to their Metamask account. 2. Users and government authorities must have a web portal account.

Table 3.1.1: Use case description of login to web portal

Use case	Register a Web Portal Account
Purpose	Require an account before being able to access the web portal.
Actor	User
Trigger	When user keys in the registration information and click 'Register'.
Main flow	1. Users will be directed back to the login page.
Precondition	1. Users must login to their Metamask account.

Table 3.1.2: Use case description of register a web portal account

Use case	Login to Metamask
Purpose	Allow usage of the web portal. Without Metamask, the web portal will not function.
Actor	User, Government authority
Trigger	When user or government authority keys in their Metamask password and click 'Login'.
Main flow	1. Both user and government authority will access their Metamask account.
Precondition	1. Both user and government authority must have the Metamask extension added to their web browser. 2. Both user and government authority must have a Metamask account.

Table 3.1.3: Use case description of login to Metamask

Use case	Add Metamask Extension to Web Browser
Purpose	The extension is needed to run Metamask. By default, the web browser will not have the Metamask extension.
Actor	User, Government authority
Trigger	When user or government authority searches for the Metamask extension and click on 'Add'.
Main flow	1. Metamask extension will be added to the web browser successfully.
Precondition	None

Table 3.1.4: Use case description of add Metamask extension to web browser

Use case	Register a Metamask Account
Purpose	Require an account before being able to access Metamask.
Actor	User, Government authority
Trigger	When user or government authority keys in the registration information and click 'Register'.
Main flow	1. Both user and government authority will be brought to the Metamask login page after registration.
Precondition	None

Table 3.1.5: Use case description of register a Metamask account

Use case	Register Land Asset at Web Portal
Purpose	Store land ownership information in the Blockchain.
Actor	User
Trigger	When user keys in the registration information and click on 'Register'.
Main flow	1. User will be brought back to the home page after registration.
Precondition	None

Table 3.1.6: Use case description of register land asset at web portal

Use case	Approve or Reject User's Land Asset Registration
Purpose	Determine whether users' land ownership information is legitimate.
Actor	Government authority
Trigger	When government authority checks user's land ownership information and click on 'Approve' or 'Reject'.
Main flow	1. Government authority will be brought back to the pending land registration list after clicking on approve or reject. 2. User will be notified about the approval or rejection. 3. If approve, user's land details will be stored in the blockchain. 4. If fail, user's land details will not be stored in the blockchain.
Precondition	1. User must first send land registration to government authority.

Table 3.1.7: *Use case description of approve or reject user's land asset registration*

Use case	View Registered Land Asset
Purpose	Allow users to view their own registered land assets.
Actor	User
Trigger	None
Main flow	None
Precondition	1. Users must successfully register their land asset.

Table 3.1.8: Use case description of view registered land asset

Use case	View All Transactions
Purpose	Allow all land registration and land dealing transactions to be publicly viewed.
Actor	User, Government authority
Trigger	None
Main flow	None
Precondition	None

Table 3.1.9: Use case description of view all transactions

Use case	Place Registered Land for Sale
Purpose	Allow registered land to be sold to buyers.
Actor	User ← Seller
Trigger	When sellers click on the 'Put On Sale' button on their registered land.
Main flow	1. Seller's registered land will be place in the market for potential buyers to purchase.
Precondition	None

Table 3.1.10: Use case description of place registered land for sale

Use case	Approve or Reject Buyer's Bid Request
Purpose	Seller gets to choose which buyer will purchase the land.
Actor	User ← Seller
Trigger	Seller click on 'Approve' or 'Reject' for buyer's bid request.
Main flow	1. Buyer will be notified about the approval or rejection. 2. If approve, buyer will be able to purchase the seller's land. 3. If reject, buyer will not be able to purchase the seller's land.
Precondition	1. Buyer must first send the bid request to seller.

Table 3.1.11: Use case description of approve or reject buyer's bid request

Use case	Send Bid Request to Seller.
Purpose	Allow buyers to purchase registered land
Actor	User ← Buyer
Trigger	Buyer clicks on 'Place Bid' on the seller's land for sale.
Main flow	1. Seller will receive the bid request.
Precondition	2. Sellers must first place their registered land for sale.

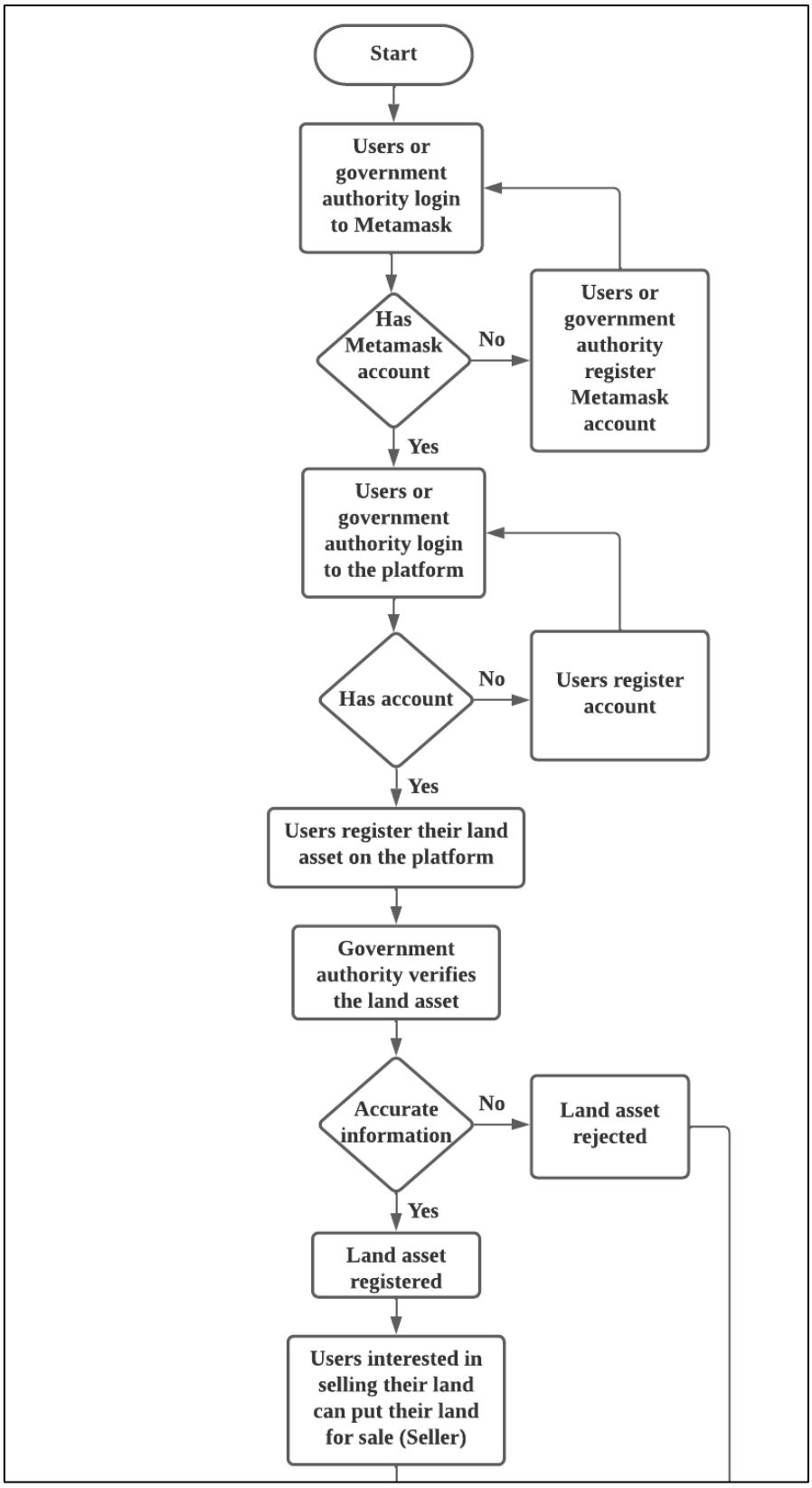
Table 3.1.12: Use case description of send bid request to seller

Use case	Receive Land Ownership from Seller
Purpose	Allow the transfer of land ownership from seller to buyer once purchase is completed.
Actor	User ← Buyer
Trigger	Buyer clicks on 'Transfer Funds'.
Main flow	1. Seller's land ownership will be transferred to the buyer.
Precondition	1. Buyer must receive approval from seller for the bid request. 2. Buyer must transfer sufficient amount of ether to seller.

Table 3.1.13: Use case description of receive land ownership from seller

4 Chapter 4: System Design

4.1 Flow Diagram



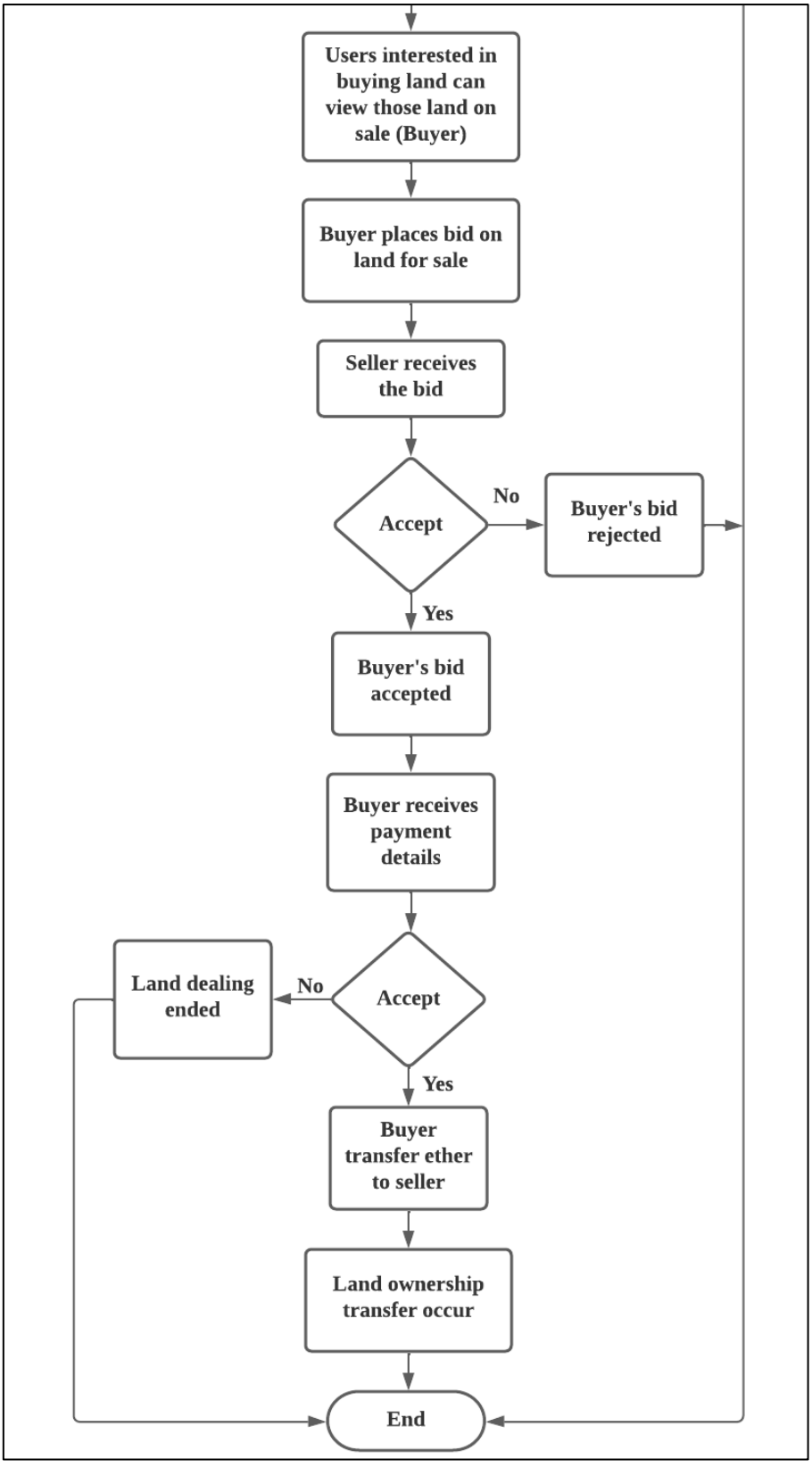


Figure 4.1.1: Flow diagram of proposed system

In the beginning, users or government authorities will need to login to their Metamask account. Metamask is a web browser extension that can be added to the web browser easily. Metamask's purpose is to store cryptocurrency, called as ether, for both users and government authorities. Other than that, Metamask also provides a unique login ID for each user and government authority to access the land registration portal. Without Metamask, the land registration portal will not function. Hence, users or government authorities will need to register a Metamask account for their first-time use. After that, users or government authorities will need to login to the land registration portal. However, users or government authorities who are first-time users need to register an account before logging in. Users can just register their account through the land registration portal while government authorities will need to seek help from system administrators for their account registrations.

Once users are logged into the land registration portal, they are able to register their land assets to be stored in the blockchain. They need to provide the necessary information like land address, ownership number, land title, land type, land size, land image and land status for the registration to be processed. Here's a brief explanation of the information required. Firstly, land address is the full address for a piece of land while ownership number is a unique number for a piece of land. Next, the types of land title include master title, individual title and strata title. Master title indicates that estate developers are the land owners until individual or strata title is issued. Individual title is for landed properties while strata title is for condominiums, apartments and other high-rise buildings. Furthermore, land type can be categorized into freehold and leasehold while land status means whether or not the land is bumiputera reserved. Finally, an image of the land is needed followed by the land size in square feet. Each land registration made by the users will be verified by a government authority.

The government authority ensures that the details given by the users are legitimate before those details enter the blockchain. This process is very important as it prevents users from simply submitting fake or false information. The government authority will compare the information given by the users with the information stored in the old database to ensure legitimacy. If the information aligned, the government authority will approve the user's land registration and the status for that land registration will display as success. If the information mismatch, the government authority will reject the user's land registration and the status for that land registration will display as fail. All land registration transactions will be display in the portal so

users can be notified about their land registration status. A ‘Success’ status indicates that the user’s land details are successfully stored in the blockchain.

Once users’ land assets are registered into the blockchain, they can view their own land details in the portal. Following that, users have a choice to sell their land assets. If users are interested in selling their land, they can just place their land for sale through the portal. Buyers can then view the lands for sale and when interested can place their bids on that land. Once a buyer places a bid on the land, the bidding of that land will begin and the duration of the bidding is 7 days. This means that other buyers will have a chance to bid for the land as well within the 7 days duration. Multiple buyers can bid for a particular land but only the highest bid will be shown to the seller. Buyers will know when their bids are overtaken by others.

Next, the seller receives the buyers’ bids and can choose to accept or close it. If the seller does not accept a buyer’s bid within the 7 days bidding duration, the status of the bid will be mark as fail. Closing the bid will also mark the status of the bid as fail. When the seller accepts the buyer’s bid, the seller will send a payment request to the buyer. Upon receiving the payment request, the buyer will need to response within 3 days. The buyer can either transfer the payment to the seller or reject the deal. If the buyer does not response within 3 days, the status of the bid will be mark as fail. Rejecting the deal will also mark the status of the bid as fail. When the buyer does decide to transfer the payment, there must be enough ether in the Metamask wallet. Once the payment transfer is complete, the land ownership will automatically be transferred from the seller to the buyer. All land dealing transactions will be display in the portal so users can be notified about their land dealing status.

4.2 Graphical User Interface

4.2.1 Land Registration Process

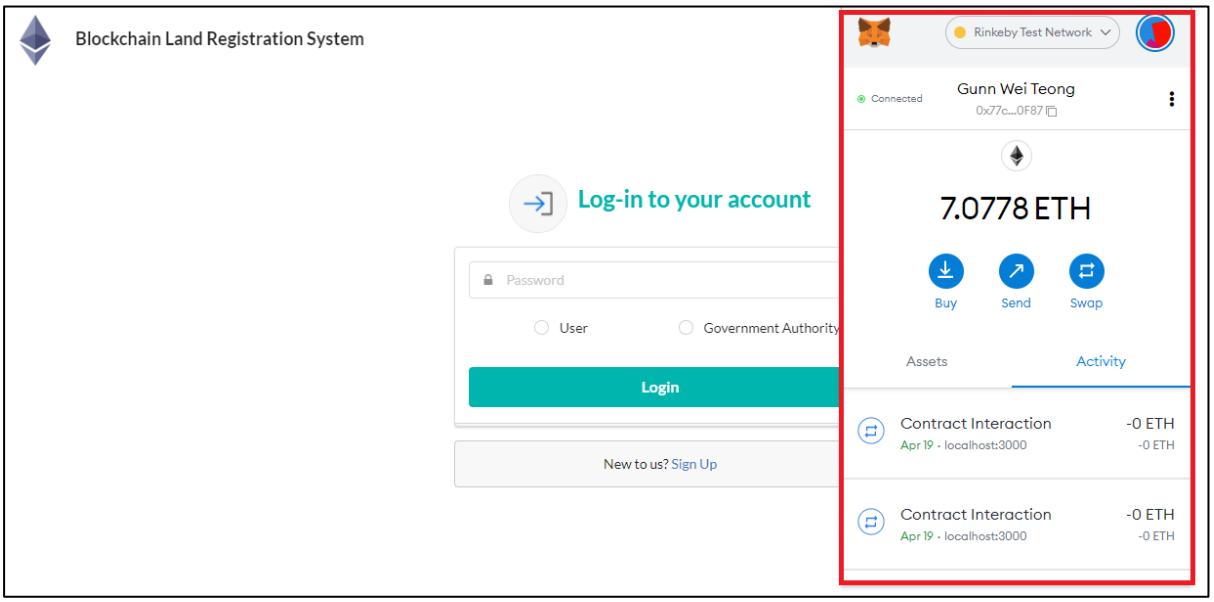


Figure 4.2.1.1: Metamask login

Before utilizing the land registration portal, users or government authorities need to ensure that they have their Metamask account logged in. Without Metamask, the land registration portal will not function. Figure 4.2.1.1 shows a logged in Metamask account.

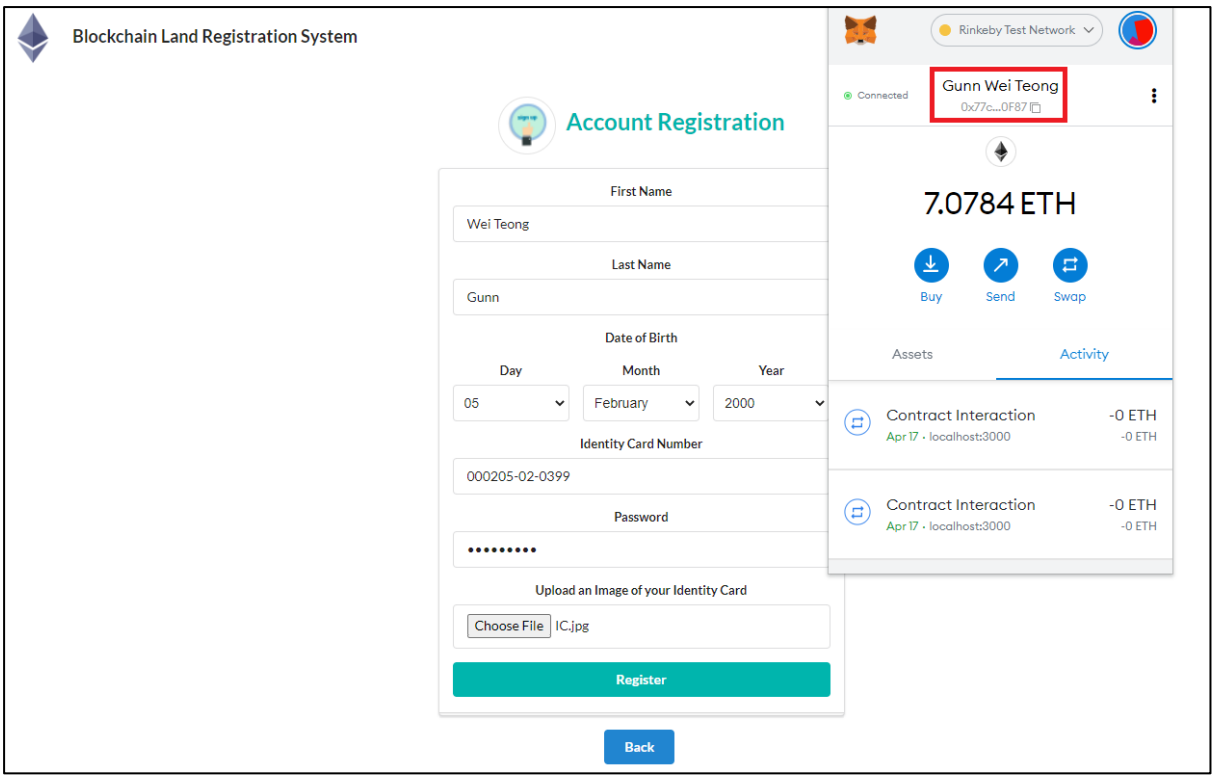


Figure 4.2.1.2: Account registration for user (1)

First-time users will need to sign up an account before accessing the land registration portal. Users must fill in sign-up details like first name, last name, date of birth, identity card number, account password and an image of their identity card. These details will be stored into the blockchain upon registration so they are practically safe from any misconduct. Furthermore, the details given are very important as they are later use in the land registration process. Therefore, users must provide accurate information or else their land registrations will fail.

Users must take note of their account password as it is needed for the land registration portal login. As for the login ID, Metamask got it covered. Metamask provides a unique ID for each user and government authority upon Metamask sign-up. This unique ID is then used to identity each individual in the land registration portal. The unique ID is shown in figure 4.2.1.2.

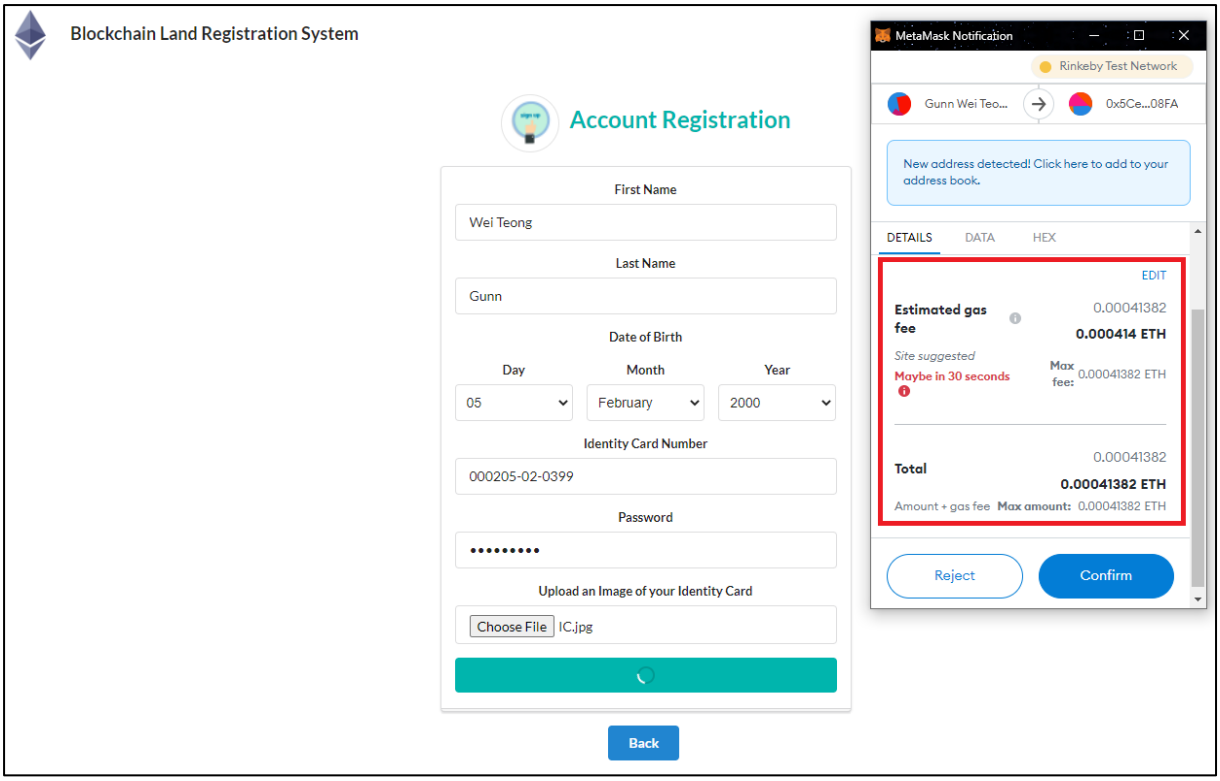


Figure 4.2.1.3: Account registration for user (2)

Once all the details are filled in, users can press on the 'Register' button. After that, a Metamask prompt up will appear asking users to pay a transaction fee, called as gas fee. This is because there will be interaction occurring between a smart contract function and the blockchain. Therefore, a gas fee is needed to complete the transaction. Figure 4.2.1.3 shows the gas fee required. Once users click on the 'Confirm' button, their account will be successfully registered and they can access the land registration portal. Take note that only users register their accounts through the land registration portal while government authorities need to seek help from system administrators for their account registration.

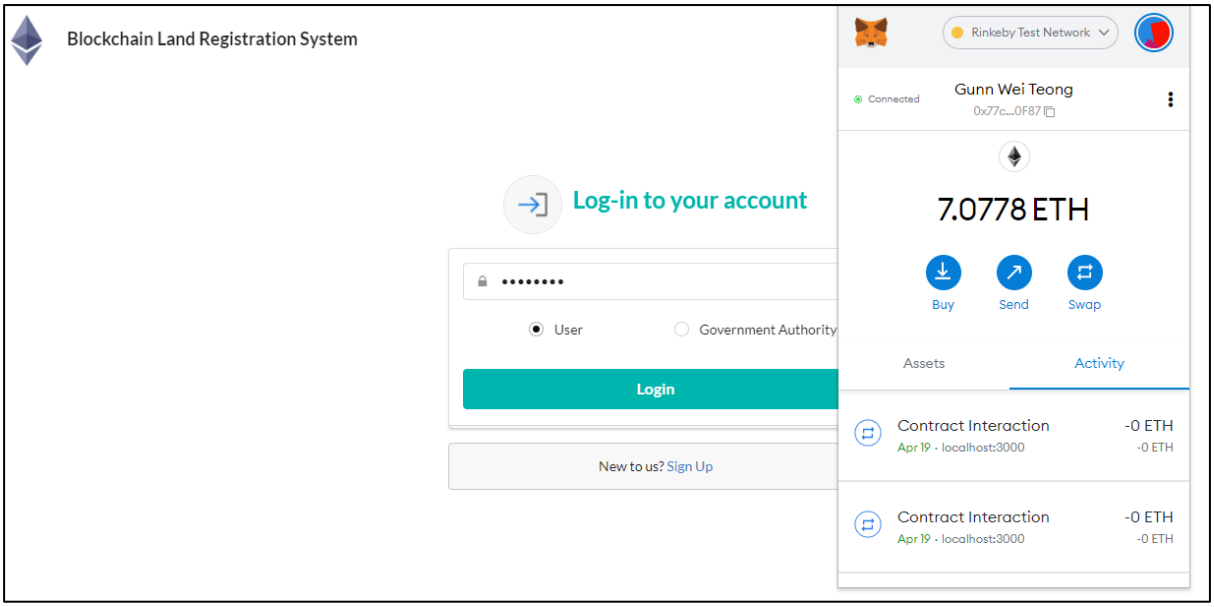


Figure 4.2.1.4: Login for user

Once users have their accounts registered, they can login into the land registration portal by filling in their password, clicking on the 'User' radio-button and clicking on the 'Login' button. Metamask's unique ID will act as the users' login ID.

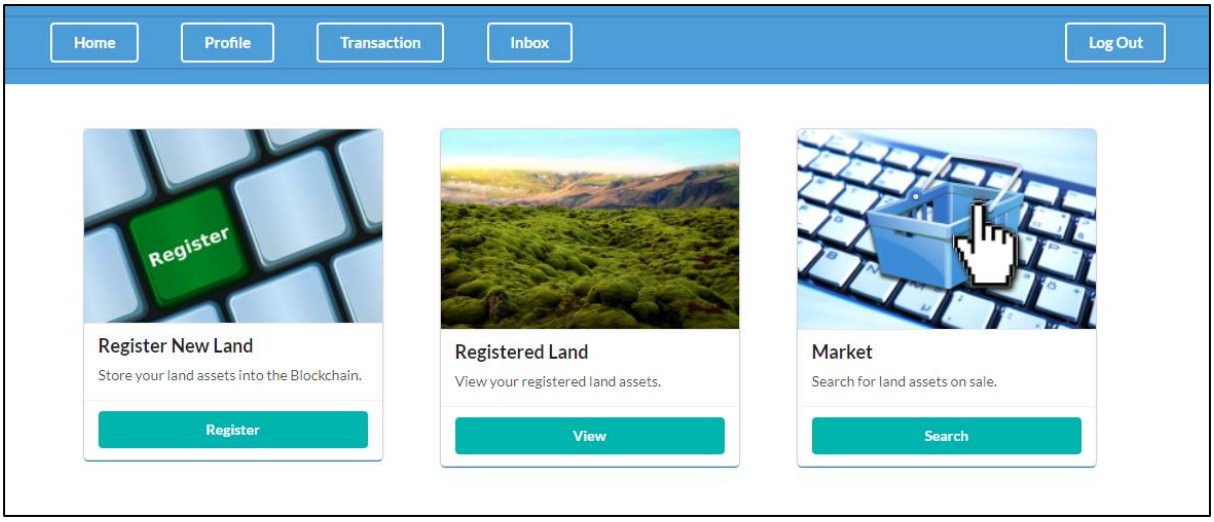


Figure 4.2.1.5: Homepage for user

After user login, they will be presented with the homepage in figure 4.2.1.5. The 'Home' button brings users back to the homepage, the 'Profile' button shows users their account registration details, the 'Transaction' button shows users a list of past and ongoing transactions about land registration or land dealing while the 'Inbox' button shows users incoming bids and ongoing payments for the land dealing process.

Other than that, the 'Register' button allows users to register their land assets into the blockchain, the 'View' button allows users to view their own land assets stored in the blockchain while the 'Market' button allows users to search for lands on sale.

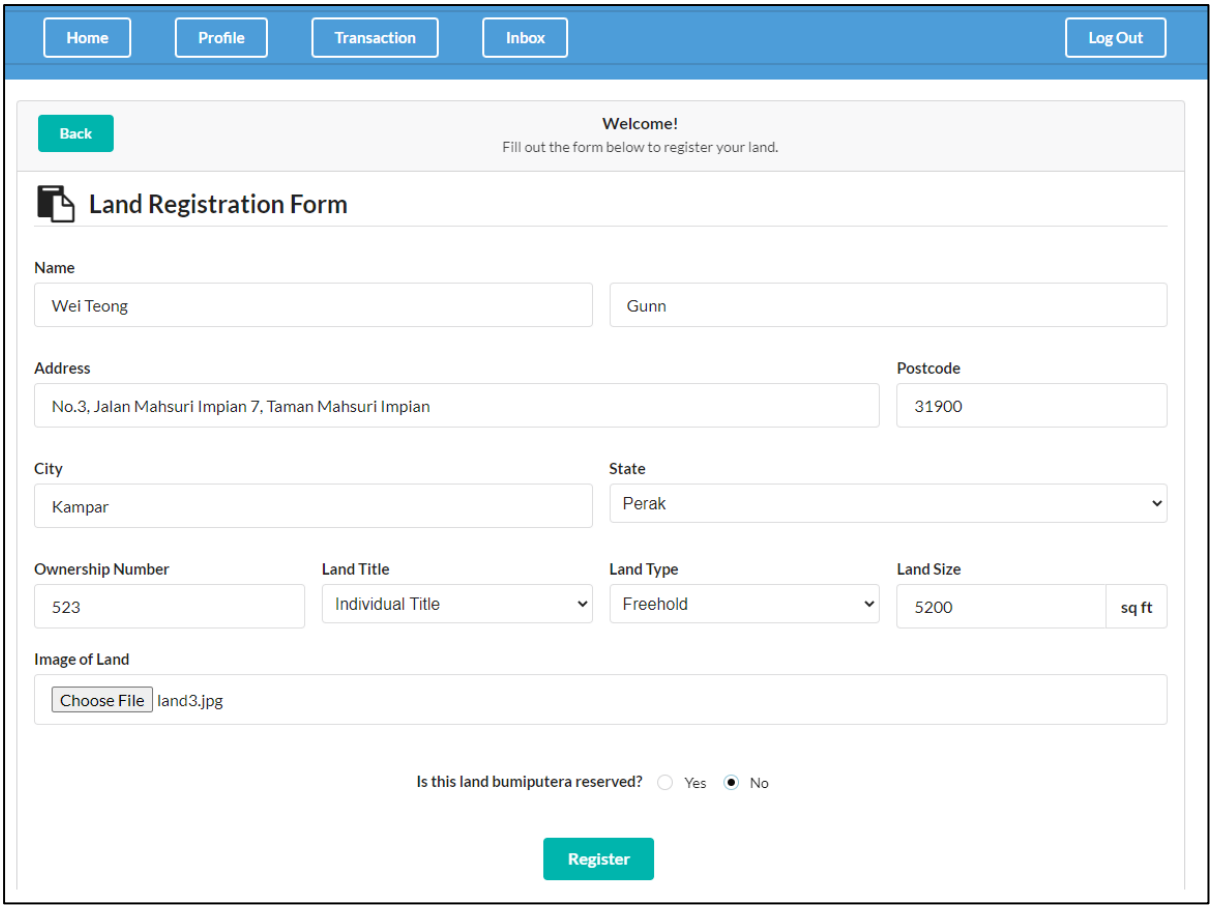


Figure 4.2.1.6: Land registration for user (1)

By clicking on the 'Register' button at the homepage (Figure 4.2.1.5), users will be redirected to this land registration form in figure 4.2.1.6. They need to provide the necessary information like land address, ownership number, land title, land type, land size, land image and land status for the land registration to be processed. Here's a brief explanation of the information required. Firstly, land address is the full address for a piece of land while ownership number is a unique number for a piece of land. Next, the types of land title include master title, individual title and strata title. Master title indicates that estate developers are the land owners until individual or strata title is issued. Individual title is for landed properties while strata title is for condominiums, apartments and other high-rise buildings. Furthermore, land type can be categorized into freehold and leasehold while land status means whether or not the land is bumiputera reserved. Finally, an image of the land is needed followed by the land size in square feet. Each land registration made by the users will be verified by a government authority.

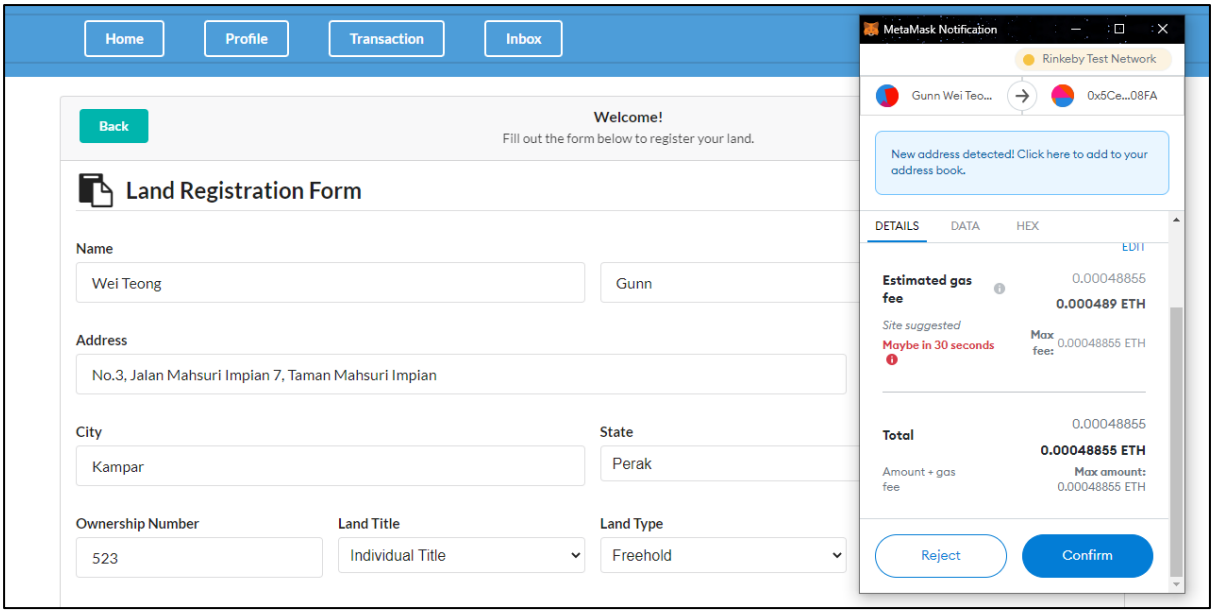


Figure 4.2.1.7: Land registration for user (2)

After filling in the land registration form, users can press on the 'Register' button. A Metamask prompt up will appear asking the users to pay a gas fee. Once users click on the 'Confirm' button, their land details will be sent to a government authority for verification. The land details will be stored successfully into the blockchain once the government authority approves the registration.

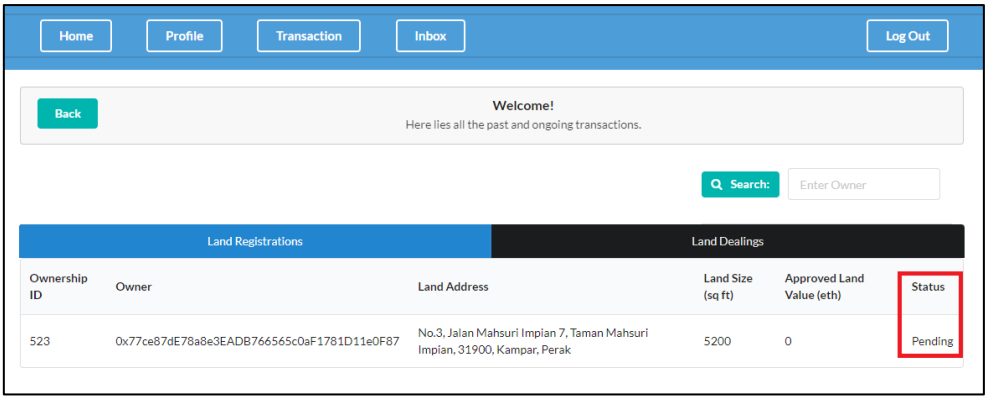


Figure 4.2.1.8: Land registration transactions, pending status

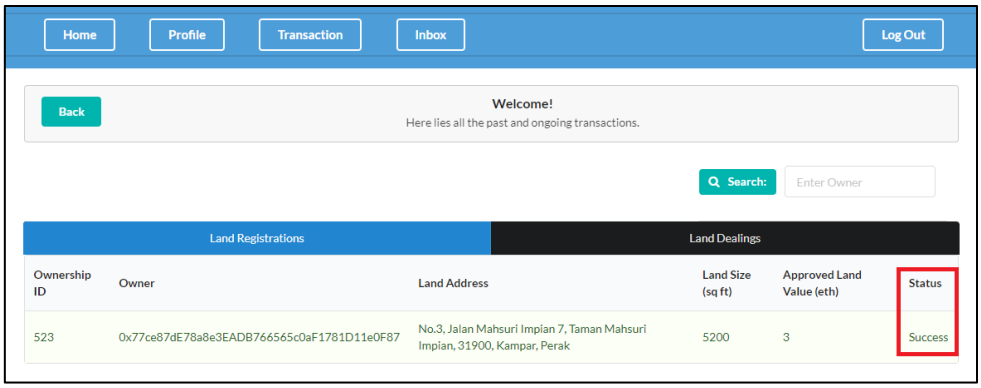


Figure 4.2.1.9: Land registration transactions, success status

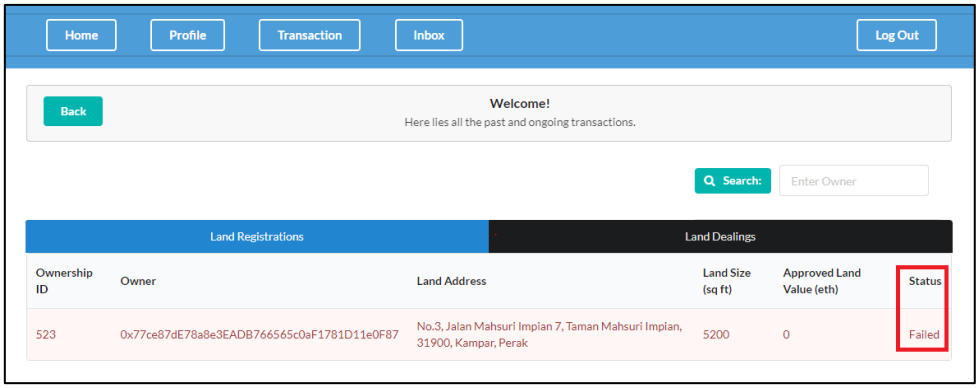


Figure 4.2.1.10: Land registration transactions, failed status

By clicking on the 'Transaction' button at the homepage (Figure 4.2.1.5), users will be redirected to this land registration or land dealing transactions page. From here, users can follow up with their land registration's status. In figure 4.2.1.8, the land registration transaction is pending approval or rejection from the government authority. In figure 4.2.1.9, the land registration transaction is approved by the government authority so the land details are successfully stored into the blockchain. In figure 4.2.1.10, the land registration transaction is rejected by the government authority so the land details are not stored into the blockchain.

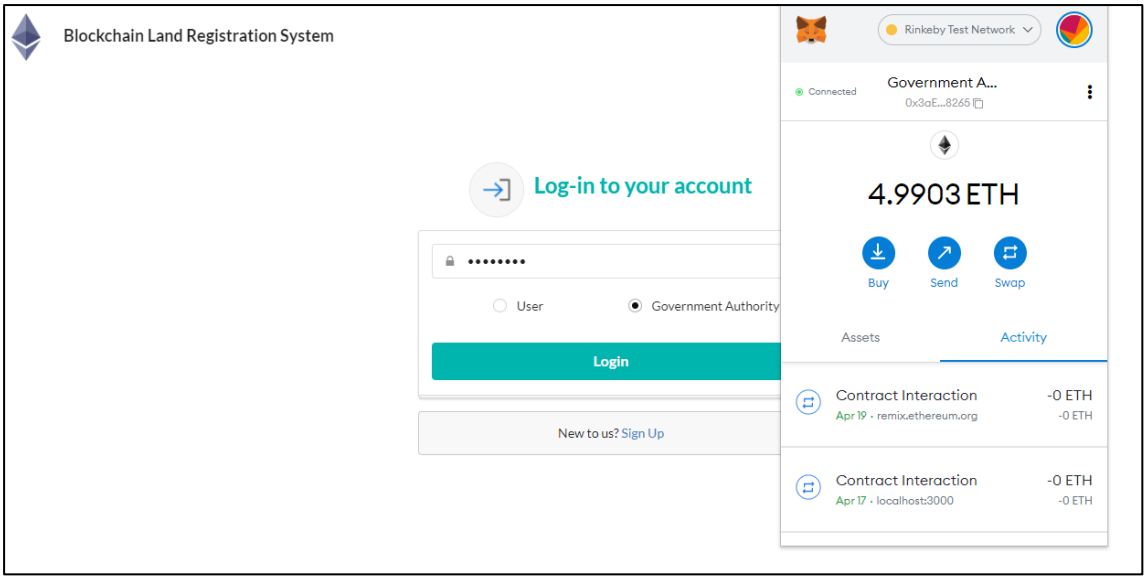


Figure 4.2.1.11: Login for government authority

Now let's look at how a government authority approve or reject a user's land registration. Once government authorities have their accounts registered by the system administrators, they can login into the land registration portal by filling in their password, clicking on the 'Government Authority' radio-button and clicking on the 'Login' button. Metamask's unique ID will act as their login ID.

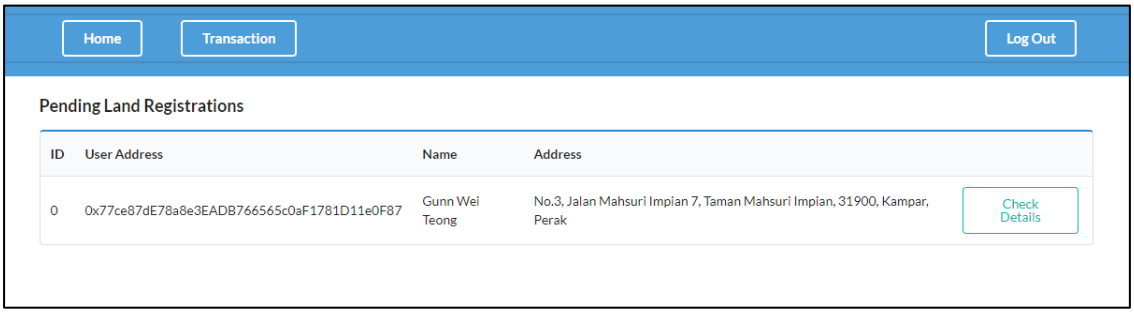


Figure 4.2.1.12: Homepage for government authority

After government authority login, they will be presented with the homepage in figure 4.2.1.12. This homepage shows a list of pending land registrations by users. A government authority can verify a user's land registration by clicking on the 'Check Details' button.

Furthermore, the 'Home' button brings government authorities back to the homepage while the 'Transaction' button shows them a list of past and ongoing transactions about land registration or land dealing.

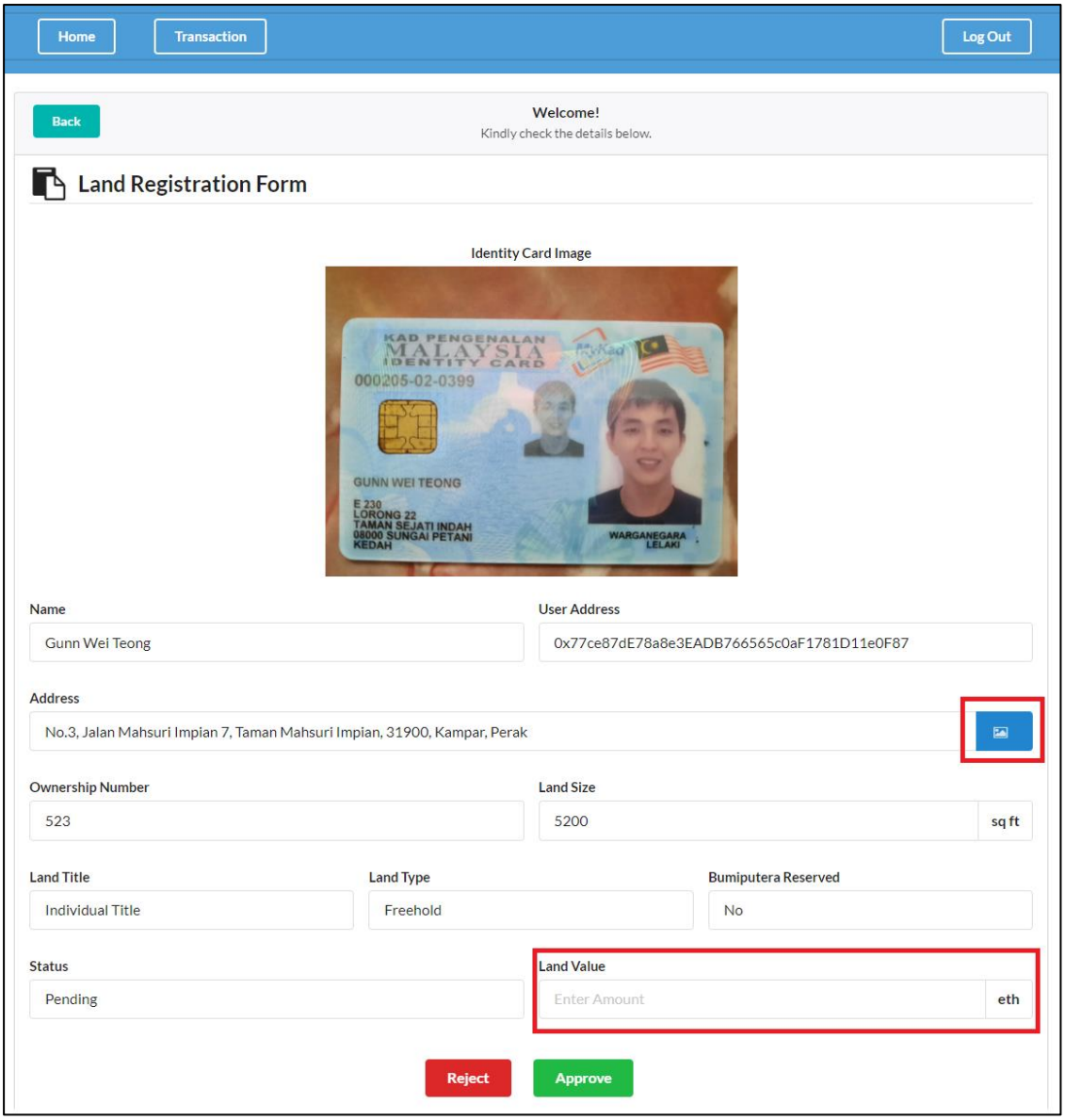


Figure 4.2.1.13: Verification of land registration by government authority

By clicking on the 'Check Details' button at the homepage (Figure 4.2.1.12), government authority will be redirected to this land registration form in figure 4.2.1.13 for verification. The government authority will compare the information given by the users with the information stored in the old database to ensure legitimacy. If the information aligned, the government authority will enter the land's worth in ether and approve the user's land registration. If the information mismatch, the government authority will just reject the user's land registration. In addition, the identity card of the user is present to prevent imposters from simply submitting fake or false information. The blue button highlighted allows government authority to view the land image submitted by user.

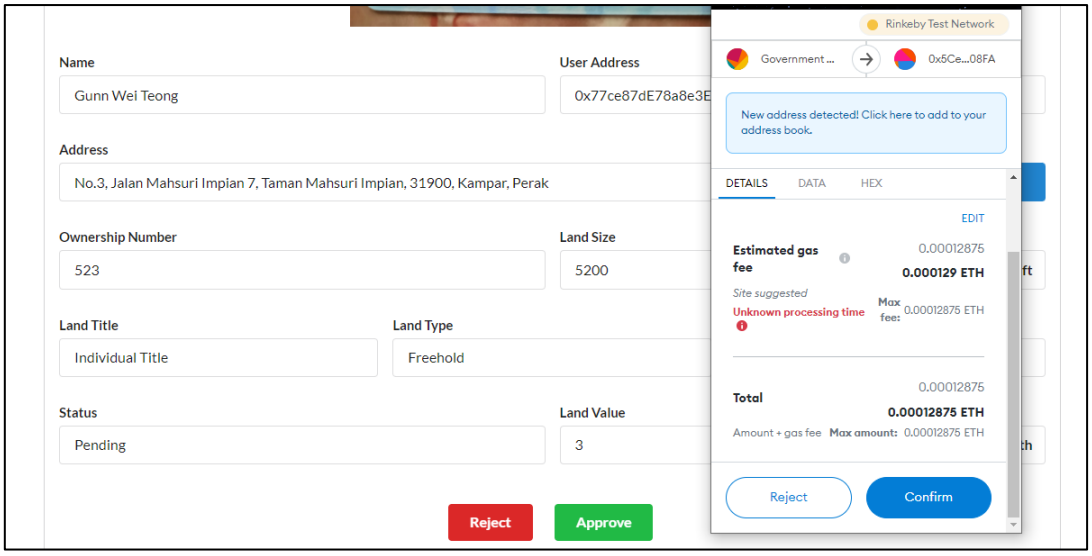


Figure 4.2.1.14: Approving of land registration by government authority

After entering the land's worth, government authority can press on the 'Approve' button. A Metamask prompt up will appear asking to pay a gas fee. Once the government authority clicks on the 'Confirm' button, the user's land details will be successfully stored into the blockchain.

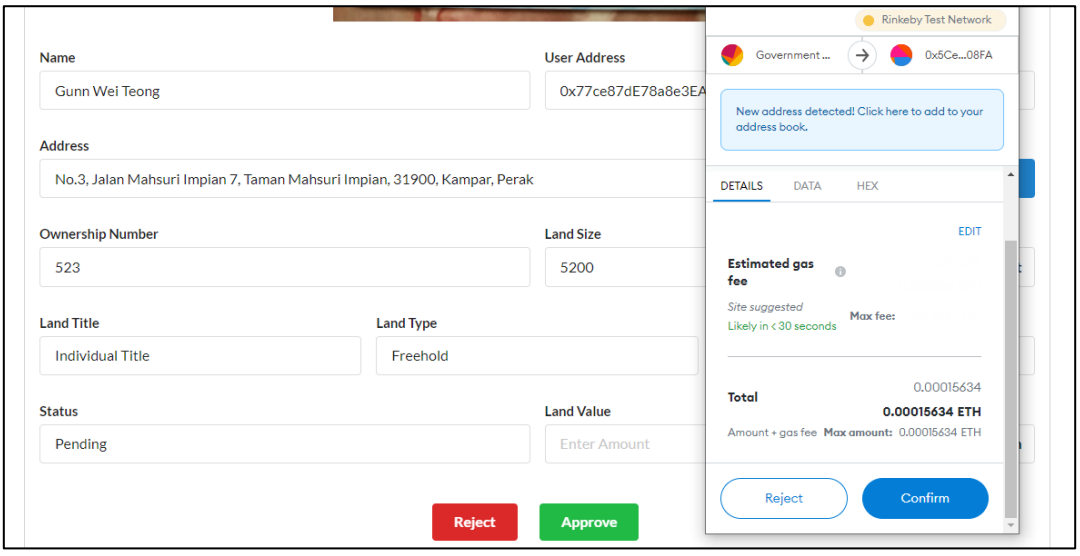


Figure 4.2.1.15: Rejecting of land registration by government authority

Without entering the land's worth, government authority can just press on the 'Reject' button. A Metamask prompt up will appear asking to pay a gas fee. Once the government authority clicks on the 'Confirm' button, the user's land registration is marked as fail.

4.2.2 Land Dealing Process

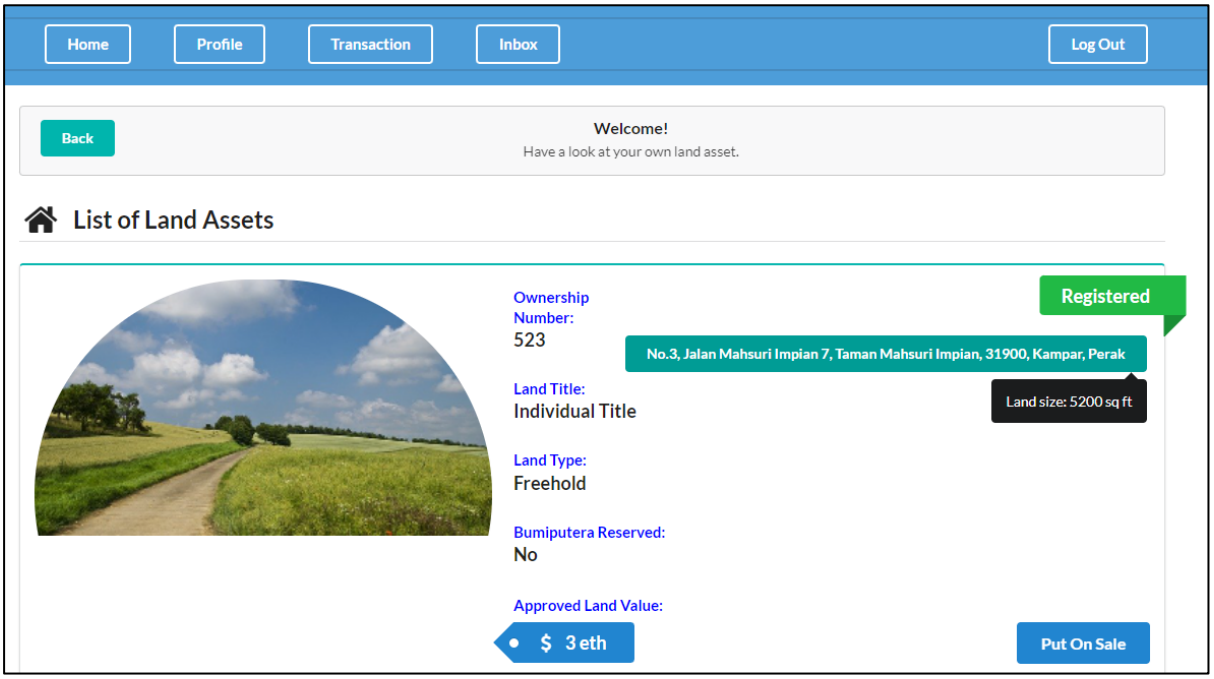


Figure 4.2.2.1: List of land assets, registered

After land registration approval from government authority, users will be able to view their own land through the portal. By clicking on the 'View' button at the homepage (Figure 4.2.1.5), users will be redirected to this list of land assets in figure 4.2.2.1. All information given during the land registration process are retrieved from the blockchain and displayed here. The land size will appear when the mouse cursor hovers over the land address. Take note that approved land value is the land's worth set by the government authority. Other than that, the 'Put On Sale' button allows users to place their land on sale for potential buyers.

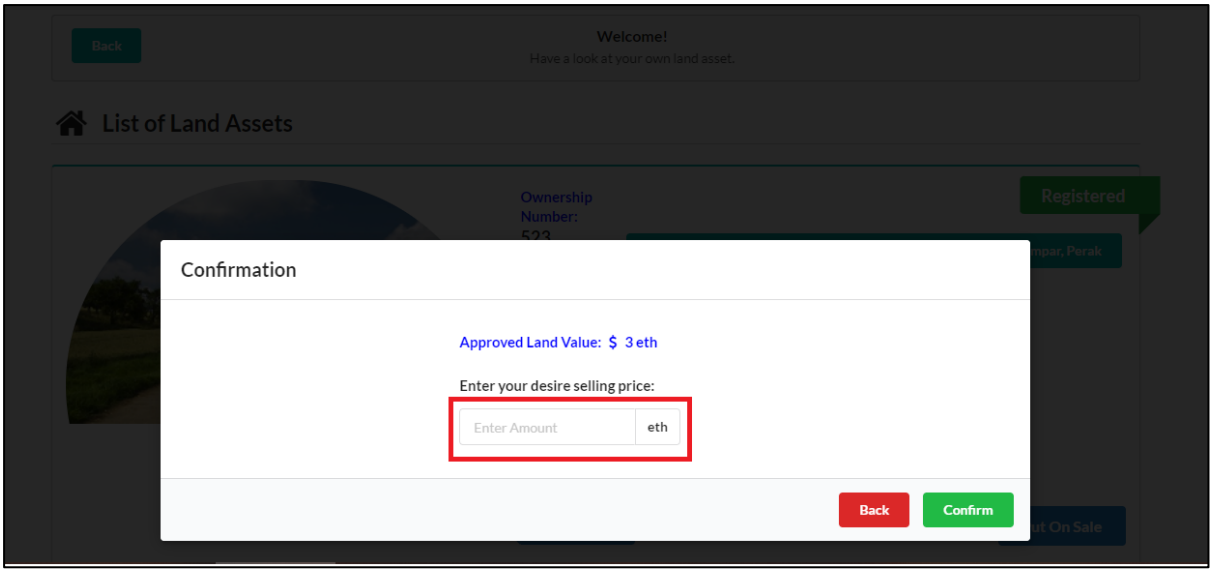


Figure 4.2.2.2: Put land on sale

If users do decide to sell their land, they can press the 'Put On Sale' button and this confirmation will prompt up. In this confirmation tab, users will need to enter their desire selling price. The selling price can be higher or lower than the approved land value. Once the selling price is entered, users then click on the 'Confirm' button.

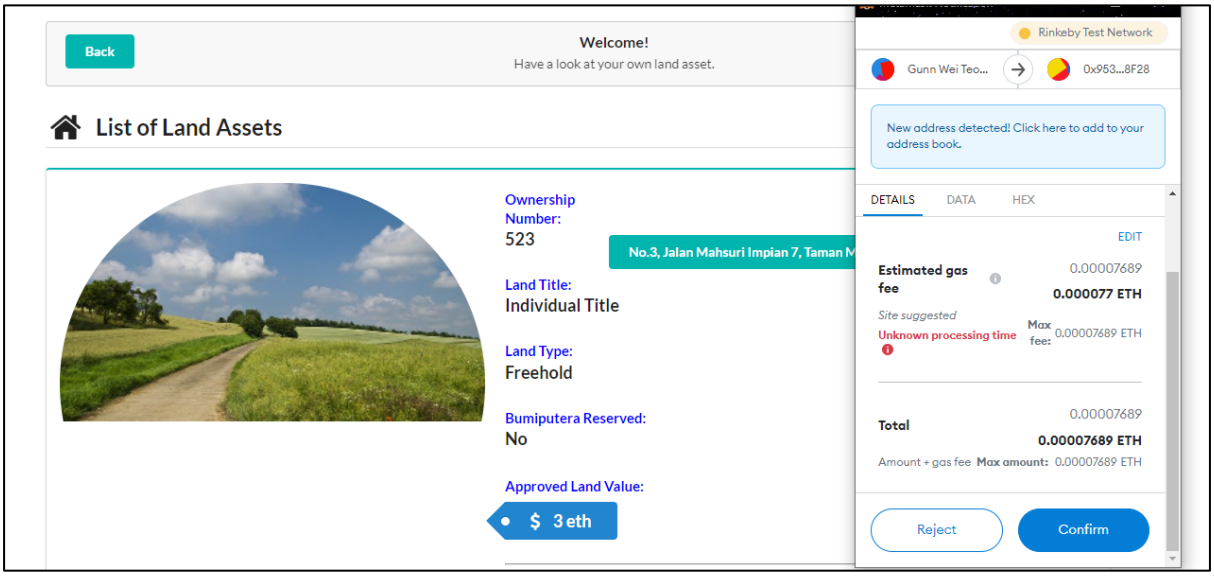


Figure 4.2.2.3: Put land on sale (2)

Next, a Metamask prompt up will appear asking users to pay a gas fee. After confirming the Metamask prompt up, the user's land will be place in the market for sale.

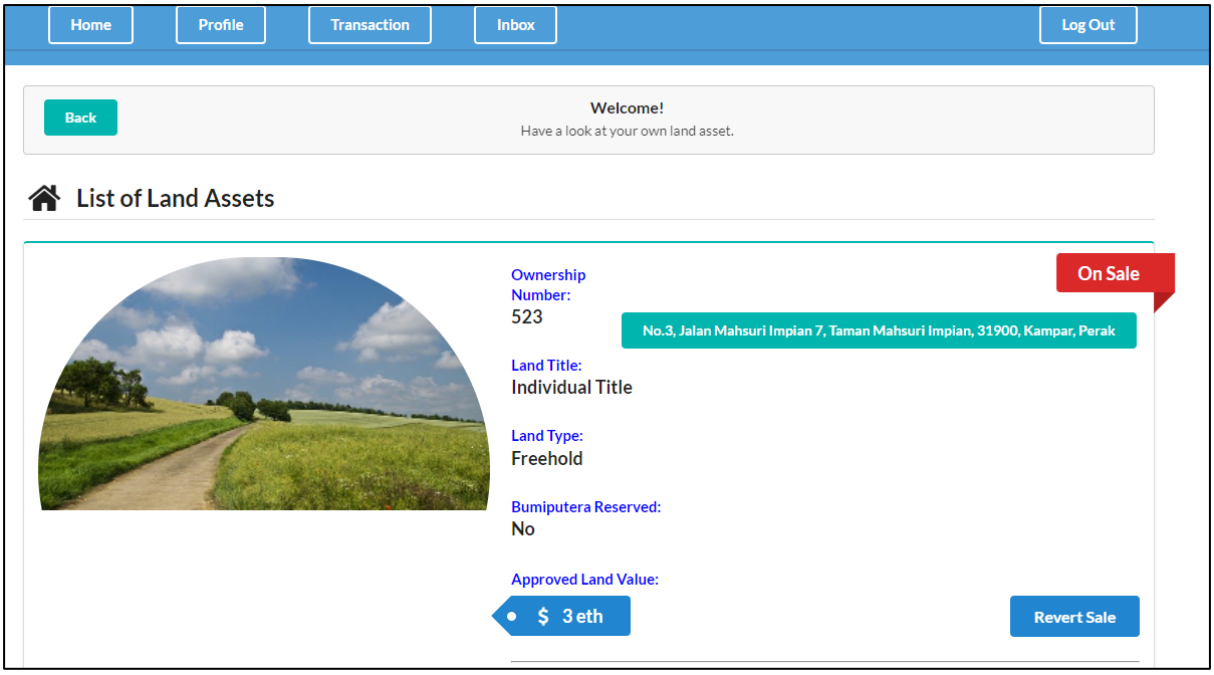


Figure 4.2.2.4: List of land assets, on sale

When users place their land on sale, the interface for list of land assets will change from figure 4.2.2.1 to figure 4.2.2.4. The only changes are the top right ribbon (Registered → On Sale) and the bottom right button (Put On Sale → Revert Sale). If for some reason like users wanting to change their selling price, they can click on the 'Revert Sale' button to retrieve their land back from the market. However, this is only possible if no buyers bid on that particular land. When buyers start to bid on the land, the 'Revert Sale' button will not be visible anymore.

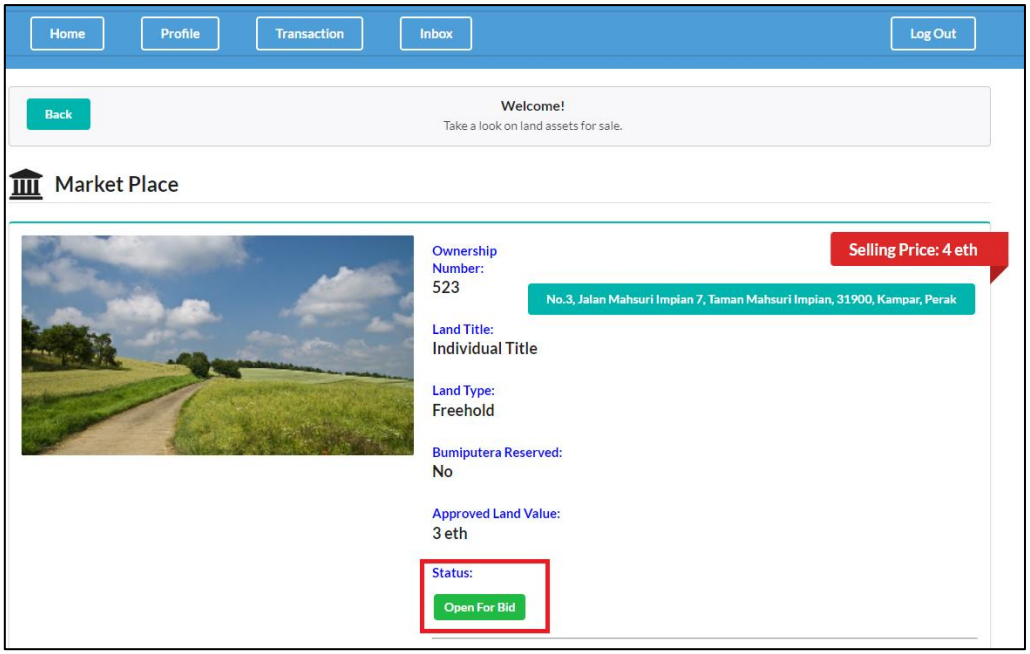


Figure 4.2.2.5: Market place, land owner point of view (1)

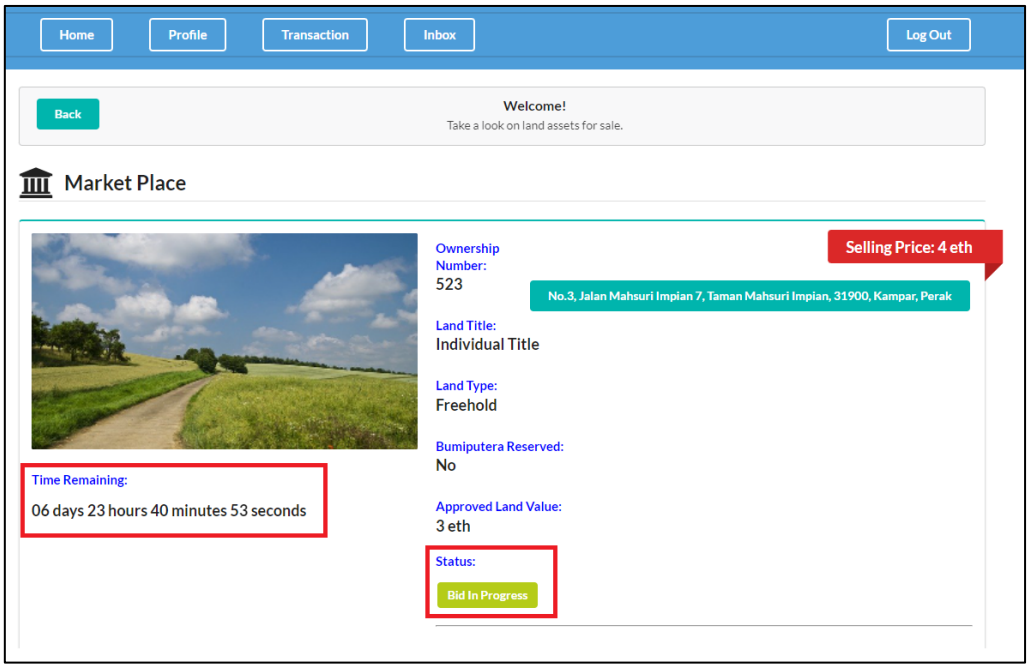


Figure 4.2.2.6: Market place, land owner point of view (2)

Once land owners put their land on sale, they can actually see their land through the market place by clicking on the 'Search' button at the homepage (Figure 4.2.1.5). However, they cannot interact with their own land, it is basically for display. The status of 'Open For Bid' means that no buyers have started bidding yet while the status of 'Bid In Progress' means that buyers have started their bids. The timer shows the time left before the bidding is close.

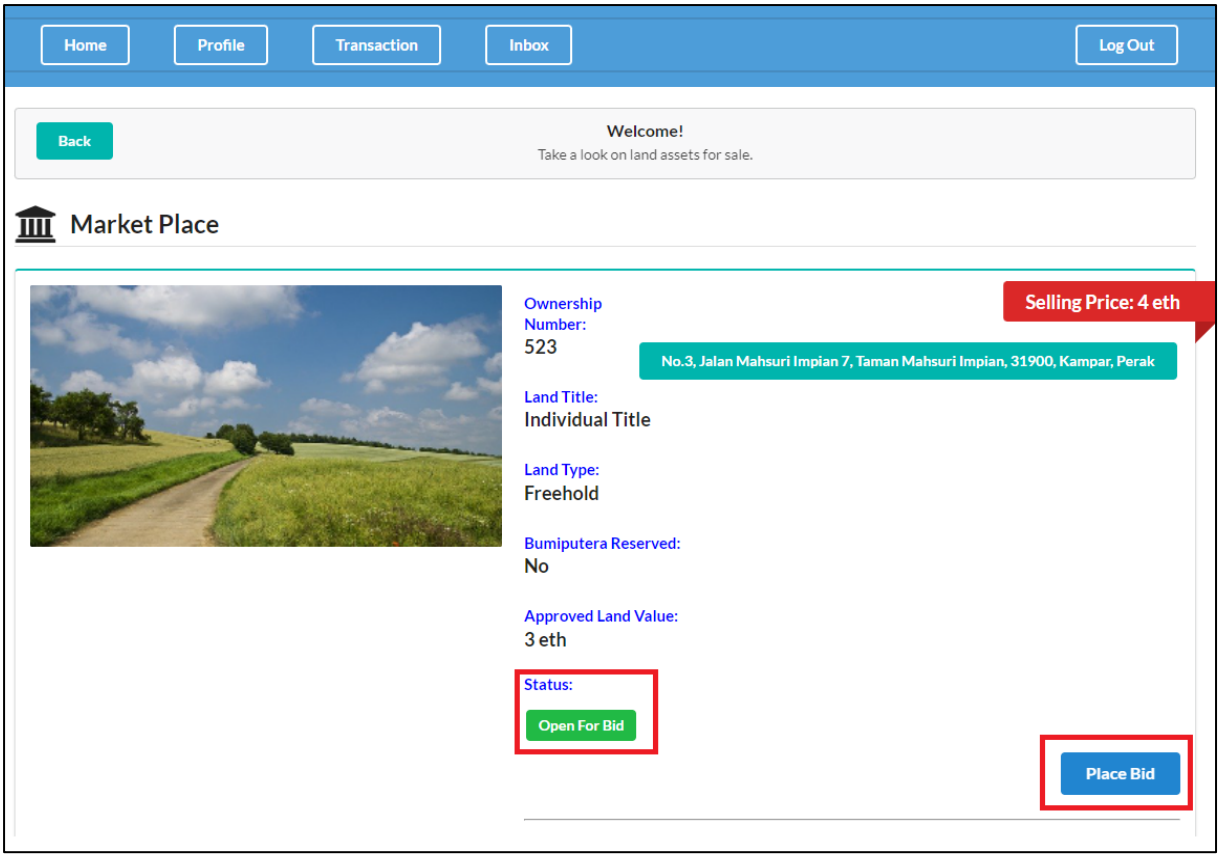


Figure 4.2.2.7: Market place, buyer point of view (1)

By clicking on the 'Search' button at the homepage (Figure 4.2.1.5), buyers will be redirected to this market page in figure 4.2.2.7. Only lands put on sale by land owners will be display here. All the land information will be display to the buyers so they get to know the land before purchasing it.

The status 'Open For Bid' means that no buyers have started bidding on that land yet. If a buyer is interested in the land, the bid can be started by clicking on the' Place Bid' button.

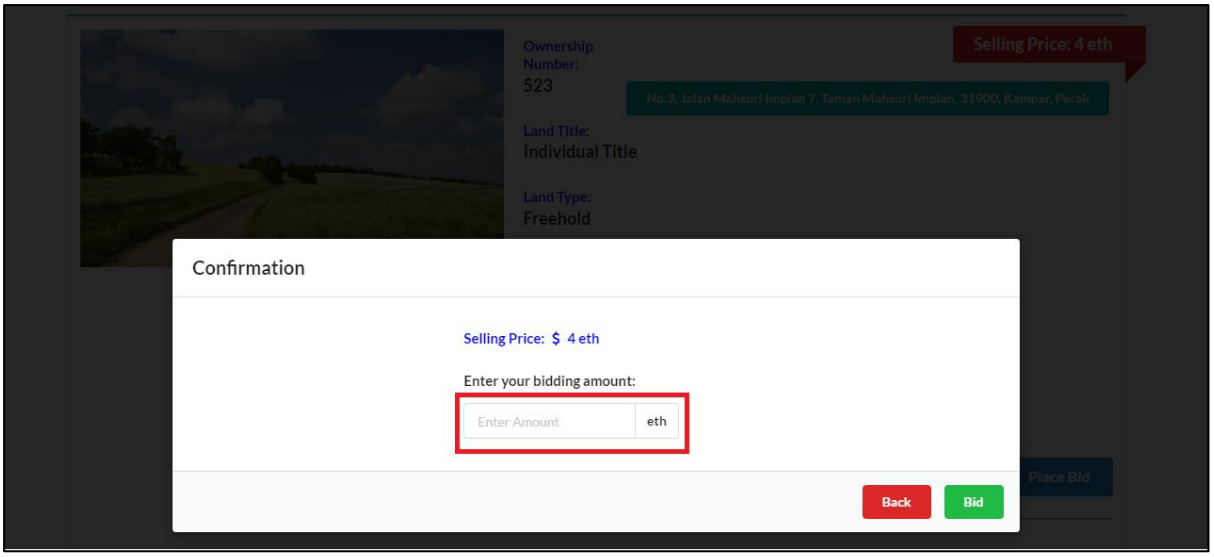


Figure 4.2.2.8: Market place, buyer point of view (2)

When buyers click on the 'Place Bid' button, this confirmation in figure 4.2.2.8 will prompt up. In this confirmation tab, buyers will need to enter their bidding amount. The bidding amount must be higher than the selling price of the land. Once the bidding amount is entered, users then click on the 'Bid' button.

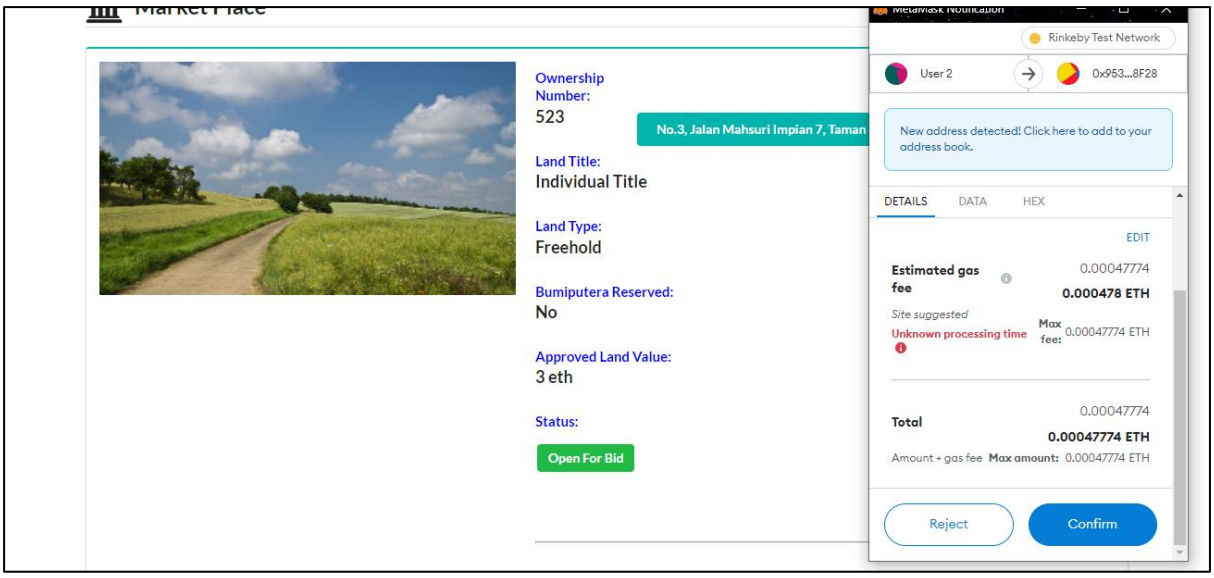


Figure 4.2.2.9: Market place, buyer point of view (3)

Next, a Metamask prompt up will appear asking buyers to pay a gas fee. After confirming the Metamask prompt up, the buyer's bid will be placed on that land.

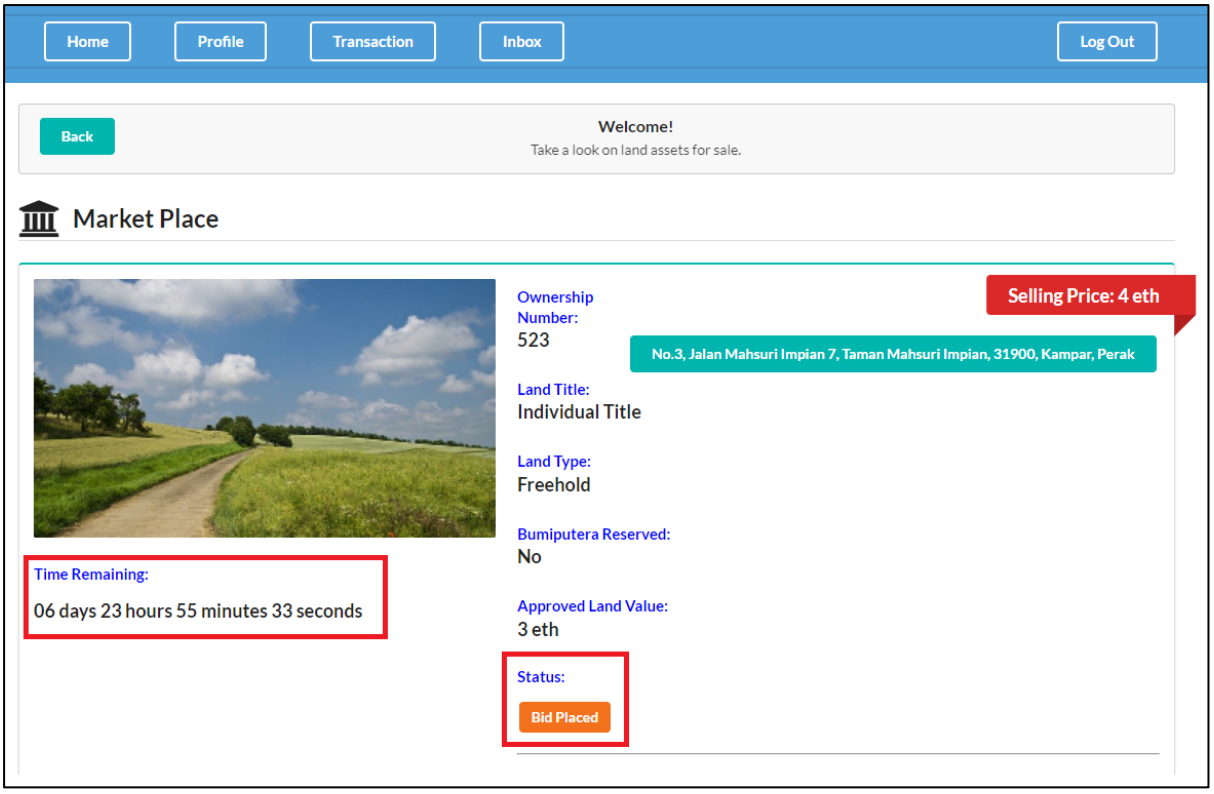


Figure 4.2.2.10: Market place, buyer point of view (4)

After starting a bid on a land, a timer will appear below the land image. This timer will countdown 7 days starting from the bid start time. This means that other buyers will have a duration of 7 days to challenge the bid. The bidding will close after 7 days. In addition, the status highlighted will change to 'Bid Placed'. Buyers who can see this status indicates that they are currently holding the highest bid for that land.

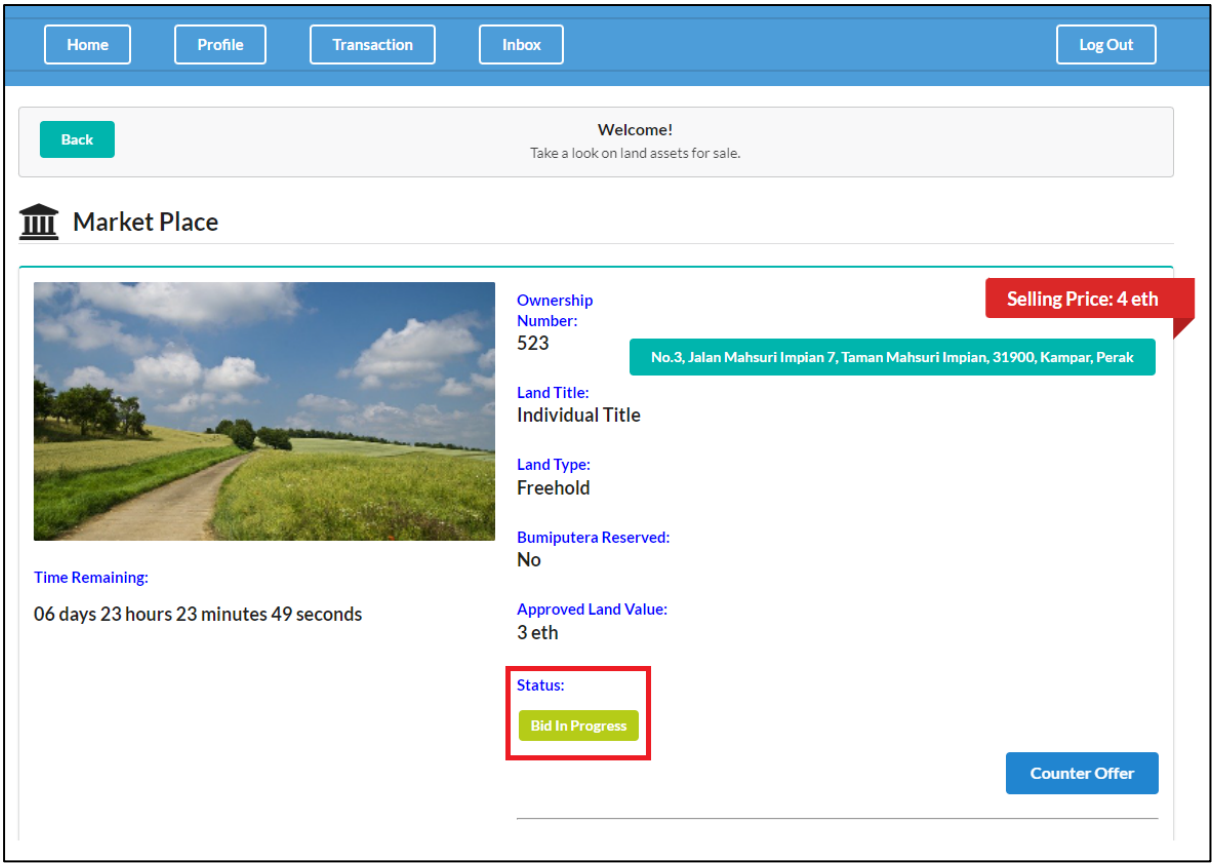


Figure 4.2.2.11: Market place, buyer point of view (5)

If a buyer sees this status of 'Bid In Progress', it means that bidding has started for that land and currently someone else is having the highest bid. If buyers are interested in that land, they can challenge the highest bidder by clicking on the 'Counter Offer' button.

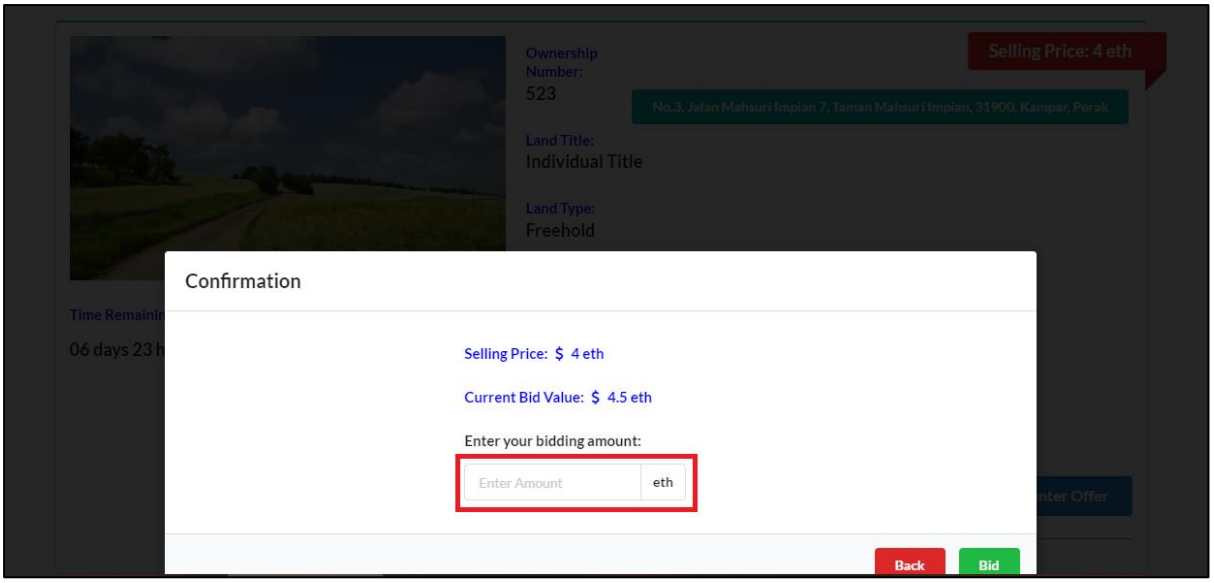


Figure 4.2.2.12: Market place, buyer point of view (6)

When buyers click on the 'Counter Offer' button (Figure 4.2.2.11), this confirmation in figure 4.2.2.12 will prompt up. In this confirmation tab, buyers will need to enter their bidding amount. The bidding amount must be higher than the current bid value. Once the bidding amount is entered, users then click on the 'Bid' button.

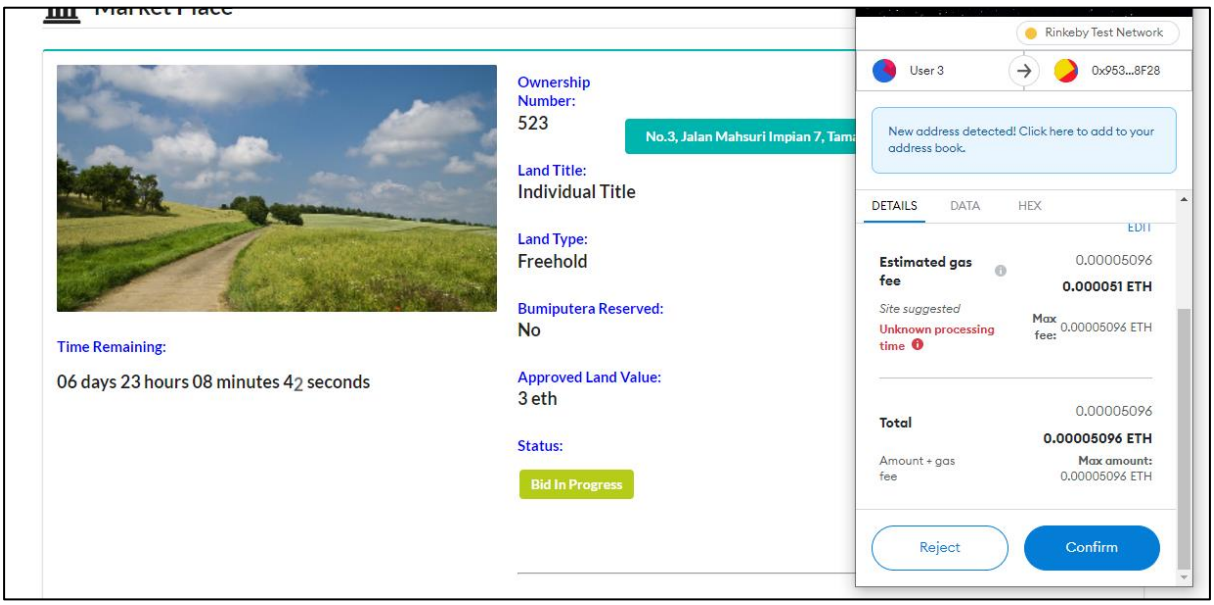


Figure 4.2.2.13: Market place, buyer point of view (7)

Next, a Metamask prompt up will appear asking buyers to pay a gas fee. After confirming the Metamask prompt up, the buyer's bid will replace the highest bidder.

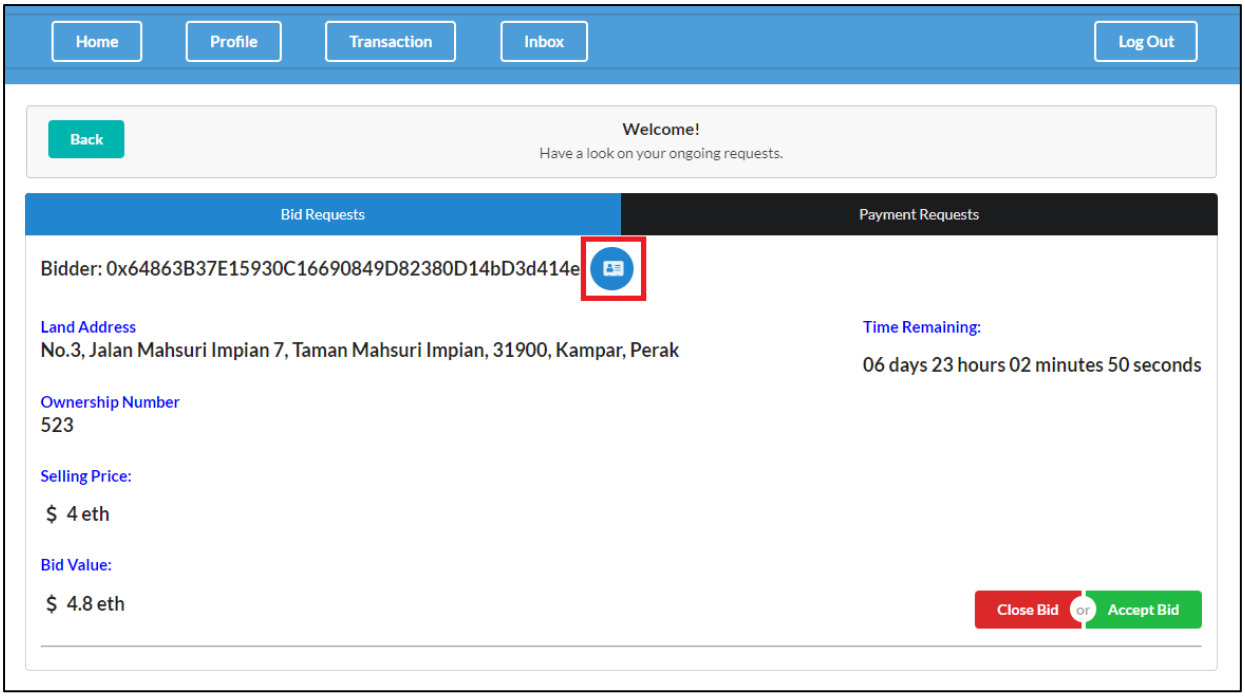


Figure 4.2.2.14: Bid Requests, land owner point of view

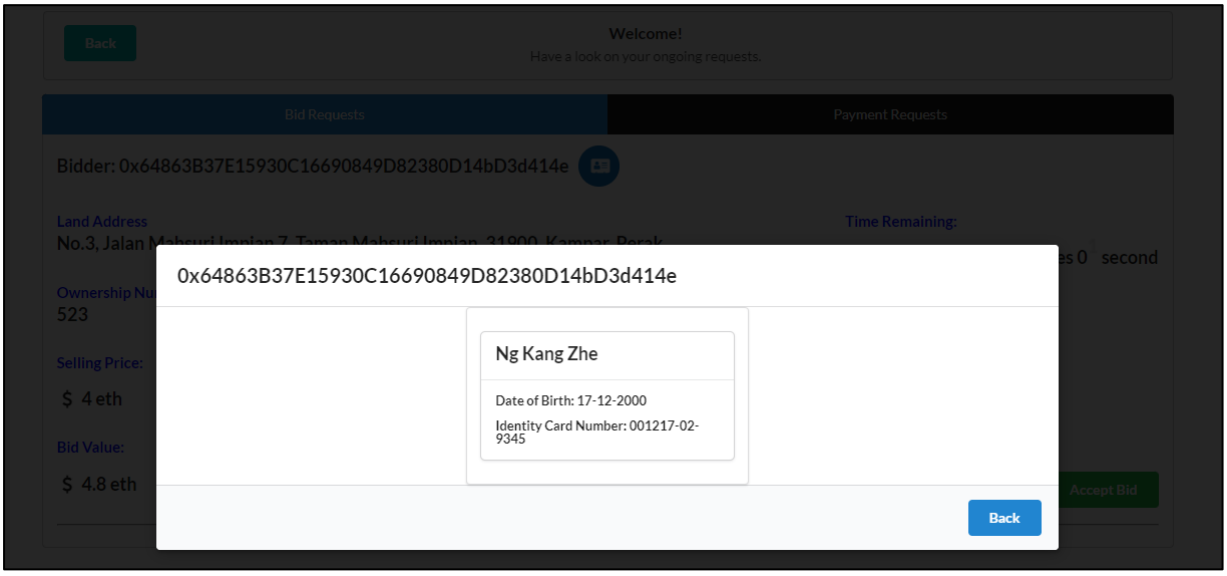


Figure 4.2.2.15: Bidder's information

By clicking on the 'Inbox' button at the homepage (Figure 4.2.1.5), land owners will be redirected to this page in figure 4.2.2.14. This page will actually display the bids from buyers. However, for each land on sale, only the highest bidder will be displayed. The blue button highlighted in figure 4.2.2.14 will display the bidder's information in figure 4.2.2.15 when clicked.

Once the land owner receives a bid, a decision has to be made on approving the bid, closing the bid or waiting for a higher bidder. Approving the bid means that the land owner accepts the deal with the buyer and sends a payment request to the buyer. Closing the bid means that the land owner removes the land from the market place and ends the bidding process. Waiting for a higher bidder means that the land owner is not satisfied with the current bid and wants to wait for a higher bid. Take note that if the land owner does not accept the bid before the timer runs out, the bid will be mark as fail and that land will be removed from the market place.

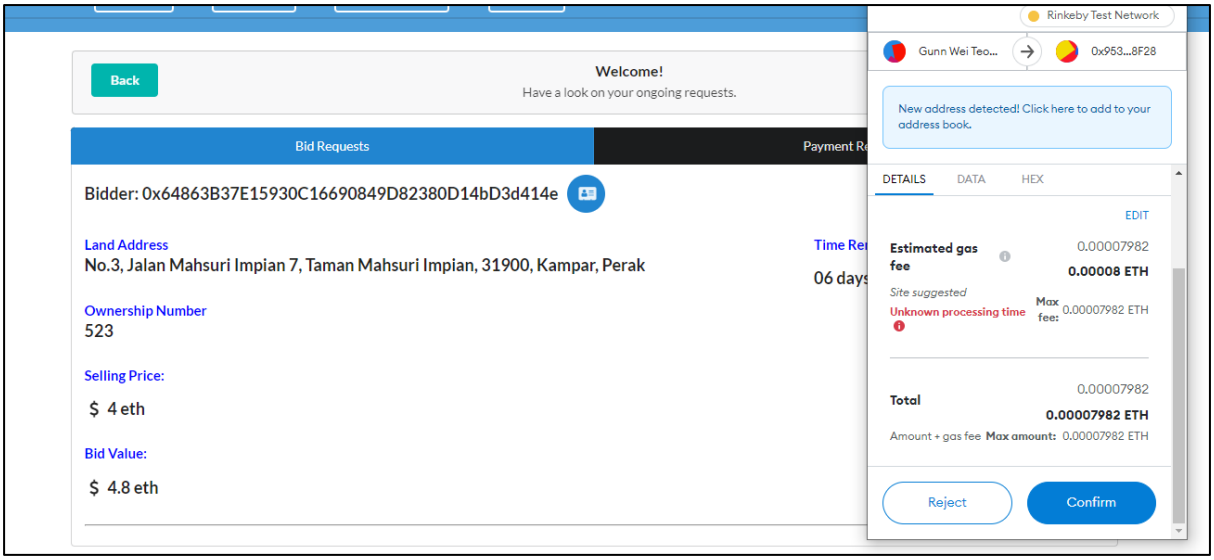


Figure 4.2.2.16: Close bid

If land owner clicks on the 'Close Bid' button in figure 4.2.2.14, a Metamask prompt up will appear asking to pay a gas fee. After confirming the Metamask prompt up, the land will be removed from the market place and the bidding process will end.

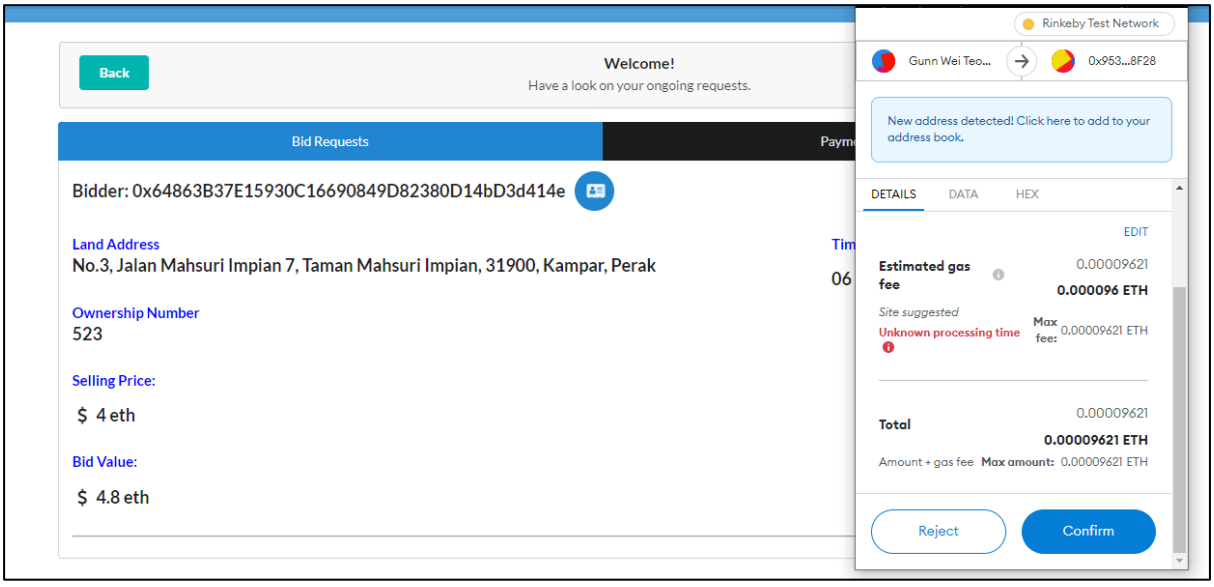


Figure 4.2.2.17: Accept bid

If land owner clicks on the 'Accept Bid' button in figure 4.2.2.14, a Metamask prompt up will appear asking to pay a gas fee. After confirming the Metamask prompt up, the land owner accepts the deal with the buyer and a payment request is sent to the buyer.

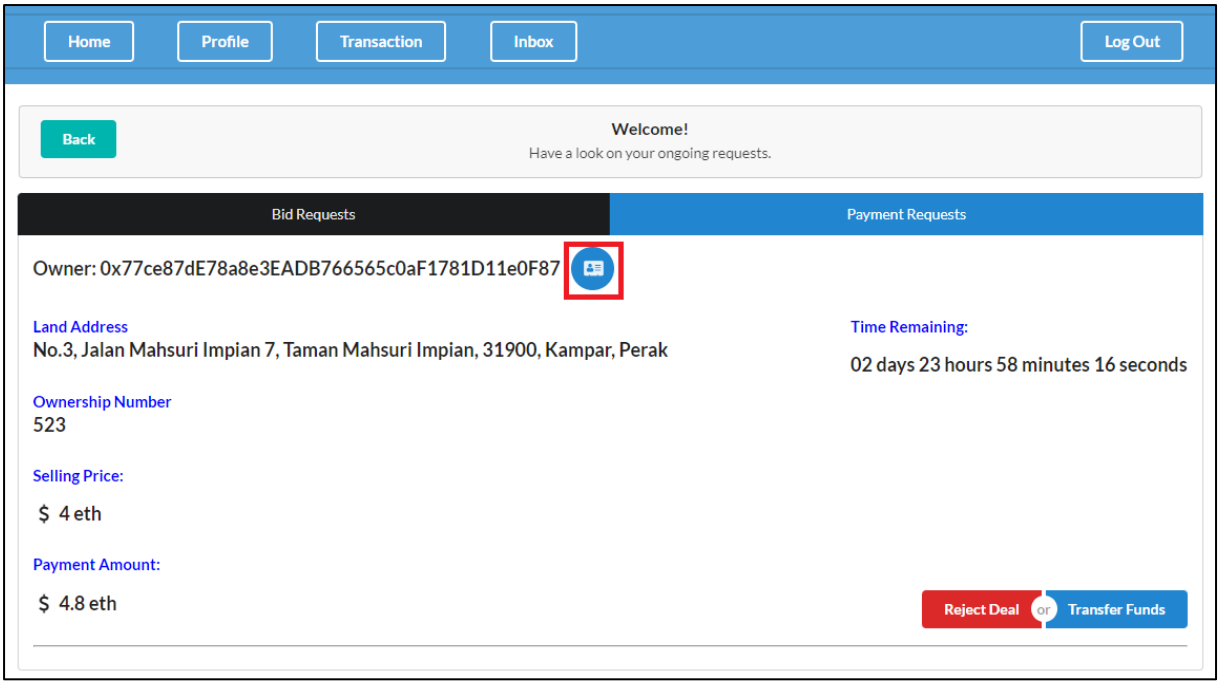


Figure 4.2.2.18: Payment Requests, buyer point of view

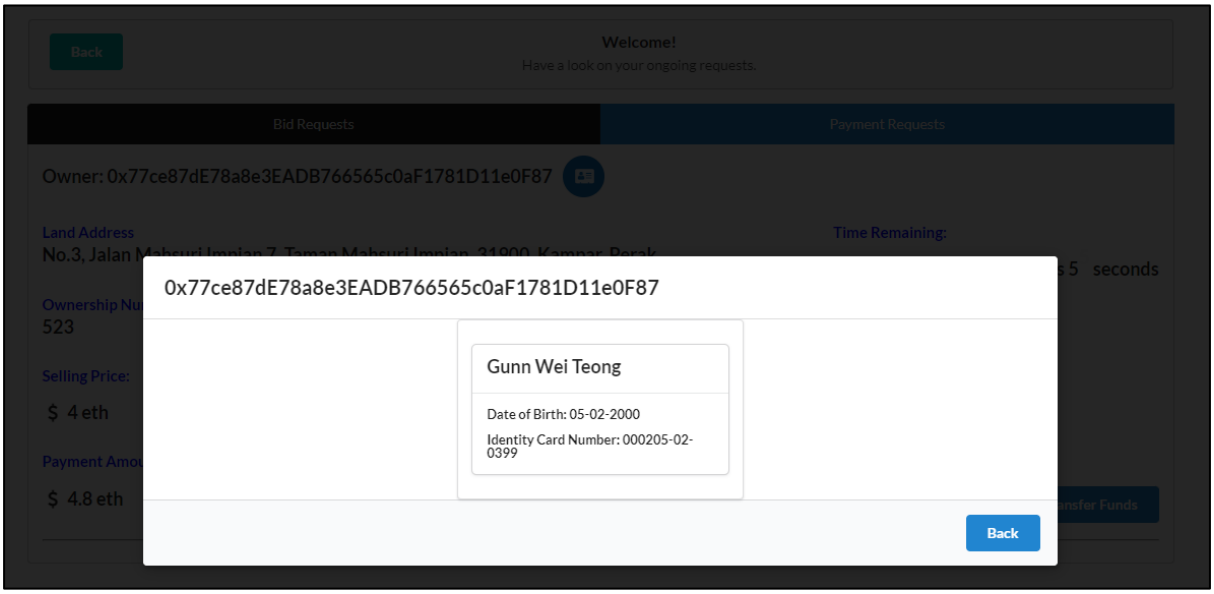


Figure 4.2.2.19: Owner's Information

After the land owner accepts the bid request, the buyer will receive a payment request just like in figure 4.2.2.18. Buyers can access this page by clicking on the 'Inbox' button at the homepage (Figure 4.2.1.5). The blue button highlighted in figure 4.2.2.18 will display the land owner's information in figure 4.2.2.19 when clicked.

Once the buyer receives a payment request, a decision has to be made on transferring the funds or rejecting the deal. Transferring the funds means that the buyer

transfers the payment amount to the land owner while land ownership will be transferred to the buyer. Rejecting the deal means that the buyer ends the deal with the land owner and land is remove from the market place. Take note that if the buyer does not transfer the funds within 3 days, the payment will be mark as fail and that land will be removed from the market place. In addition, buyers need to ensure that their Metamask wallet has enough ether before the transfer.

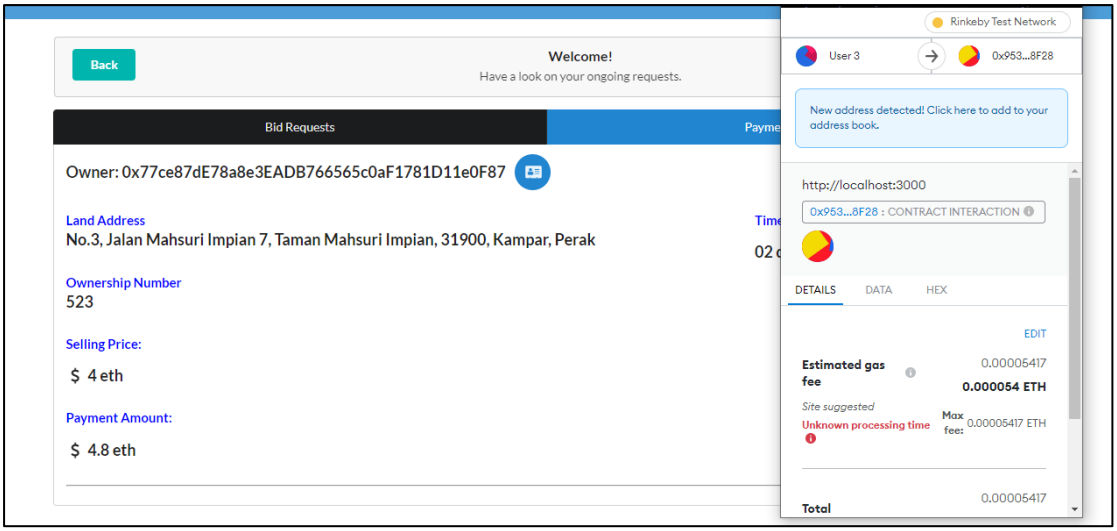


Figure 4.2.2.20: Reject deal

If buyer clicks on the 'Reject Deal' button in figure 4.2.2.18, a Metamask prompt up will appear asking buyers to pay a gas fee. After confirming the Metamask prompt up, the deal between the buyer and land owner is mark as fail and the land will be removed from the market place.

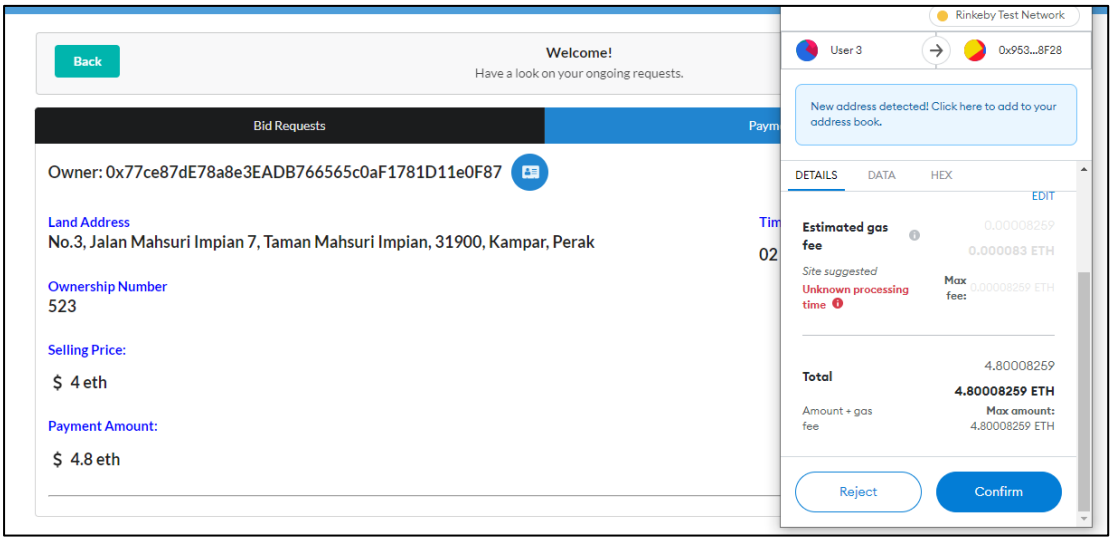


Figure 4.2.2.21: Transfer funds

If land owner clicks on the 'Transfer Funds' button in figure 4.2.2.18, a Metamask prompt up will appear asking to pay a gas fee. After confirming the Metamask prompt up, the buyer will transfer the payment amount to the land owner while the land ownership is transferred from the land owner to the buyer. This completes the land dealing process.

5 Chapter 5: System Implementation

5.1 System Methodology

For this project, the methodology used to develop the blockchain-based land registration system is prototyping. The prototyping model is a system development method where a prototype is built, tested and then reworked when necessary until an acceptable prototype is achieved by which the final system can be developed. Since a working model of the system is provided, users will have a better understanding of the system being developed. Moreover, there will be lots of interaction between the developer and the end users, therefore quicker user feedbacks are available leading to errors and missing functionalities being identified much earlier and easily. Figure 3.1.1.1 shows the six phases of prototyping modelling.

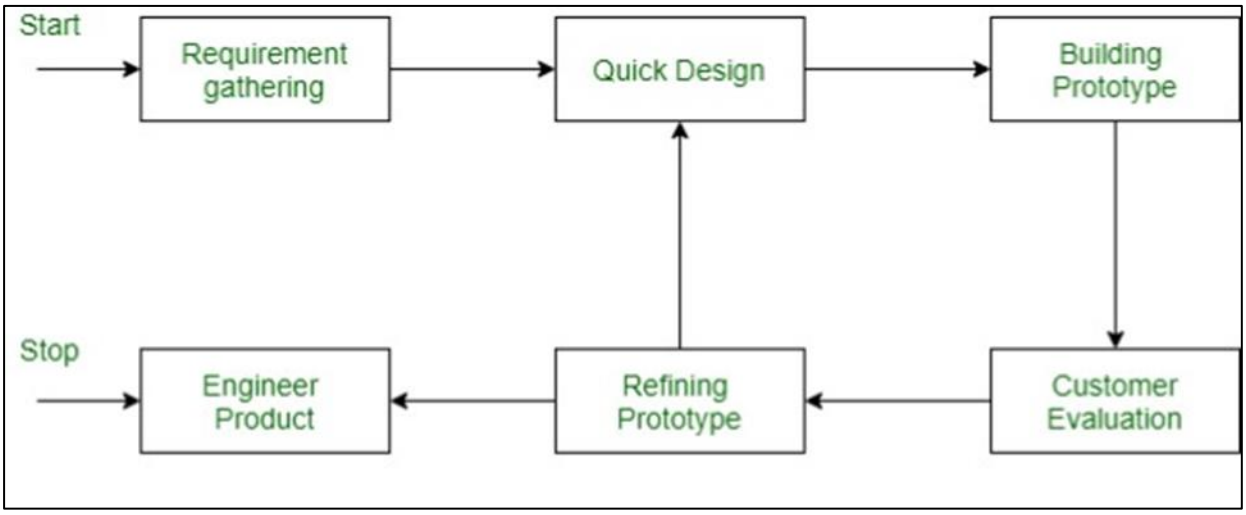


Figure 5.1.1: Prototyping methodology

5.1.1 Phase 1: Requirements gathering and analysis

A prototype model starts with requirement gathering and analysis. In this phase, user requirements for the system are defined. However, users do not need to list down all their requirements at one go. They just need to provide some basic or main requirements needed in the system. This is because users can add more requirements or remove some requirements if not pleased during the evaluation phase. The requirements gathering process is conducted through interview with end users to determine the user interface, functionalities and expectations of the system. Once the

requirements are gathered, the requirements are analyzed through data visualization with graphs and charts to come out with suitable user requirements for the prototype.

5.1.2 Phase 2: Quick design

The second phase of prototype modelling is a preliminary design. In this stage, a simple design of the system is created by using CASE tools like Visual Paradigm and Lucidchart. With these CASE tools, the system use-case diagram and flow diagram can be created. The diagrams developed are based on the user requirements determined in phase 1. However, the design created is not complete and not finalize. This design is supposed to give a brief idea of the system to the users while also aid the developer in developing the prototype.

5.1.3 Phase 3: Build a prototype

In the following phase, an actual prototype is designed based on the information gathered from phase 2, quick design. The prototype is a small working model of the actual system, but errors and missing functionalities are expected.

5.1.4 Phase 4: Initial user evaluation

For this stage, the prototype is presented to the end users for initial evaluation. Users will be able to test the system hands-on and provide their feedback to the developer. This helps in identifying the strengths and weaknesses of the prototype. Users are encouraged to give comments and suggestions to further improve the prototype. This is where users are able to add or remove user requirements.

5.1.5 Phase 5: Refining prototype

After receiving user's evaluation of the prototype, the developer needs to refine the prototype based on the user's feedback and suggestions. Once refinement is done, the prototype is presented to the users again. Users will then give their comments and suggestions. This cycle is repeated until all the requirements specified by the users are met and the users are satisfied with the developed prototype. Finally, the final system is developed according to the approved final prototype.

5.1.6 Phase 6: Implement product and maintain

The last phase starts when the final system is developed complete based on the final prototype. The final system is tested thoroughly and then deployed to production. It will need to undergo routine maintenance to avoid prolonged downtime and large-scale system failure.

5.2 Project Timeline

Activity	Period													
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
Chapter 1: Introduction														
Problem Statement and Motivation														
Project Scope														
Project Objectives														
Impact, Significance and Contribution														
Background Information														
Chapter 2: Literature Review														
Fact Finding														
Critical Remarks of Previous Works														
Chapter 3: System Design														
Use-Case Diagram														
Flow Diagram														
Chapter 4: System Implementation														
System Methodology														
Technologies and Tools Involved														
Project Timeline														
Verification Plan														
System Development														
Implementation Issues and Challenges														
System Testing														
System Documentation														
Chapter 5: Conclusion														
Project Review and Discussion														
Novelties and Contributions														
Future Work														
Check and Finalize FYP2 Report														
FYP2 Report Submission														
FYP2 Presentation														

Figure 5.2.1: Gantt chart for final year project II

5.3 Technologies and Tools Involved

Tool	Type	Description
Metamask	Cryptocurrency wallet	A browser extension that provides the simplest yet secure way to connect to the Blockchain land registration system. Metamask enables users to interact with the Blockchain land registration system, store cryptocurrency, pay transaction fees and transfer cryptocurrency to others.
Remix	IDE	An open source tool that allows developers to code smart contract with solidity language straight from the browser. Remix is used for the initial development and testing of smart contract.
Visual Studio Code	IDE	The code editor used for the development of the Blockchain land registration system from front-end to back-end.
Rinkeby Test Network	Ethereum Blockchain	An Ethereum test network that allows deployment of smart contract and interaction with smart contract.
Infura	Ethereum API	This API connects the Blockchain land registration system to the Ethereum network for smart contract deployment purpose.
Solidity	Programming language	To develop smart contract on Ethereum.
JavaScript	Programming language	To develop the front-end and back-end of the Blockchain land registration system.
React	JavaScript library	To develop the front-end and back-end of the Blockchain land registration system.
Semantic UI	Front-end framework	To develop the user interface of the Blockchain land registration system.
Web3.js	Ethereum JavaScript API	To enable the interaction between smart contract and the front-end of the Blockchain land registration system.
Next.js	React framework	To assist in front-end development by providing navigation to the Blockchain land registration system.

Node.js	JavaScript runtime	To install the packages or dependencies required during the development of the Blockchain land registration system. It also prepares the runtime environment for the system to run.

Table 5.3.1: Technologies and tools used

5.4 Implementation Issues and Challenges

There are issues and challenges faced during the implementation of my proposed system, Blockchain land registration system. Blockchain is an upcoming and growing technology that I am highly unfamiliar with. Therefore, more time and effort were needed to research and develop the proposed system. Since the technology is quite new, the learning resources and references to Blockchain are very limited. However, I managed to find some learning resources that helped me understand the development of Blockchain tremendously. With the understanding of Blockchain development, I was able to tackle the proposed system steadily. Although there were many hardships and overtime faced during the development process, I am happy with the results as this is an important skill for my future career.

In addition, a more technical challenge faced during the development of the proposed system is uploading images into the blockchain. When uploading an image into blockchain, a smart contract function will need to be called. This smart contract function will then take the image and store it into the blockchain. However, gas fee will be needed to complete the transaction. This gas fee will vary based on what the smart contract function takes in. Since the file size of images is quite large, uploading them straight to the blockchain will heighten the gas fee tremendously and make it too expensive for the users. Therefore, this way of storing images into the blockchain is not viable and an alternate solution is needed. After some research, I found a solution using Interplanetary File System (IPFS), a peer-to-peer storage network. The image now will go through IPFS before entering the blockchain. Firstly, the image will be stored into IPFS. Next, we retrieve the hash of the image through IPFS. This hash represents the content address of the image stored in IPFS. Lastly, we take the hash and store it into the blockchain. By only storing the hash into the blockchain, the gas fee needed to complete the transaction is very low. Users do not need to worry about their images being hacked as their images will not be accessible without the hash. The hash is securely stored in the blockchain.

5.5 System Testing

These are the major functionalities of the proposed system that must be tested for their expected results. There are two roles in this system, which are user and government authority. User can be further divided into buyer and seller as well.

Test Case	Expected Result
User and government authority do not login to Metamask before using the land registration portal	All functionalities in the land registration portal will not work.
User register an account on the land registration portal	One Metamask account can only have one land registration portal account.
User and government authority login to land registration portal	Only registered user or government authority are allowed to login.
User registers land asset on the land registration portal	Once registered, the registration status will be 'Pending'. A government authority needs to approve the registration to change the status to 'Success'. Upon approval, the user's land information is stored in the Blockchain. However, government authority can reject the registration to change the status to 'Failed'. This indicate that the registration has failed.
User views registered land asset	All land assets successfully registered and stored into the Blockchain can be retrieve and display to their own users.
User and government authority view all transactions	All transactions such as land registrations and land dealings are stored in the Blockchain and can be retrieve for display.
Seller place registered land for sale	All registered lands have the option to be put on sale for buyers. It is not compulsory to sell registered land.
Buyer sends bids to seller	Buyer can request to purchase land if the seller place the land for sale. Seller have the option to approve or reject buyer's bid. Upon approval, buyer is able to purchase the land. Upon rejection, buyer's bid has failed.

Buyer receives land ownership from seller	Once receiving approval for the bid, buyer will need to transfer the purchase price of the land to seller. The buyer must ensure that there is enough ether in the Metamask account for the transfer to be successful. After transferring the ether successfully, buyer will receive the land ownership from seller.

Table 5.5.1: Use-case testing plan

6 System Evaluation and Discussion

6.1 System Testing Results

Based on the use-case testing plan (Table 5.5.1), here are the results for the system testing.

6.1.1 Use-case 1

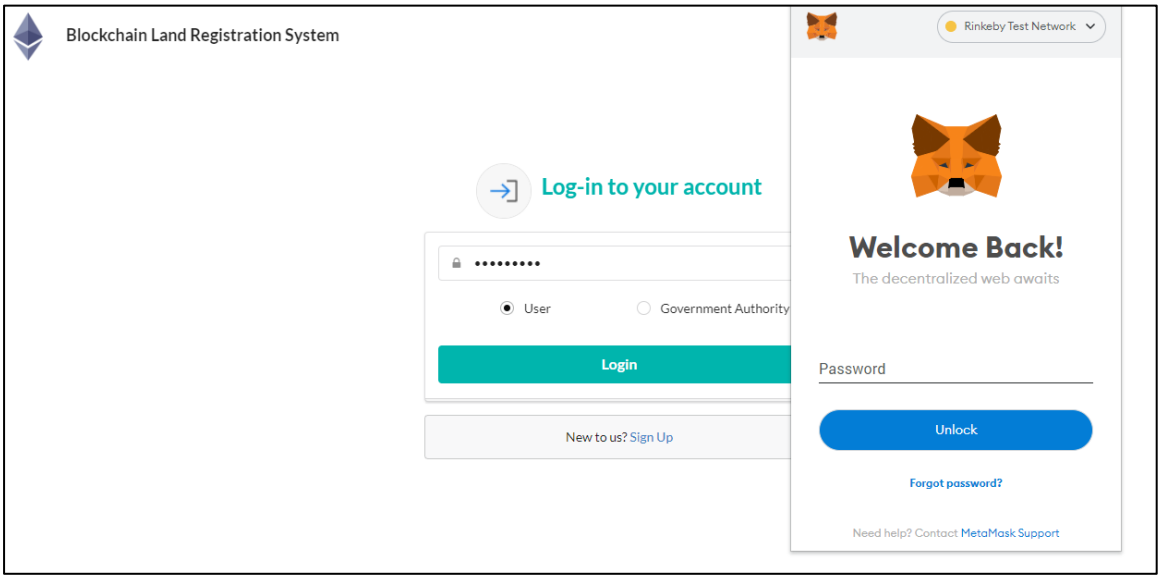


Figure 6.1.1.1: Login without Metamask, user

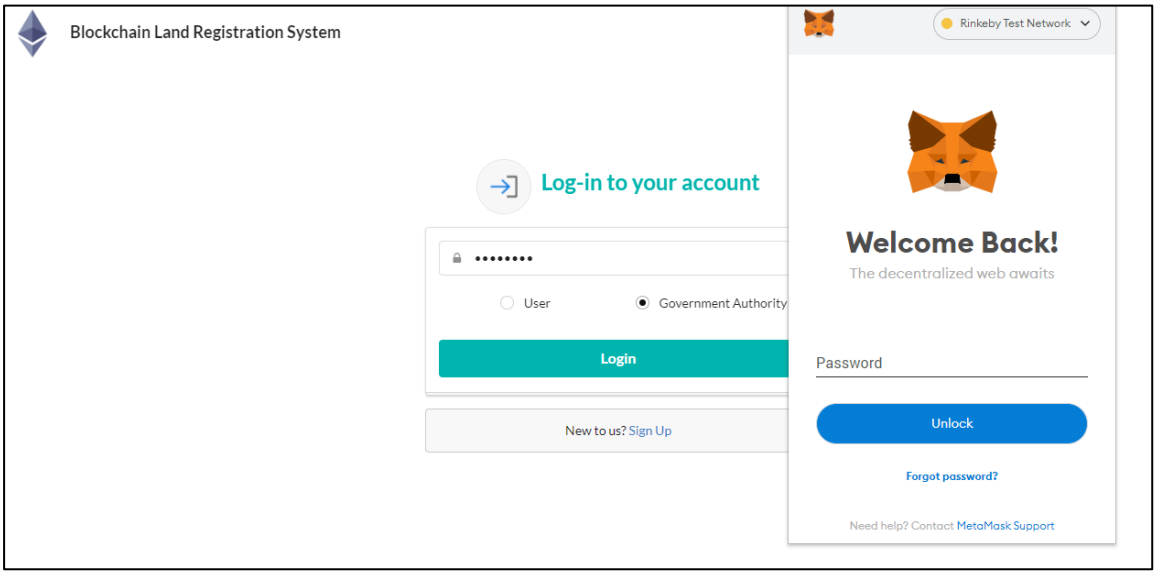


Figure 6.1.1.2: Login without Metamask, government authority

The first test case is user and government authority do not login to Metamask before using the land registration portal. The expected result for this is all functionalities

in the land registration portal will not work. As expected, user and government authority cannot login to the land registration portal when Metamask is not logged in. This is because user and government authority require the unique ID generated by Metamask as the login ID. Since Metamask is not logged in, the land registration portal cannot retrieve the login ID of user and government authority.

6.1.2 Use-case 2

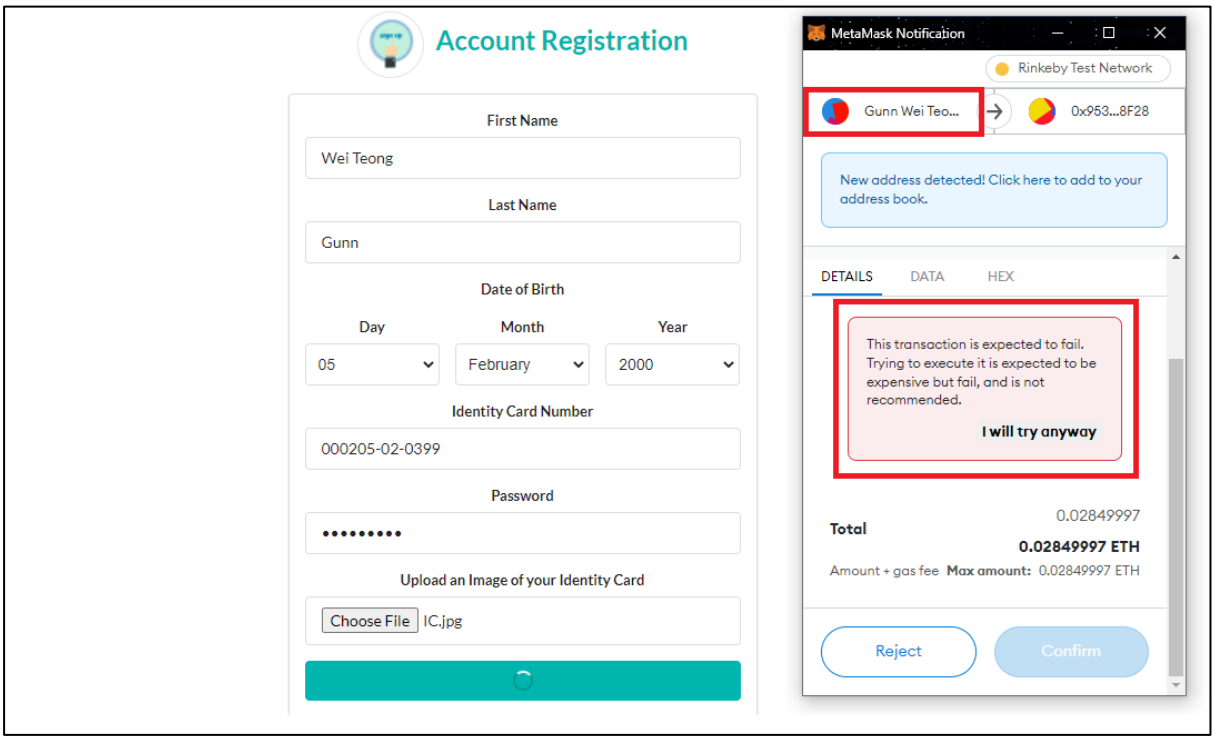


Figure 6.1.2.1: Duplicate registration, user

The second test case is user register an account on the land registration portal. The expected result is one Metamask account can only have one land registration portal account. Since I already registered an account using this Metamask account, the Metamask prompt up has a warning stating that this transaction will fail and prevents duplicate registration.

6.1.3 Use-case 3

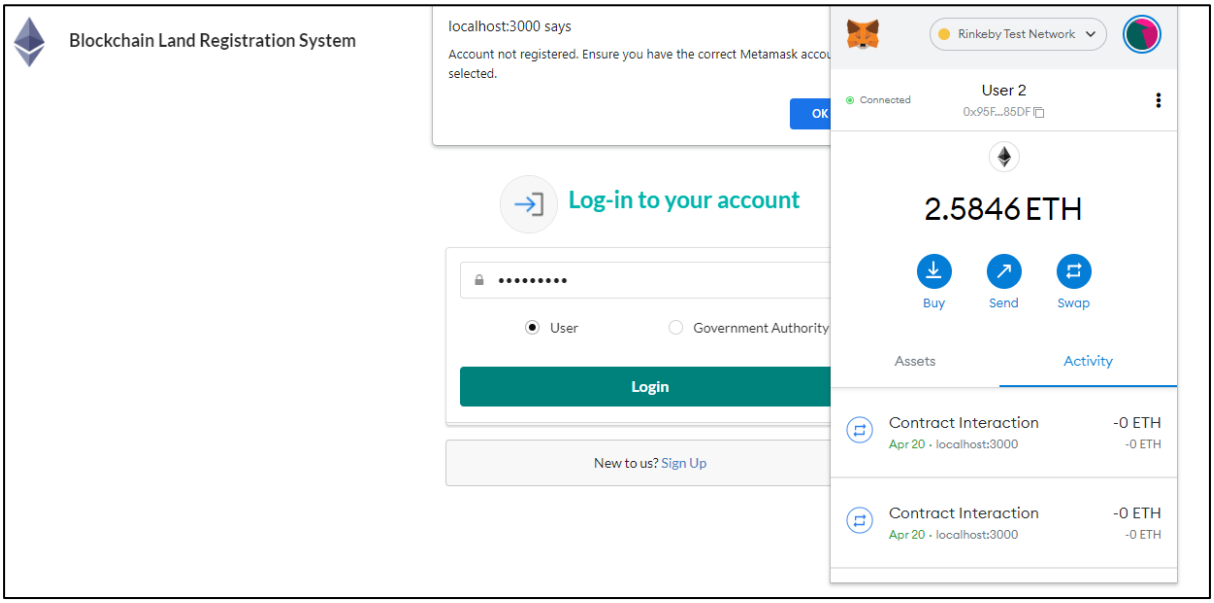


Figure 6.1.3.1: Account not registered, user

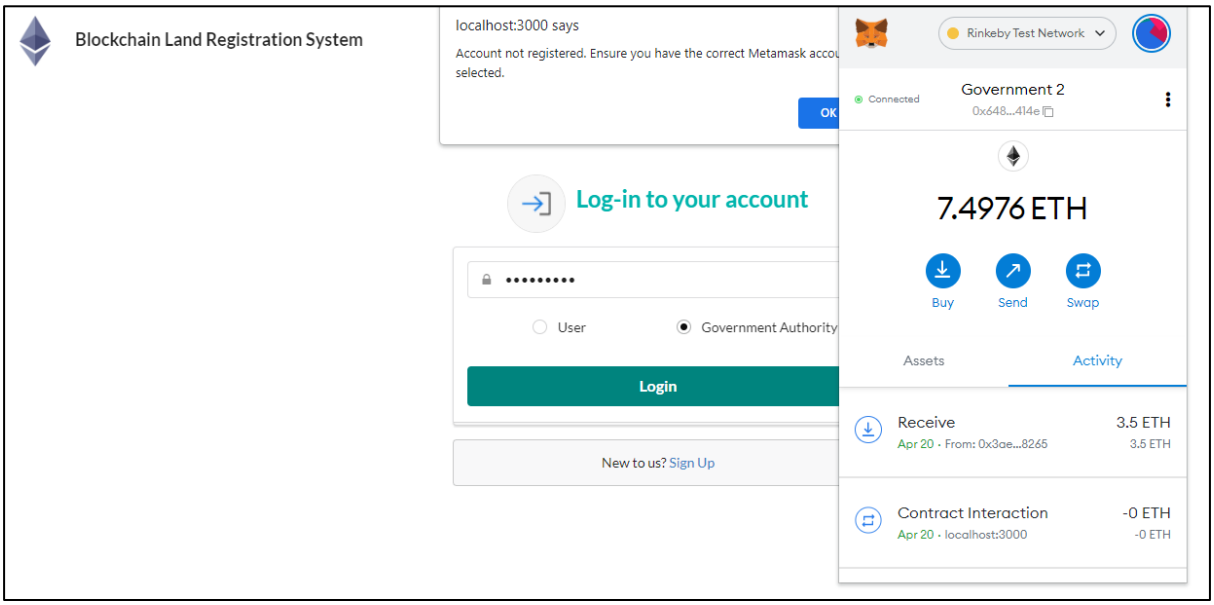


Figure 6.1.3.2: Account not registered, government authority

The third test case is user and government authority login to land registration portal. The expected result is only registered user or government authority are allowed to login. Without registration, user and government authority will receive the message in figure 6.1.3.1 and figure 6.1.3.2.

6.1.4 Use-case 4

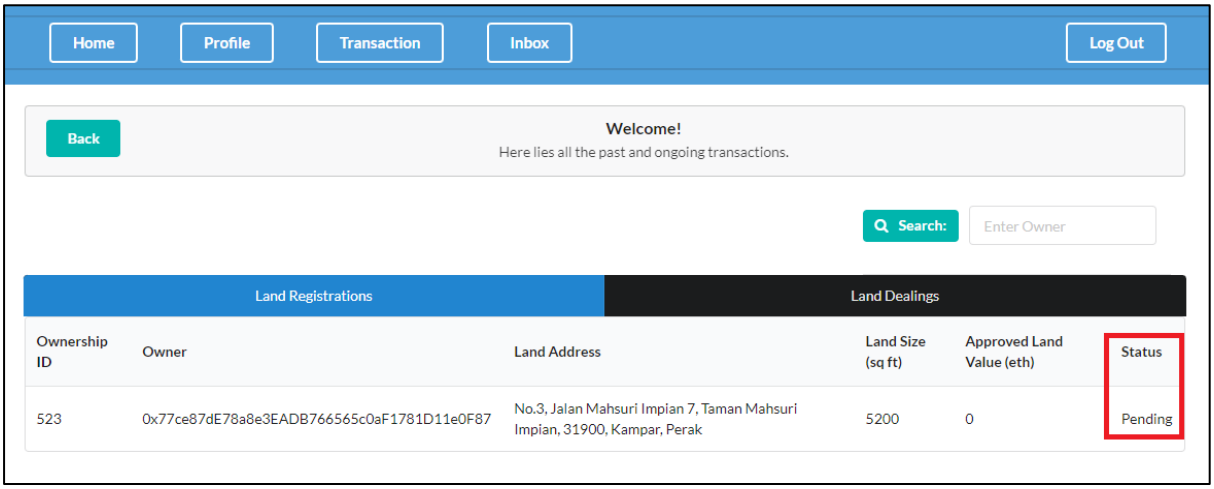


Figure 6.1.4.1: Land registration, pending status

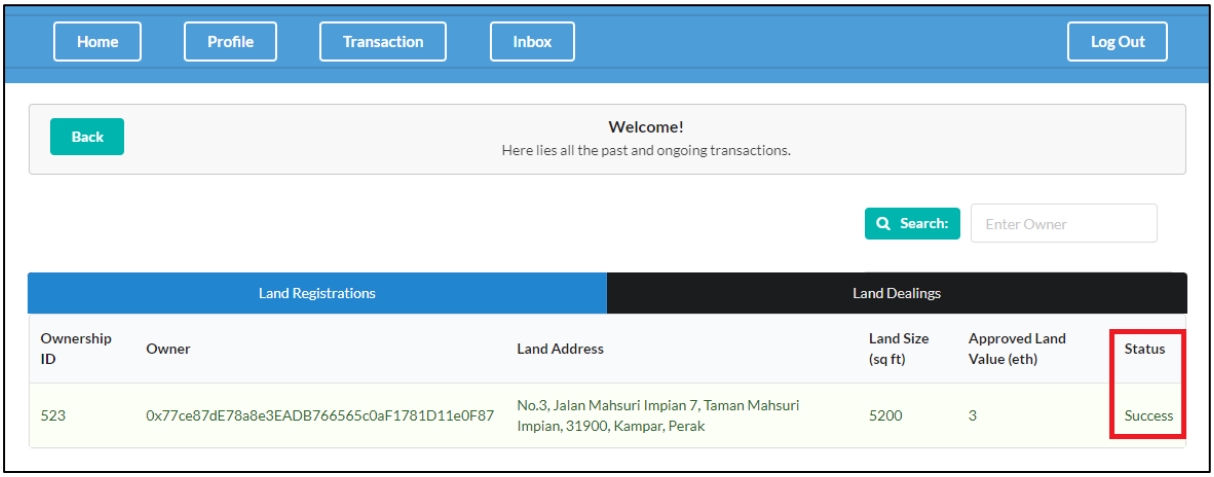


Figure 6.1.4.2: Land registration, success status

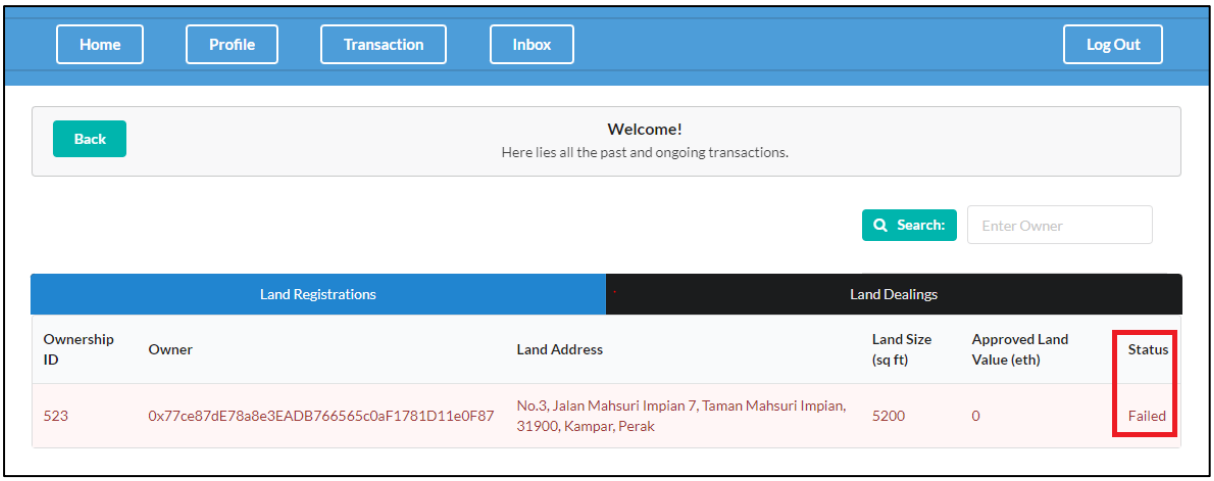


Figure 6.1.4.3: Land registration, failed status

The fourth test case is user registers land asset on the land registration portal. Once registered, the registration status will be 'Pending'. A government authority needs

to approve the registration to change the status to ‘Success’. Upon approval, the user’s land information is stored in the Blockchain. However, government authority can reject the registration to change the status to ‘Failed’. This indicate that the registration has failed. The status of land registrations can be view through the land registration transactions page.

6.1.5 Use-case 5

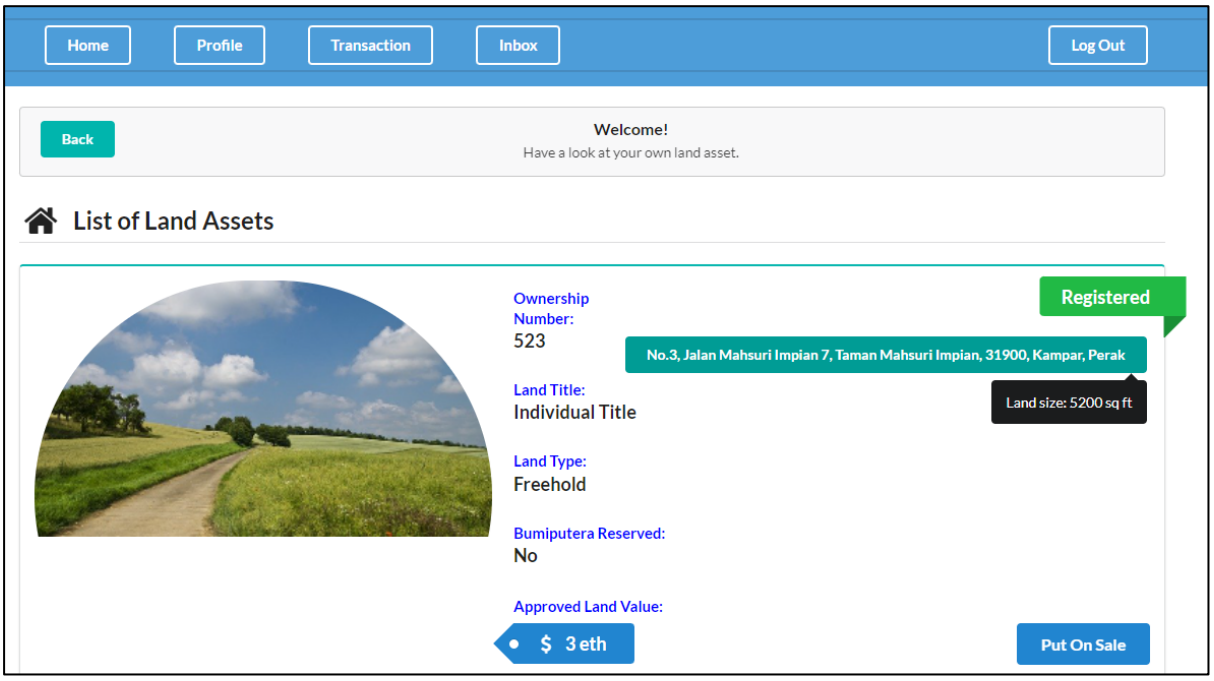


Figure 6.1.5.1: Registered land, user

The fifth test case is user views registered land asset. The expected result is all land assets successfully registered and stored into the Blockchain can be retrieve and display to their own users. As expected, the land information is successfully retrieved from the Blockchain and displayed to the users.

6.1.6 Use-case 6

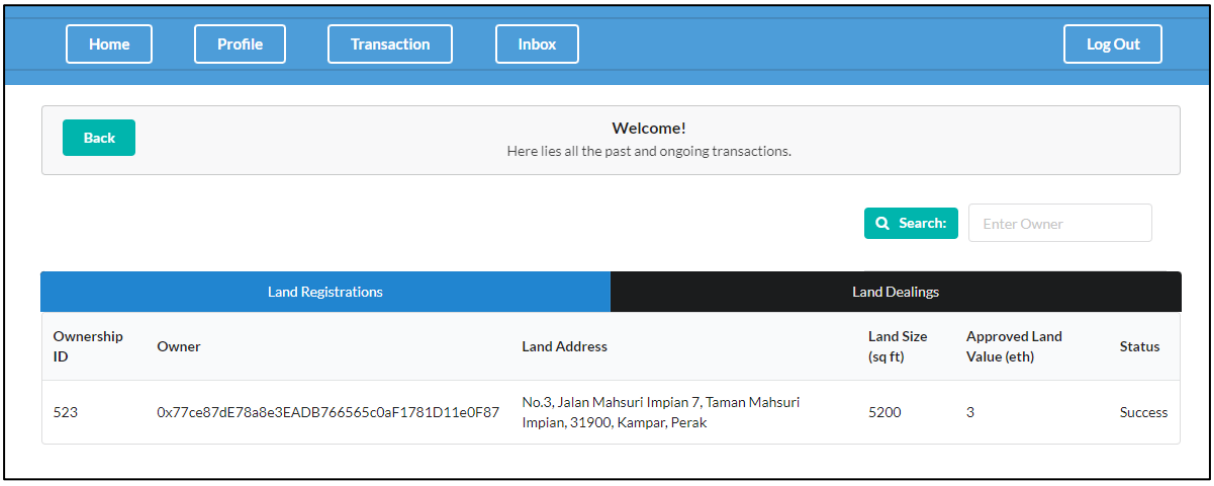


Figure 6.1.6.1: Land registration transactions page

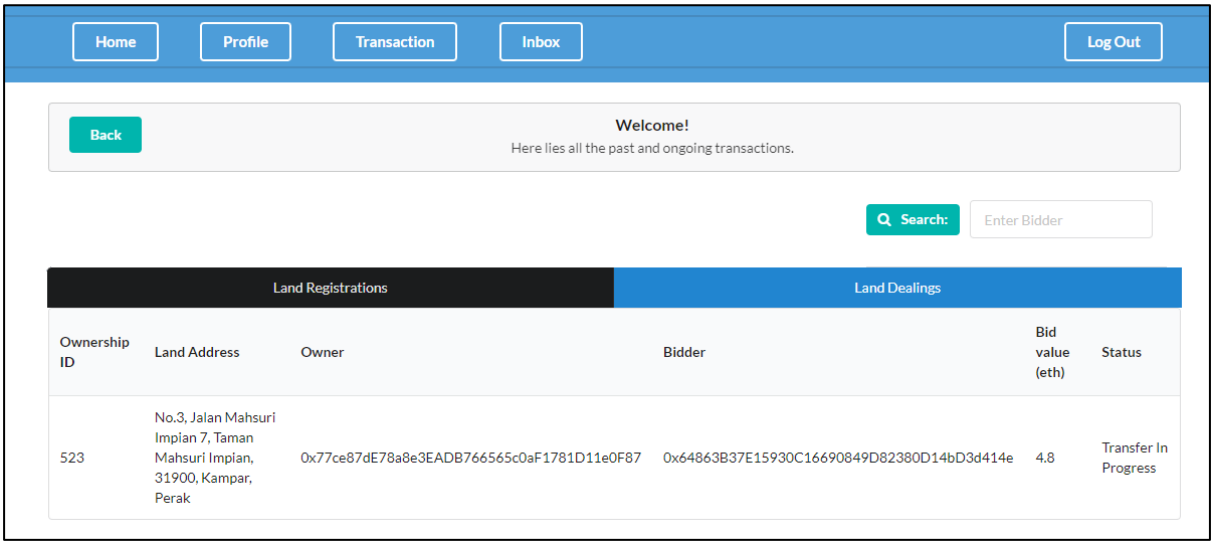


Figure 6.1.6.2: Land dealing transactions page

The sixth test case is user and government authority view all transactions. This means that all transactions such as land registrations and land dealings are stored in the Blockchain and can be retrieve for display. Both user and government authority will have the land registration and land dealing transactions page in figure 6.1.6.1 and figure 6.1.6.2.

6.1.7 Use-case 7

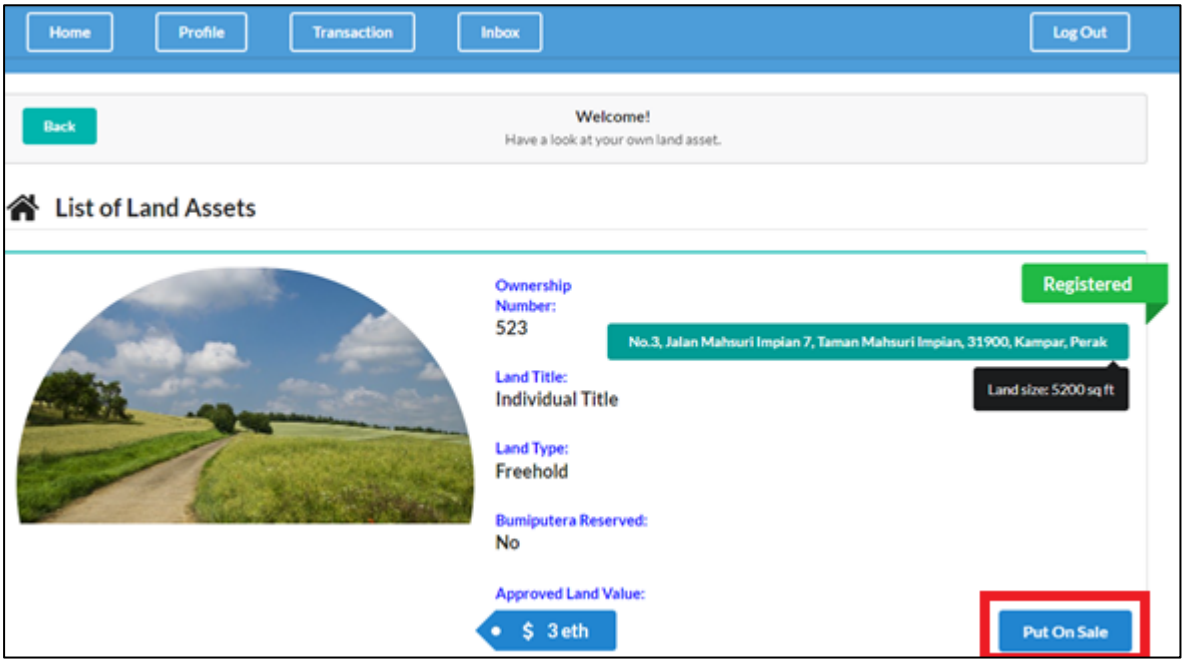


Figure 6.1.7.1: Put registered land on sale

The seventh test case is seller places registered land for sale. It is expected that all registered lands have the option to be put on sale for buyers. It is not compulsory to sell registered land. Sellers can put their registered land on sale by clicking on the 'Put On Sale' button.

6.1.8 Use-case 8

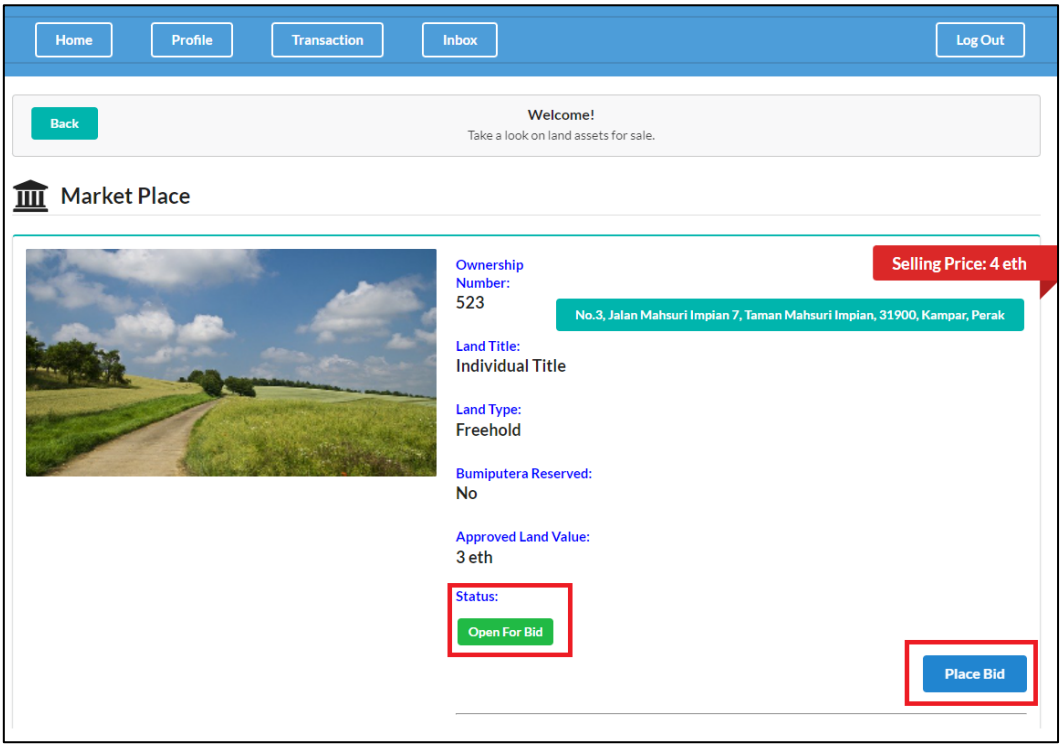


Figure 6.1.8.1: Bidding land on sale

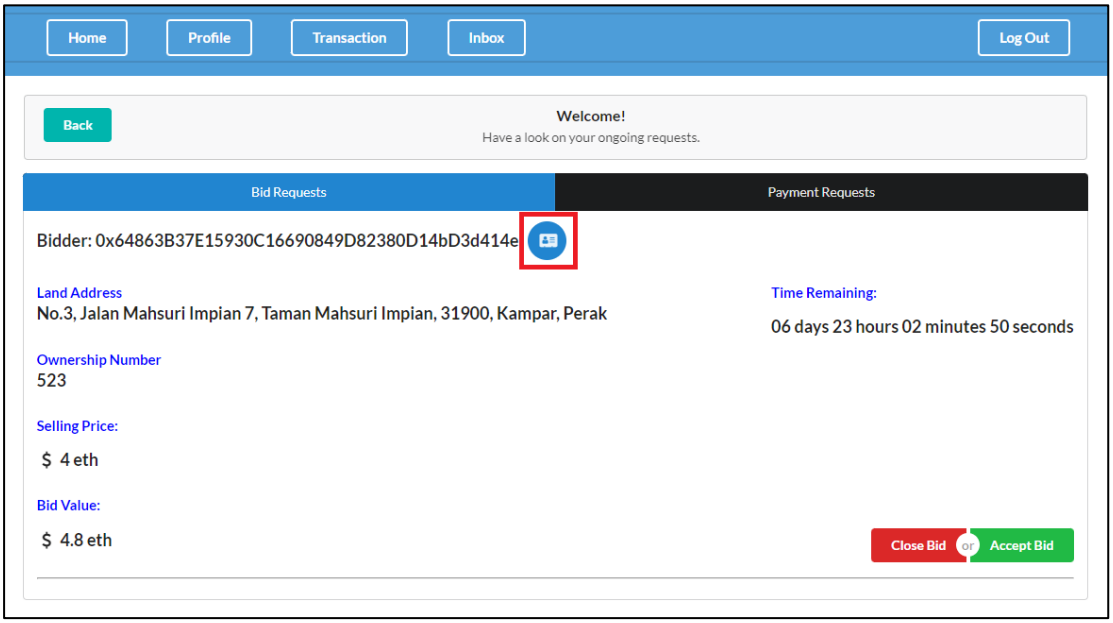


Figure 6.1.8.2: Bid request from buyer

The eighth test case is buyer sends bids to seller. It is expected that buyer can place bids if the seller places the land for sale (Figure 6.1.8.1). Seller have the option to approve or reject buyer's bid. Upon approval, buyer is able to purchase the land. Upon rejection, buyer's bid has failed (Figure 6.1.8.2).

6.1.9 Use-case 9

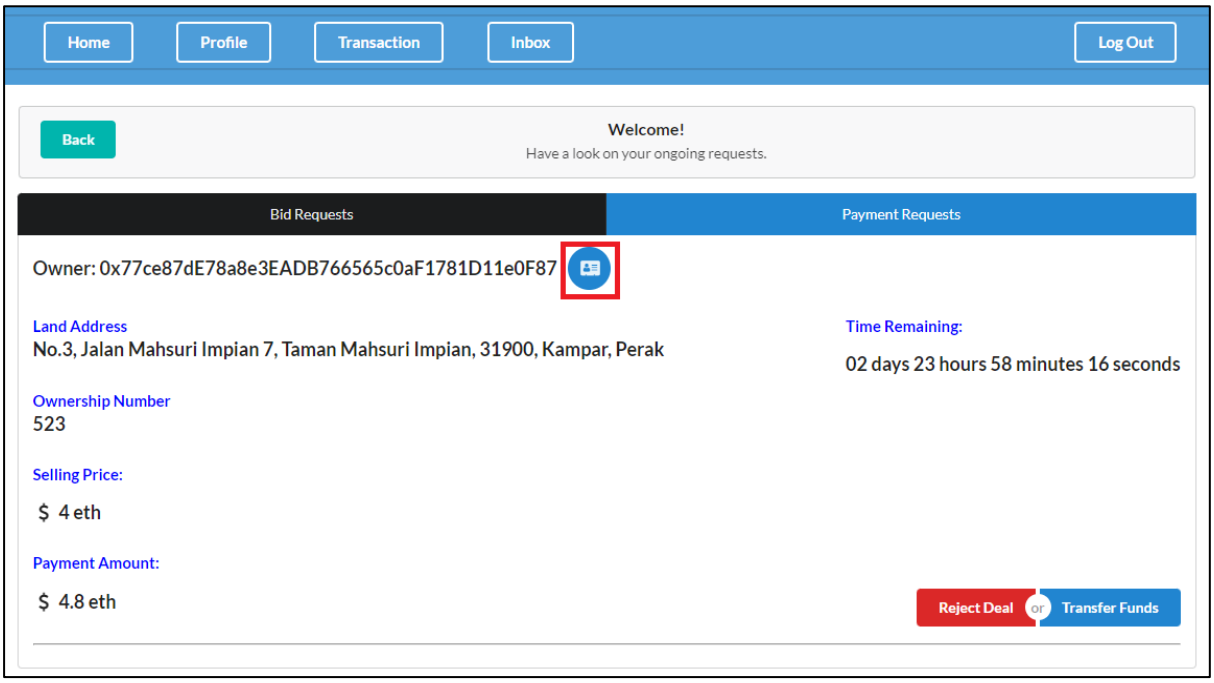


Figure 6.1.9.1: Payment request from seller

The last test case is buyer receives land ownership from seller. Once receiving approval for the bid, buyer will need to transfer the purchase price of the land to seller (Figure 6.1.9.1). The buyer must ensure that there is enough ether in the Metamask account for the transfer to be successful. After transferring the ether successfully, buyer will receive the land ownership from seller.

7 Conclusion and Recommendation

7.1 Conclusion

This project is developing a Blockchain-based land registration system for the Minister of Home Affairs in Malaysia. The concept of the Ethereum Blockchain network and smart contracts will be used in developing the proposed system to improve the government services. The Blockchain land registration system will be able to counteract the problems faced in the land registration and land dealing process in Malaysia. Problems such as fraud cases increment in land registration, restriction of interest in land dealing and time-consuming land registration and land dealing process.

Blockchain land registration system allows land owners to upload their land deatils into the blockchain network where others can verify the details when needed. The records kept in the blockchain network are immutable thereby proving the ownership of each land and preventing forgery of documents. Furthermore, all transactions of land dealings between buyer and seller will be stored in the blockchain network. Transaction like transfer of ownership between seller and buyer or registration of new lands are stored. The restriction of interest in land dealing can be removed while still have all land dealings traceable without limiting land owners' rights.

Other than that, land owners do not have to go through many government intermediaries to prove their land ownership, they will just go through one government authority. The land owners and government authorities will be connected through the system which saves a lot of time for the land registration process. The use of smart contracts has accelerated the land dealing process as well. Smart contracts are able to trace back ownership records from the blockchain network and easily proves the seller's ownership of the land. Smart contracts also enable sellers to deal their lands on their own. Sellers are able to find buyers through the system and smart contracts trigger the transfer of ownership between them. These smart contracts have removed the need for middlemen such as government authorities and brokers in the land dealing process which sped up the process drastically.

7.2 Recommendation

After developing my proposed system, I noticed that the system still lacks a few key features. Here's some recommendations for improvement of future works. In the land dealing process, the proposed system requires the buyer to pay in full amount to the seller. Majority of the buyers will not be able to pay in full as the price of land is expensive. Therefore, a solution is needed to solve this problem. The solution that I propose is implementing a loan feature or an installment feature into the system. With a loan feature, buyers can lend money from banks to settle their payment. With an installment feature, buyers will have a longer period to finish off their payment. Instead of paying a lump-sum of money in one day, buyers will have monthly installments for a year.

Furthermore, the account registration process for the proposed system can be improved as well. In land registration and land dealing process, it is important that the participating users are legitimate and not fake users. Currently, the account registration process does not involve government authority in verifying user's identity. Hence, I would suggest adding a verification process in the account registration process. During account registration, users will need to send their details together with their fingerprint to a government authority. User's fingerprint will act as the base of verification for the government authority to approve the account registration. The government authority will compare the fingerprint provided by the user with the one stored at the old database to see whether they match using its artificial intelligence system. The government authority will approve the account registration only when the matching percentage of the two fingerprints reaches a certain range (e.g. 96 – 100%).

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WEEKLY LOG

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3,3	**Study week no.:**1
Student Name & ID: Gunn Wei Teong 18ACB02416	
Supervisor: Mr. Su Lee Seng	
Project Title: Development of Decentralized Apps using Blockchain Technology to Improve Malaysian Government Services at Ministry of Home Affairs	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

2. WORK TO BE DONE

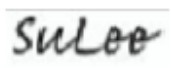
- Review FYP1 report and migrate to FYP2 report

3. PROBLEMS ENCOUNTERED

- No problems.

4. SELF EVALUATION OF THE PROGRESS

- Good start in a new semester.



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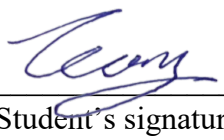

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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3,3	**Study week no.:2**
Student Name & ID: Gunn Wei Teong 18ACB02416	
Supervisor: Mr. Su Lee Seng	
Project Title: Development of Decentralized Apps using Blockchain Technology to Improve Malaysian Government Services at Ministry of Home Affairs	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Started FYP2 report.

2. WORK TO BE DONE

.

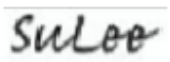
- Begin system development of proposed system

3. PROBLEMS ENCOUNTERED

- No problems.

4. SELF EVALUATION OF THE PROGRESS

- Good progress, all according to plan.



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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3,3	**Study week no.:3**
Student Name & ID: Gunn Wei Teong 18ACB02416	
Supervisor: Mr. Su Lee Seng	
Project Title: Development of Decentralized Apps using Blockchain Technology to Improve Malaysian Government Services at Ministry of Home Affairs	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Improved the land registration process for the proposed system.

2. WORK TO BE DONE

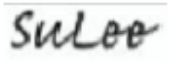
- Begin developing the land dealing process for the proposed system.

3. PROBLEMS ENCOUNTERED

- No problems.

4. SELF EVALUATION OF THE PROGRESS

- Good progress, all according to plan.



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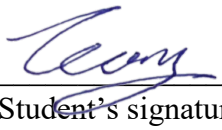


Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3,3	**Study week no.:4**
Student Name & ID: Gunn Wei Teong 18ACB02416	
Supervisor: Mr. Su Lee Seng	
Project Title: Development of Decentralized Apps using Blockchain Technology to Improve Malaysian Government Services at Ministry of Home Affairs	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- In-progress developing the land dealing process of the proposed system.

2. WORK TO BE DONE

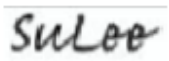
- Finish developing the land dealing process for the proposed system
- Made adjustment to both use-case diagram and flow diagram.

3. PROBLEMS ENCOUNTERED

- No problems.

4. SELF EVALUATION OF THE PROGRESS

- Good progress, all according to plan.



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Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3,3	**Study week no.:5**
Student Name & ID: Gunn Wei Teong 18ACB02416	
Supervisor: Mr. Su Lee Seng	
Project Title: Development of Decentralized Apps using Blockchain Technology to Improve Malaysian Government Services at Ministry of Home Affairs	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- In-progress developing the land dealing process of the proposed system.
- Updated use-case diagram and flow diagram

2. WORK TO BE DONE

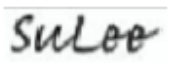
- Finish developing the land dealing process for the proposed system
- Improve chapter 1 of report

3. PROBLEMS ENCOUNTERED

- No problems.

4. SELF EVALUATION OF THE PROGRESS

- Good progress, all according to plan.



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Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3,3	**Study week no.:6**
Student Name & ID: Gunn Wei Teong 18ACB02416	
Supervisor: Mr. Su Lee Seng	
Project Title: Development of Decentralized Apps using Blockchain Technology to Improve Malaysian Government Services at Ministry of Home Affairs	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- In-progress developing the land dealing process of the proposed system.
- Completed chapter 1 of report

2. WORK TO BE DONE

- Finish developing the land dealing process for the proposed system
- Review chapter 2 of report

3. PROBLEMS ENCOUNTERED

- No problems.

4. SELF EVALUATION OF THE PROGRESS

- Good progress, all according to plan.

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3,3	**Study week no.:7**
Student Name & ID: Gunn Wei Teong 18ACB02416	
Supervisor: Mr. Su Lee Seng	
Project Title: Development of Decentralized Apps using Blockchain Technology to Improve Malaysian Government Services at Ministry of Home Affairs	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- In-progress developing the land dealing process of the proposed system.
- Completed chapter 2 of report

2. WORK TO BE DONE

- Finish developing the land dealing process for the proposed system
- Finish chapter 3 of report

3. PROBLEMS ENCOUNTERED

- No problems.

4. SELF EVALUATION OF THE PROGRESS

- Good progress, all according to plan.

Supervisor's signature

Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3,3	**Study week no.:8**
Student Name & ID: Gunn Wei Teong 18ACB02416	
Supervisor: Mr. Su Lee Seng	
Project Title: Development of Decentralized Apps using Blockchain Technology to Improve Malaysian Government Services at Ministry of Home Affairs	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Finish developing the land dealing process for the proposed system
- Completed chapter 3 of report

2. WORK TO BE DONE

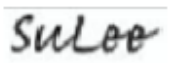
- Improve the user interface design

3. PROBLEMS ENCOUNTERED

- No problems.

4. SELF EVALUATION OF THE PROGRESS

- Good progress, all according to plan.



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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3,3	**Study week no.:9**
Student Name & ID: Gunn Wei Teong 18ACB02416	
Supervisor: Mr. Su Lee Seng	
Project Title: Development of Decentralized Apps using Blockchain Technology to Improve Malaysian Government Services at Ministry of Home Affairs	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Improved user interface design

2. WORK TO BE DONE

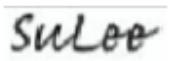
- Start chapter 4 of report

3. PROBLEMS ENCOUNTERED

- No problems.

4. SELF EVALUATION OF THE PROGRESS

- Good progress, all according to plan.



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FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3,3	**Study week no.:10**
Student Name & ID: Gunn Wei Teong 18ACB02416	
Supervisor: Mr. Su Lee Seng	
Project Title: Development of Decentralized Apps using Blockchain Technology to Improve Malaysian Government Services at Ministry of Home Affairs	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Chapter 4 of report completed

2. WORK TO BE DONE

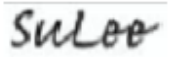
- Begin chapter 5 and 6 of report

3. PROBLEMS ENCOUNTERED

- No problems.

4. SELF EVALUATION OF THE PROGRESS

- Good progress, all according to plan.



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Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3,3	**Study week no.:11**
Student Name & ID: Gunn Wei Teong 18ACB02416	
Supervisor: Mr. Su Lee Seng	
Project Title: Development of Decentralized Apps using Blockchain Technology to Improve Malaysian Government Services at Ministry of Home Affairs	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Chapter 5 and 6 of report completed

2. WORK TO BE DONE

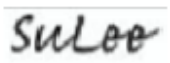
- Begin the last chapter of the report
- Compile and format the report

3. PROBLEMS ENCOUNTERED

- No problems.

4. SELF EVALUATION OF THE PROGRESS

- Good progress, all according to plan.



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Student's signature

FINAL YEAR PROJECT WEEKLY REPORT

(Project II)

Trimester, Year: 3,3	**Study week no.:12**
Student Name & ID: Gunn Wei Teong 18ACB02416	
Supervisor: Mr. Su Lee Seng	
Project Title: Development of Decentralized Apps using Blockchain Technology to Improve Malaysian Government Services at Ministry of Home Affairs	

1. WORK DONE

[Please write the details of the work done in the last fortnight.]

- Chapter 7 of report completed
- Compilation and formatting of report done

2. WORK TO BE DONE

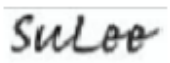
- Send report for draft check

3. PROBLEMS ENCOUNTERED

- No problems.

4. SELF EVALUATION OF THE PROGRESS

- Good progress, all according to plan.



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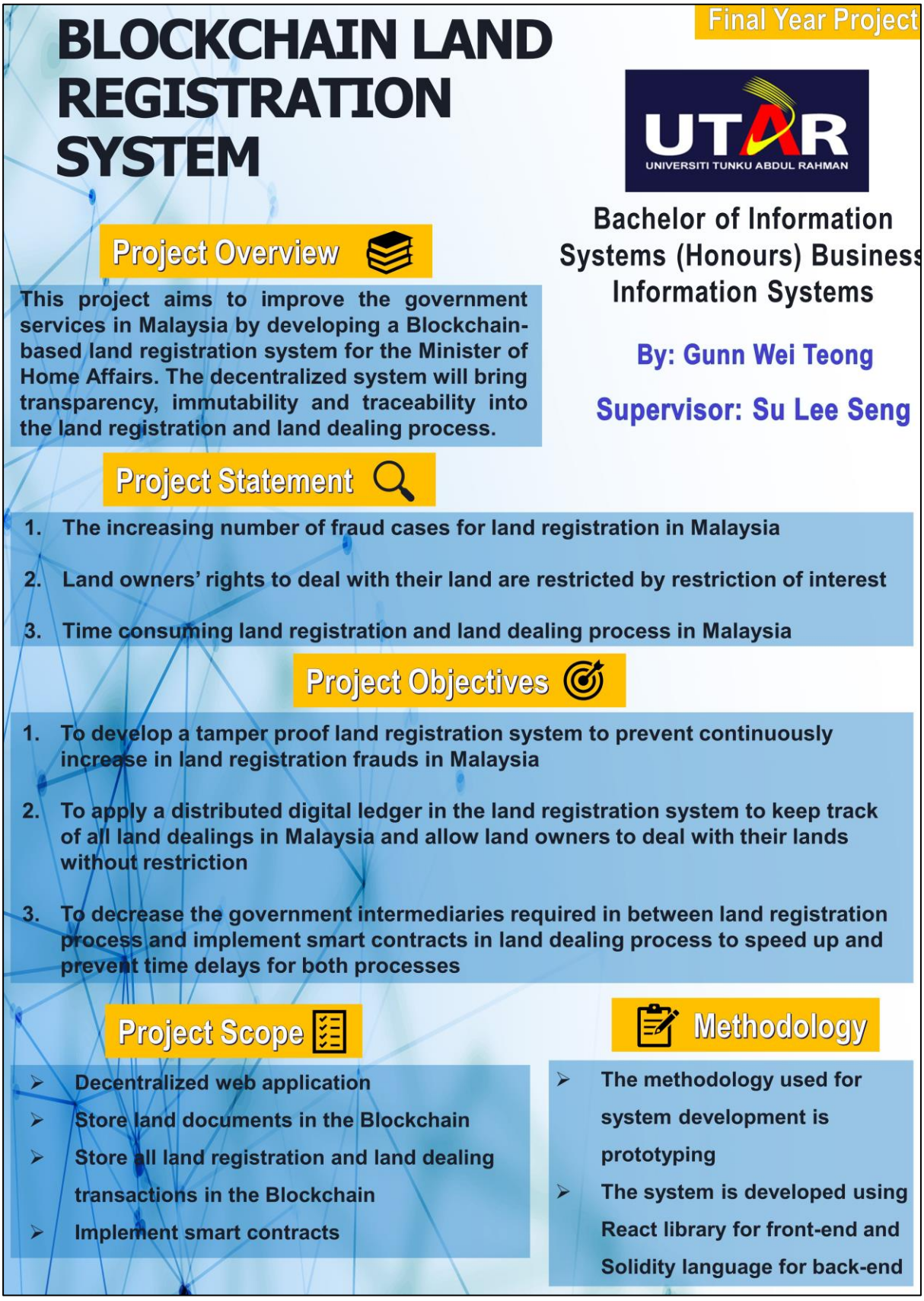
BLOCKCHAIN LAND REGISTRATION SYSTEM
Final Year Project
UTAR
UNIVERSITI TUNKU ABDUL RAHMAN
Bachelor of Information Systems (Honours) Business Information Systems
By: Gunn Wei Teong
Supervisor: Su Lee Seng
Project Overview
This project aims to improve the government services in Malaysia by developing a Blockchain-based land registration system for the Minister of Home Affairs. The decentralized system will bring transparency, immutability and traceability into the land registration and land dealing process.
Project Statement
1. The increasing number of fraud cases for land registration in Malaysia
2. Land owners' rights to deal with their land are restricted by restriction of interest
3. Time consuming land registration and land dealing process in Malaysia
Project Objectives
1. To develop a tamper proof land registration system to prevent continuously increase in land registration frauds in Malaysia
2. To apply a distributed digital ledger in the land registration system to keep track of all land dealings in Malaysia and allow land owners to deal with their lands without restriction
3. To decrease the government intermediaries required in between land registration process and implement smart contracts in land dealing process to speed up and prevent time delays for both processes
Project Scope
➢ Decentralized web application
➢ Store land documents in the Blockchain
➢ Store all land registration and land dealing transactions in the Blockchain
➢ Implement smart contracts
Methodology
➢ The methodology used for system development is prototyping
➢ The system is developed using React library for front-end and Solidity language for back-end

PLAGIARISM CHECK RESULT

Document Viewer

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Gunn Wei Teong_FYP2 By Wei Teong Gunn

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FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY

Full Name(s) of Candidate(s)	Gunn Wei Teong
ID Number(s)	18ACB02416
Programme / Course	Business Information Systems (IB)
Title of Final Year Project	Development of Decentralized Apps using Blockchain Technology to Improve Malaysian Government Services at Ministry of Home Affairs

Similarity	**Supervisor's Comments (Compulsory if parameters of originality exceeds the limits approved by UTAR)**
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Note Supervisor/Candidate(s) is/are required to provide softcopy of full set of the originality report to Faculty/Institute

Based on the above results, I hereby declare that I am satisfied with the originality of the Final Year Project Report submitted by my student(s) as named above.

_____

Signature of Supervisor

Name: Mr. Su Lee Seng

Date: _21 April 2022_____

UNIVERSITI TUNKU ABDUL RAHMAN

FACULTY OF INFORMATION & COMMUNICATION TECHNOLOGY (KAMPAR CAMPUS)

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Student Id	18ACB02416
Student Name	Gunn Wei Teong
Supervisor Name	Mr. Su Lee Seng

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(Signature of Student)
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