PATWARI X

Final Year Project
Final Evaluation Report

PatwariX

Land Registry on Block Chain

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Supervisor (Faculty)
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Acknowledgments

We would like to thank our supervisor, Dr. Shujaat Hussain for taking out their time for us and providing us with helpful suggestions and guidance.

We would also like to express our gratitude to our FYP Committee which has been a source of continuous guidance.

Executive Summary

In Pakistan the percentage of illegal land registration is very high. Such cases have been going on for years with no outcome. Along with illegal registration, fake property documents are present in a high amount in the market. There also is the issue of extra cost spent due to the middle man and this also results in corruption as wrong prices are quoted and the buyer is cheated in this way.

We intend to bring into existence such a system that will make the land registration system highly secure as it won't have any paper trail. There will be a digital print for each and every transaction made. No transaction will be possible without the consent of the original owner and related authority. In this way the property will be sold and bought at original cost without possibility of corruption and unnecessary physical effort. Our system PATWARI X tends is the solution to such troubles.

Table of Contents

Introduction

Land ownership is highly concentrated in Pakistan. In Pakistan, purchasing land is not just laboriously complex but also insecure as the law provides little or no protection to the investor's title. One interested in purchasing land has to approach the patwari to identify the land in order to obtain the legal information regarding it. As the records kept by the patwari are only presumptive so it is up to the purchaser to further investigate the 'chain of title' or not which is an extensive process itself and the percentage of fraud in approaching and trusting the patwari is high.

Our intentions are to empower the users to take control of their sensitive data by interacting with them through a web-based interface linked with a government authority so that the to-and-fro transfer of sensitive information regarding the land they own or wish to purchase is verifiable, legal, trustworthy and the percentage of fraud is reduced to zero.

Project Vision

Problem Statement

The patwari system had been a massive problem in the real estate sector since they had all the record, the property documents with them which was too much power for a third person. A patwari could withhold the transfer, sale or purchase of your land. They had the authority to make changes relating to ownership, use and taxation in the original land record. To cater this problem digitization of land records is introduced to eliminate fraud, however it has put a limit to the access of records and exploitation is still there.

Business Opportunity

Replacement of manual processes requiring departments and labor in order to transfer the land from one party to another.

Objectives

The objectives of this project are:

1. Ensure the authenticity of land ownership.
2. Prevent the forging and tempering of records.
3. Assure the payment of taxes.
4. Introduce transparency in land records by giving access to immutable transaction history.
5. Make the land registry system efficient, speedy and cheap.
6. Reduction in administrative costs by eliminating manual processes.

Project Scope

The scope of the project is defined for land reform authorities and the citizen involved in land transactions either the buyer or the seller as they are the primary beneficiaries of the proposed system. The system includes record handling of lands, buildings or any real estate related property. Chained data link i.e. history is maintained of all previous owners. Multi signature transactions as a land can't be transferred without the digital signatures of buyer, seller and the authority. Authority can add property initially. The owner is able to transfer his owned lands in separate portions i.e. break a big block and sell. The end product would be a web solution based on block chain which would have various functionalities related to land.

Constraints

The main challenges of this project include:

- Building Smart Contracts
- Integrating manual land verification
- Connecting front end to block chain.
- Division of land into chunks.
- Creating and assigning wallets to individuals.
- Mechanism of mapping public keys to meaningful identity information.
- Implementing shared ownership.

Stakeholders Description

People involved in the buying and selling of land properties are the internal stakeholders followed by the land authorities who ensure just transfer of land. The external stakeholders may include property dealers, real estate agents, etc.

Key High-Level Goals and Problems of Stakeholders

Goals	Description	Priority	Solution
Security	The system shall be secure.	High	Encoded on the blockchain ledger using cryptography.
Immutability	The system shall be immutable.	High	Using hash values and cryptography.
Cost	The system shall be cost-effective.	High	Minimal transaction cost to push the transaction on blockchain.

Software Requirement Specifications

List of Features

1. Record Storage of lands of multiple types, on the Ethereum Block Chain.
2. Chained data link i.e. history maintained of all previous owners of a specific land.
3. Registering a user on the system “Patwari-X”.
4. Storing complete details of registered users on a local Database.
5. Allocating Private Key seed to the user at the time of registration.
6. Capability to login using CNIC and a user defined password.
7. Capability to transfer lands from one user to another user on “Patwari-X”.
8. Authorization of transactions done by the Authority.
9. Creation of land by the Authority (ONLY).
10. Communication between “Patwari-X” and the Block Chain.
11. Deployment of Smart Contracts.
12. Extraction of Data from already deployed Smart Contracts.
13. Ability to make transactions i.e. changes to the Smart Contract (transaction of lands).
14. Storage of manual Property related files on a local Database mapped to the Property’s Smart Contract.
15. Incorporation of Maps to view the property on the Map.
16. Escrow Capabilities to verify that the transaction was intentionally done by the seller.

Functional Requirements

ID: F1	Title: Land Transfer
Description	The system shall be able to transfer the land keeping view of real estate procedures.
Inputs	Land info, Buyer info, Seller info
Source	Land transfer module.
Outputs	Ownership transfer.
Action	The ownership is transferred from seller to buyer is both parties agree and are verified by land.
Requirements	Party agreement and authority verification.
Pre-Condition(s)	The owner requests to sell the land.
Post-Condition(s)	Ownership is transferred to buyer. Land is added to owned properties.

ID: F2	Title: Generate Historical Data of Property
Description	Chained data is maintained on blockchain.
Inputs	Land records
Source	Blockchain
Outputs	Chained of ownership, Legacy files
Action	The land record is pushed to the blockchain each time a transaction is verified by the authority.
Requirements	Transfer of land, Verification by authority
Pre-Condition(s)	The buyer buys the land from seller. The ownership is transferred successfully.
Post-Condition(s)	The land record is pushed on blockchain and can’t be amended but only appended.

ID: F3	Title: Divide Land to Transfer
Description	The system shall be able to divide the land into chunks in order to sell it in pieces.
Inputs	Land info, Dividing ratio
Source	Land transfer module.
Outputs	Land divided into chunks to be sold accordingly.
Action	The token for the land will be divided such that the seller would be able to sell the token for that chunk of land.
Requirements	The land must be owned and verified to be sold.
Pre-Condition(s)	The seller requests to sell/transfer ownership to the buyer.
Post-Condition(s)	The seller sells the chunk of land. The ownership of that chunk of land will be transferred.

Quality Attributes

Patwari-X has the following Quality Attributes:

1. The system will be having *correctness* as all the results and desired output will be catered.
2. The system will be secure as cryptographic techniques are used.
3. The system will be *reliable* and no ambiguous results will be expected.
4. The system will be highly *learnable* and easy to interact.
5. The system will have *seamless* layouts and interfaces.
6. The system will be *robust* and will be able to handle error entries and exceptions.
7. The software will be *maintainable* as it will be *readable*, well documented and easily *upgradable*.
8. The system will be *testable* and *organized* so that all the Source code can be easily understood and tested.
9. The system will be highly *portable* as will not be machine dependent and will work on other platforms.

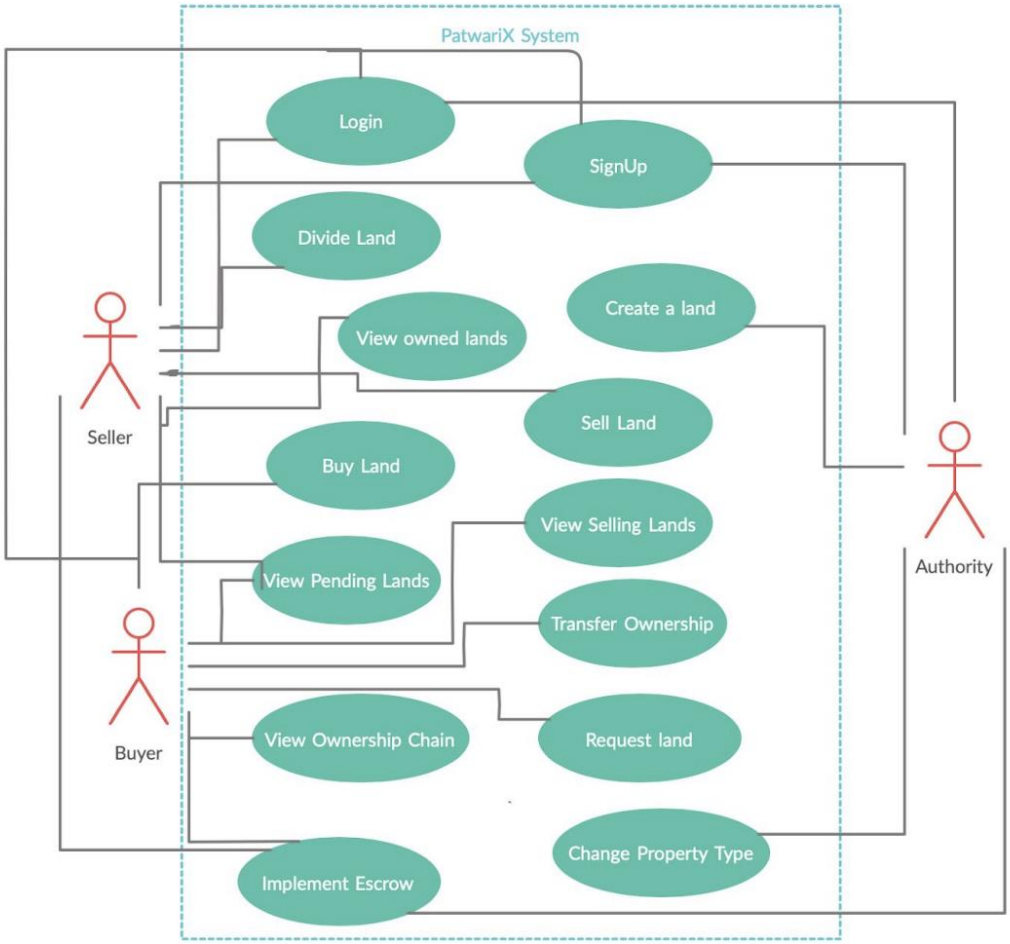
Non-Functional Requirements

ID: NF-1	Title: Product Requirements
Portability Requirements	The system shall be accessed through web remotely leading to a hassle-free process.
Reliability Requirements	The system shall be reliable in terms of usability and data security.

ID: NF-2	Title: Organizational Requirements
Development Requirements	a. The system shall be developed using Ethereum for blockchain along with Angular, NodeJS, Express and MySql for front end and side information. b. The system shall use solidity for the smart contracts.

High Level Use Cases

Use Case Diagram



Iteration Plan

Requirements, Design, Development, Testing, Deployment and Review will be done in every iteration throughout.

Iteration I

- Architecture Planning

Iteration II

- Smart Contract

Iteration III

- Front End
- Test Case

Iteration I

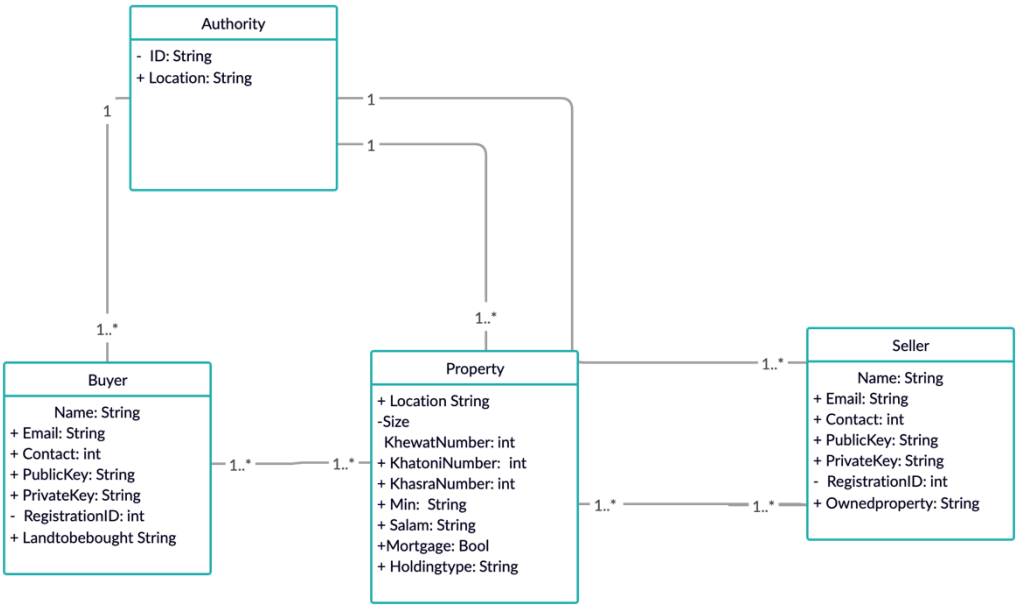
Expanded Use Cases

UC: 01	
Use Case Name	**Create Land**
Scope	Land Record of PatwariX
Level	User-Goal
Primary Actor	Authority
Description	A new land is to be registered, information of which is entered by the Authority.
Stakeholders and Interests	Buyer: Who wants to buy the created land. Authority: Who creates and sells land.
Preconditions	The authority is successfully logged into the system.
Post-conditions (Success Guarantee)	The land is added to the property list. The buyer can view land. The buyer can buy land.
Main Success Scenario	**Actor Action** **System Responsibility** 1. Authority enters land information. 2. Land record is created. 3. Land record is added to the list.
Frequency of Occurrence	Each time a new property is introduced.

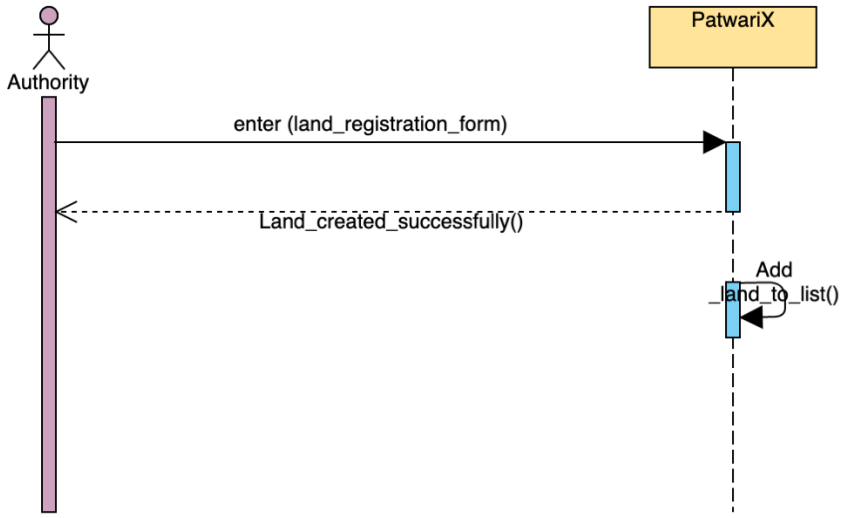
UC: 02	
Use Case Name	**View Owned Land**
Scope	Land Record of PatwariX
Level	User-Goal
Primary Actor	Authority, Buyer, Seller
Stakeholders and Interests	Authority: Owner and seller of the land at initial stages. Buyer: Pays to become the owner of land. Seller: Gets paid in return for transferring land ownership.
Preconditions	The seller sells the land. The buyer buys the land. The transfer of land is verified by the authority. Land record is added to the Owned Properties section.
Post-conditions (Success Guarantee)	The user is able to view the list of lands owned by that user. The user may
Main Success Scenario	**Actor Action** **System Responsibility** 1. The buyer requests to buy land. 2. The seller sells the land. ority for verification.
Extensions	1. In case authority is the owner. vious ownership chain in not maintained.

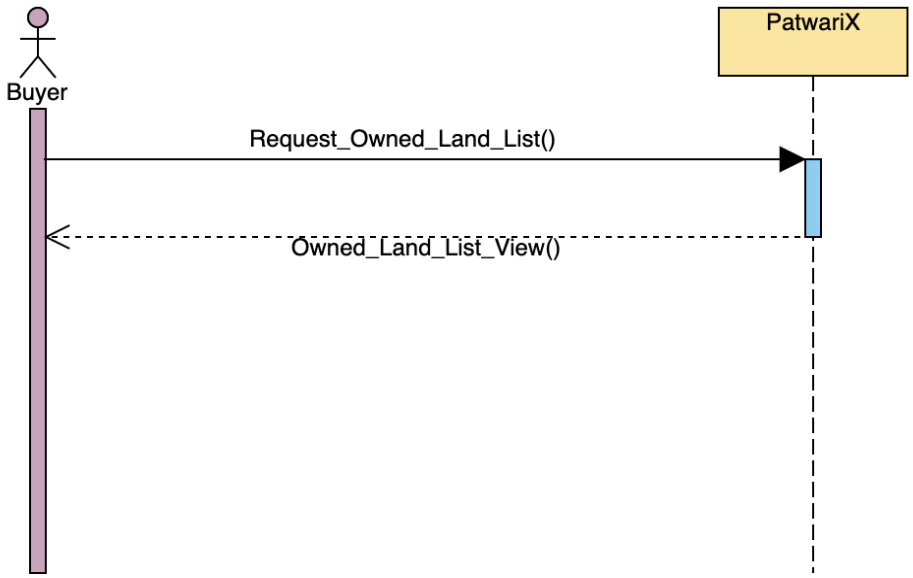
	2. In case authority is not the owner. 1a. Previous ownership chain in maintained.
Frequency of Occurrence	Invoked each time a transfer of land occurs.

Domain Model



System Sequence Diagrams





Operation Contracts

ID: CO01	Create Land
Operation:	Create_Land()
Cross References:	Use Cases: Register Land.
Pre-Conditions:	The authority is adding a new property to be registered.
Post-Condition:	• A property instance property id was created. • Related property attributes were set. • Registered Properties list was modified. • The property registered was associated with the owner.

ID: CO02	View Owned Land
Operation:	Assign_Owner_to_Land()
Cross References:	Use Cases: Register Land
Pre-Conditions:	The authority registered a new property. The buyer bought the land. The buyer is logged in.
Post-Condition:	A list of owned property is displayed. The buyer may request to sell the land.

Iteration II

Expanded Use Cases

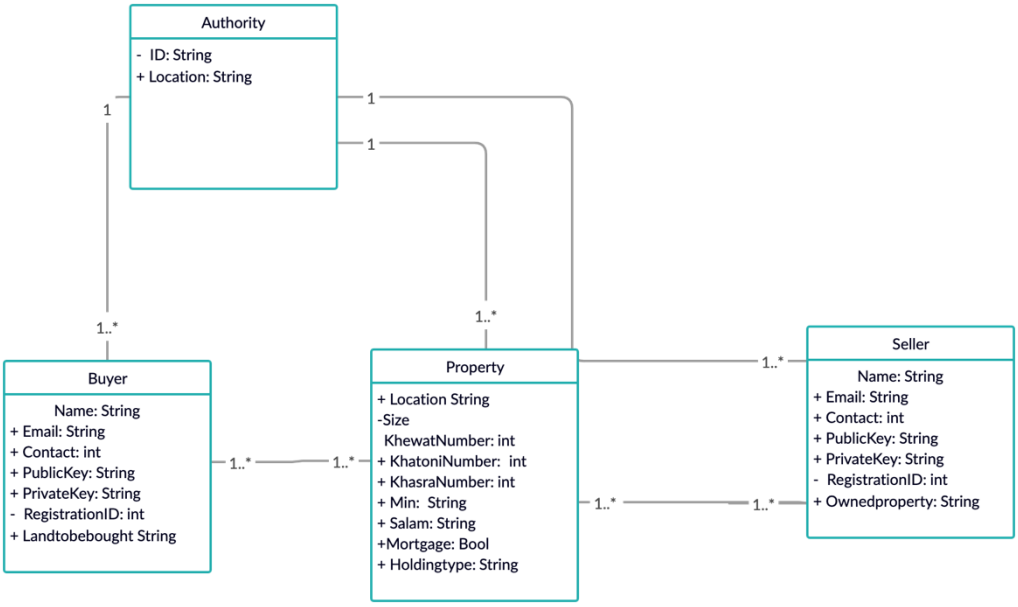
UC: 01	
Use Case Name	**Transfer Land**
Scope	Land Record of PatwariX
Level	User-Goal
Primary Actor	Authority
Description	The land ownership will be transferred from one party to another.
Stakeholders and Interests	Buyer: Who wants to buy the created land. Authority: Who will verify the land in order to be transferred. Seller: Who puts the land to sell it to the buyer.
Preconditions	The land exists i.e created by the authority. The transfer is verified by the buyer, seller and the authority.
Post-conditions (Success Guarantee)	The ownership of land is changed. New owner is appended to the blockchain along with their information.
Main Success Scenario	**Actor Action** **System Responsibility** 1. The seller puts the land for sale. 2. The land is added to land list available to be sold. 3. The buyer requests to buy the land. 4. The authority and seller verify the request in order to transfer the land.
Frequency of Occurrence	Each time a buyer requests to buy land available for sale.

UC: 02	
Use Case Name	**Escrow Land**
Scope	Land Record of PatwariX
Level	User-Goal
Primary Actor	Authority, Buyer, Seller
Stakeholders and Interests	Authority: Verify the land, buyer and seller on the basis of previous record. Buyer: Verifies the buyer request sent by that person. Seller: Verifies the seller request in order to initiate the transfer process.
Preconditions	The land is verified and not in litigation. The buyer and seller agrees to initiate the transfer.

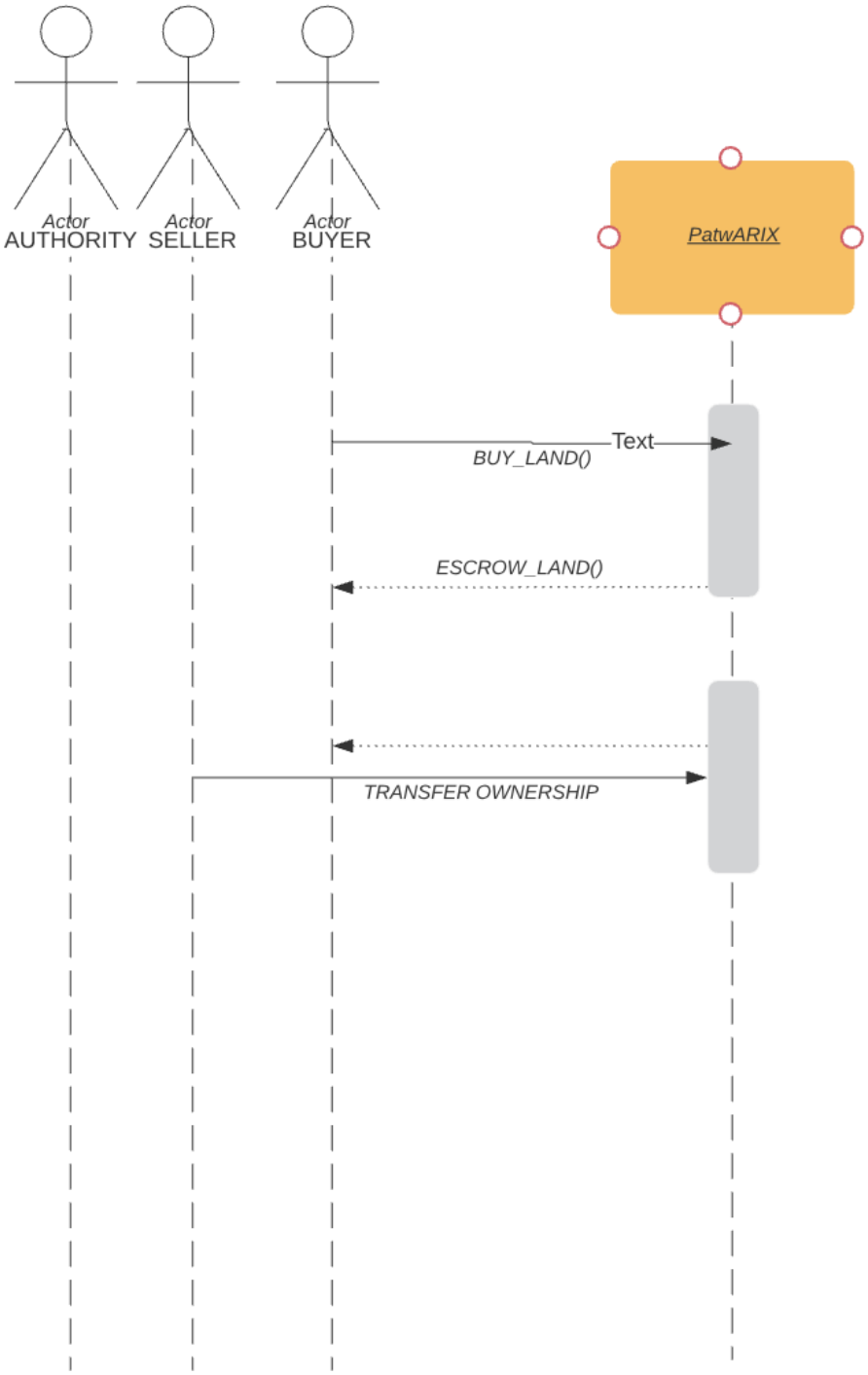
Post-conditions (Success Guarantee)	The transfer is initiated.
Main Success Scenario	**Actor Action** **System Responsibility** 1. Buyer requests to buy land. 2. The seller accepts the request. 3. The authority verifies the land to be transferred. 3. The request is forwarded to the authority for verification.
Frequency of Occurrence	Invoked each time a transfer of land occurs.

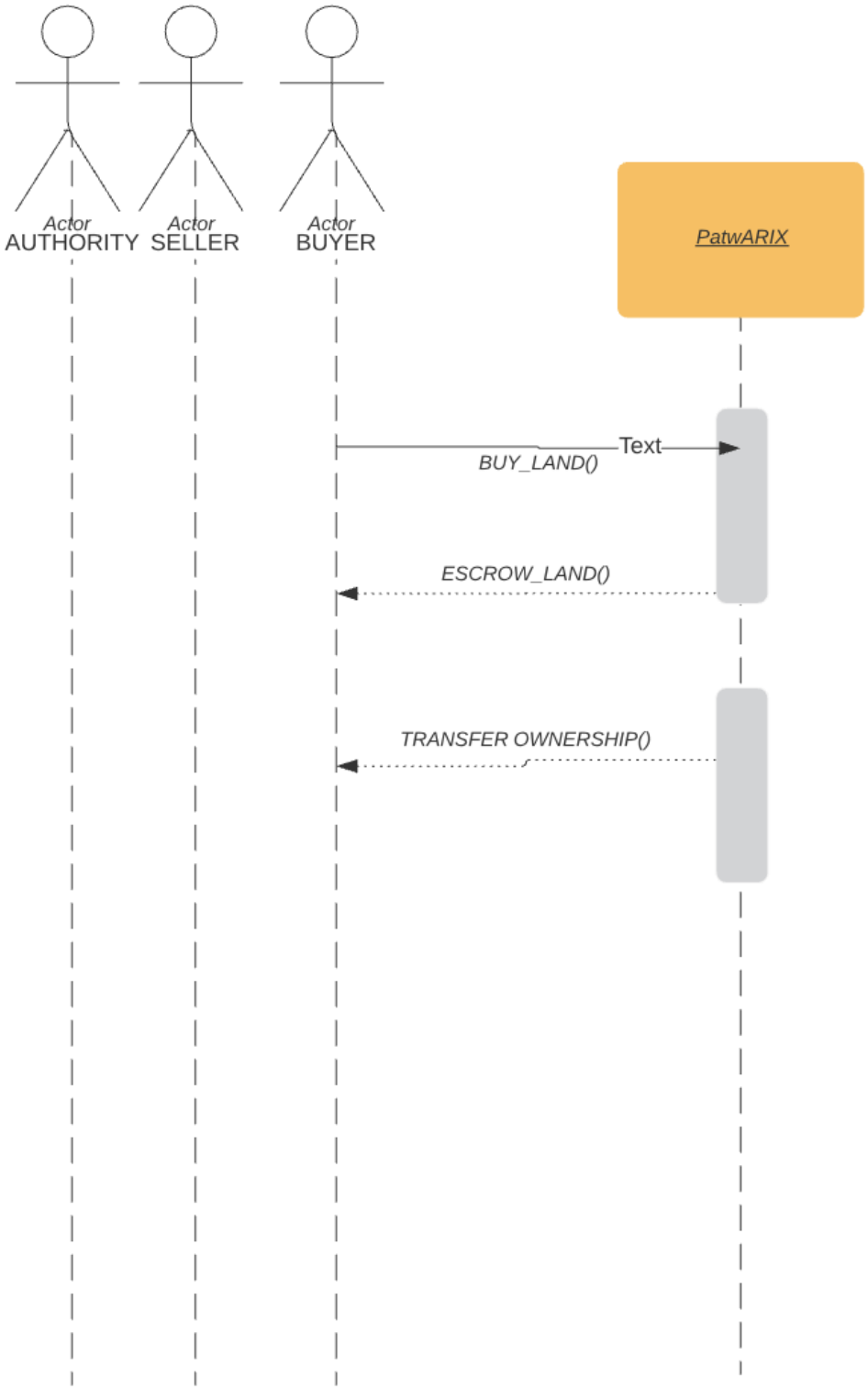
UC: 02	
Use Case Name	**Split Land**
Scope	Land Record of PatwariX
Level	User-Goal
Primary Actor	Authority, Buyer, Seller
Stakeholders and Interests	Buyer: Aims to buy a piece of land owned by the seller. Seller: Verifies the seller request in order to initiate the transfer process and token generation to split the land.
Preconditions	The seller requests to sell/transfer ownership to the buyer.
Post-conditions (Success Guarantee)	The land is divided into chunks and can be transferred separately to the buyer.
Main Success Scenario	**Actor Action** **System Responsibility** 1. Buyer requests to buy a piece of land. 2. The seller accepts the request. 3. A token is generated for the piece of land. 4. The authority verifies the land to be transferred. 5. Transfer is initiated. .
Frequency of Occurrence	Invoked each time a transfer of a piece of land occurs.

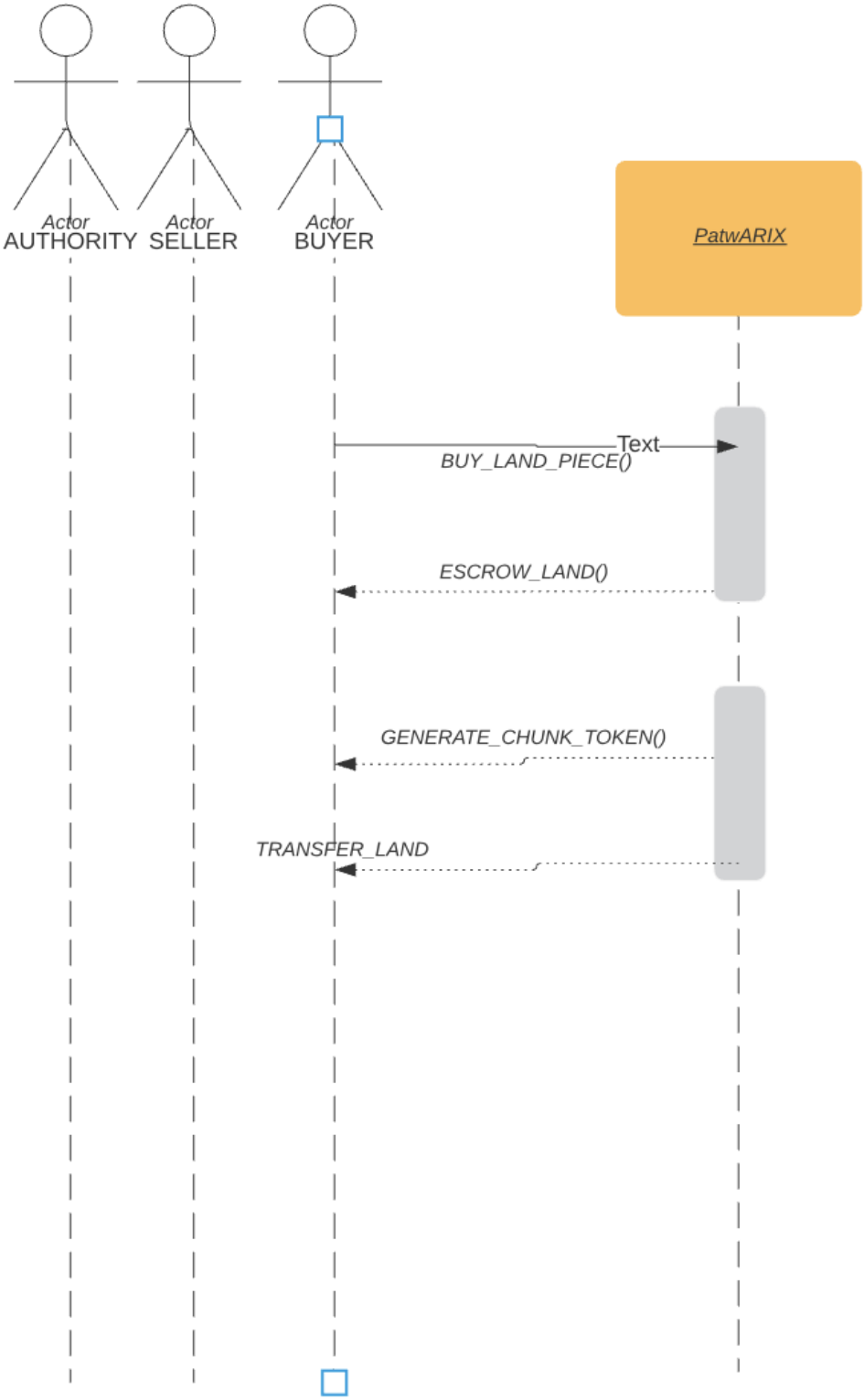
Domain Model



System Sequence Diagrams




Actor
AUTHORITY
Actor
SELLER
Actor
BUYER
PatwARIX
Text
BUY_LAND()
ESCROW_LAND()
TRANSFER OWNERSHIP()


Actor
AUTHORITY
Actor
SELLER
Actor
BUYER
PatwARIX
Text
BUY_LAND_PIECE()
ESCROW_LAND()
GENERATE_CHUNK_TOKEN()
TRANSFER_LAND

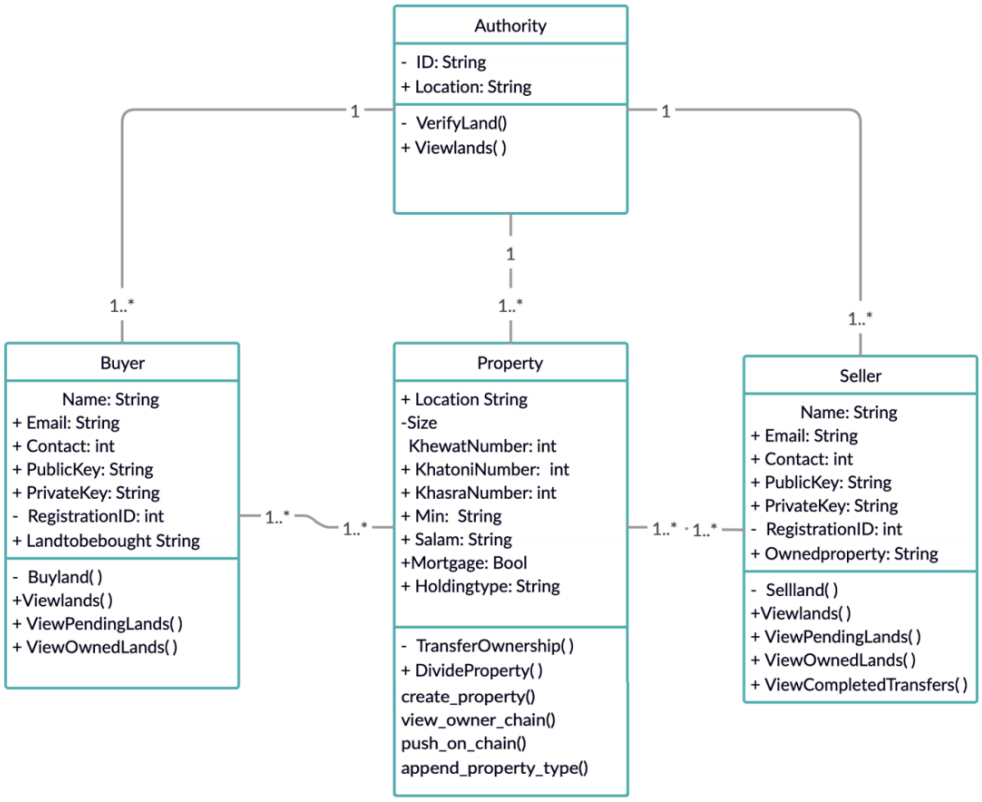
Operation Contracts

ID: CO01	Transfer Land
Operation:	Transfer_Land()
Cross References:	Use Cases: Transfer Land.
Pre-Conditions:	The land exists i.e. the land is registered in the system. Transfer of land is verified and agreed upon by seller, buyer and authority.
Post-Condition:	• A new smart contract was created for the new owner. • Property owner was changed. • Registered Properties list was modified. • The new owner was added in the block chain.

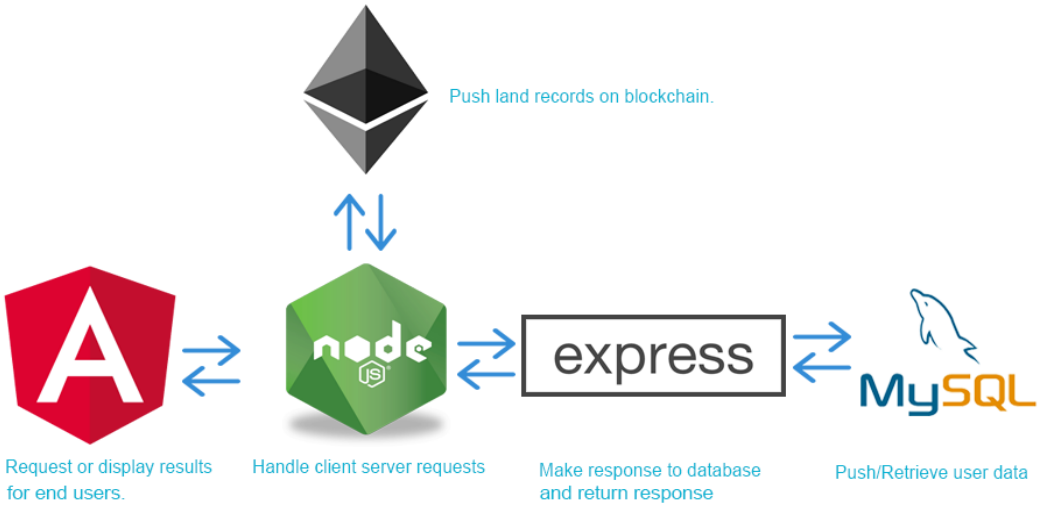
ID: CO02	Escrow Land
Operation:	Escrow_Land()
Cross References:	Use Cases: Escrow Land
Pre-Conditions:	The land is verified and not in litigation. The buyer and seller agrees to initiate the transfer.
Post-Condition:	Transfer Land is initiated. Transfer of land is accepted by buyer, seller and owner. New smart contract for change of ownership is created. Block Chain is modifies.

ID: CO02	Split Land
Operation:	Split_Land()
Cross References:	Use Cases: Transfer Land
Pre-Conditions:	The land is verified and not in litigation. Request for land splitting is made by the owner/authority. The owner agrees upon splitting the land. Owner and Authority verify the splitting of land.
Post-Condition:	New smart contract for each splitted land is created. Original smart contract is made void. Splitted lands are assigned the original owner as new property owner. BlockChain is Modified. Array of land owners is modified.

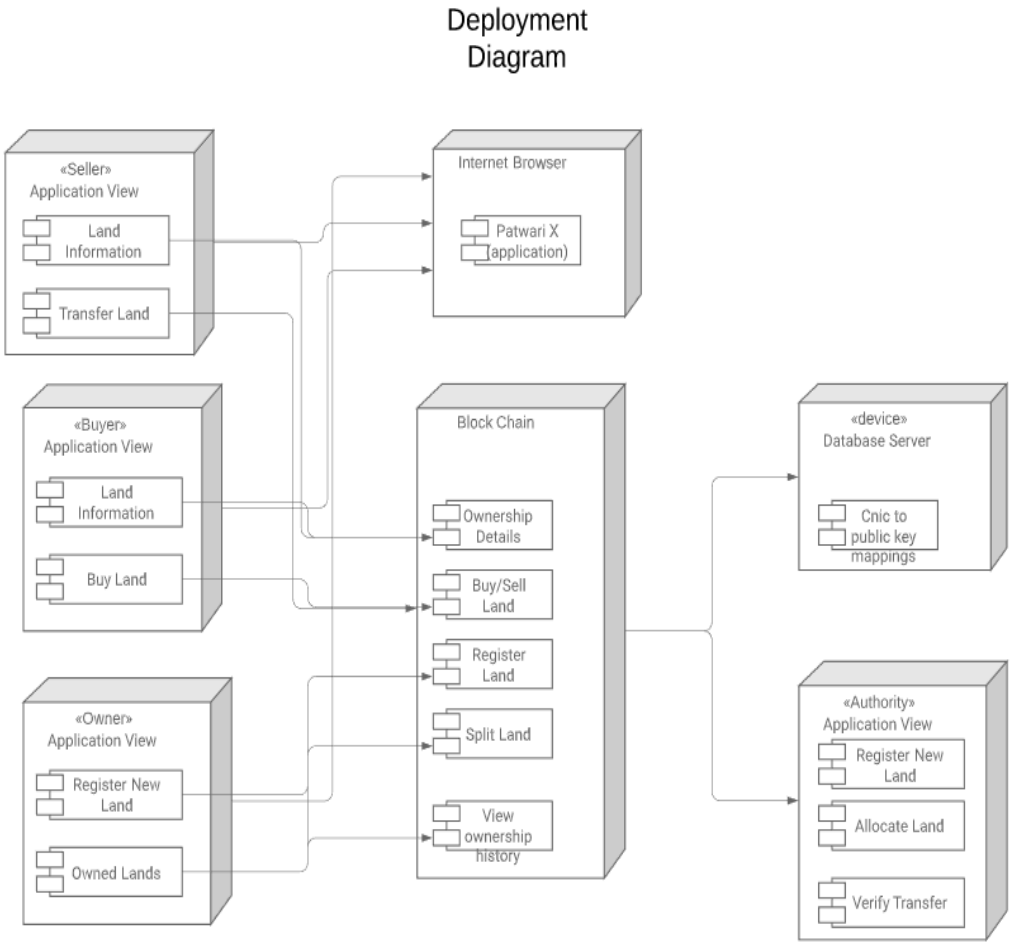
Class Diagram



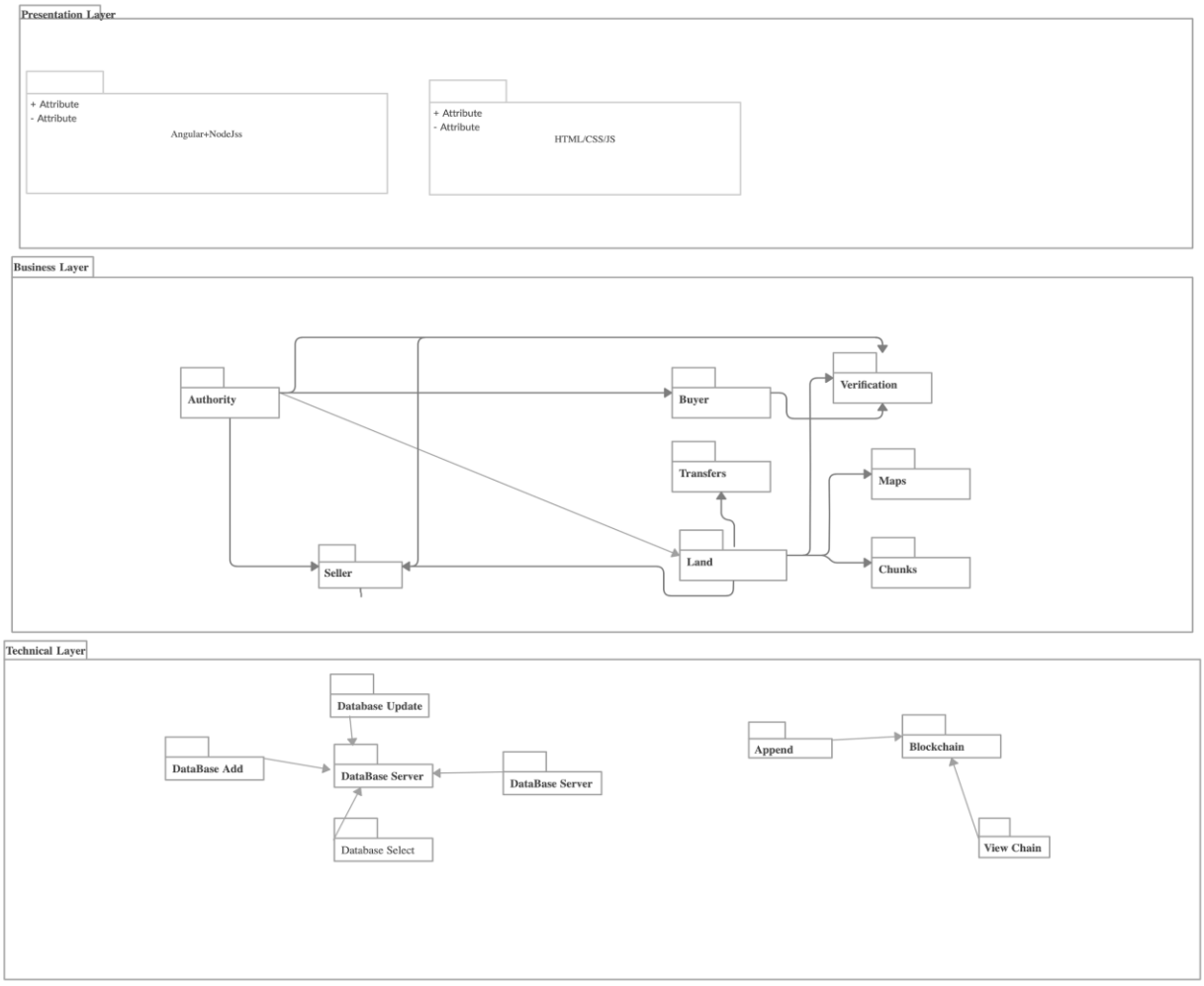
Architecture Design



Deployment Diagram



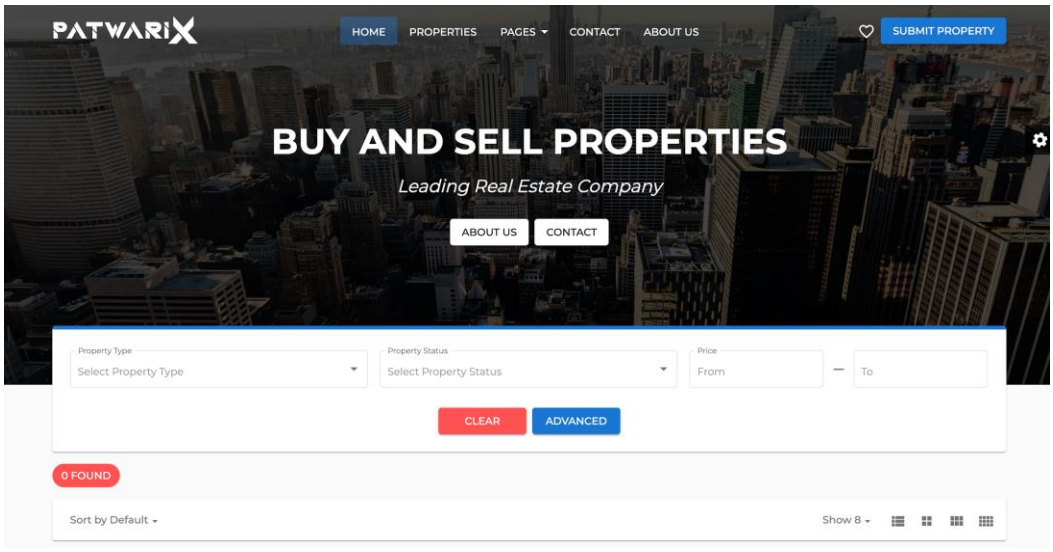
Package Diagram



Iteration III

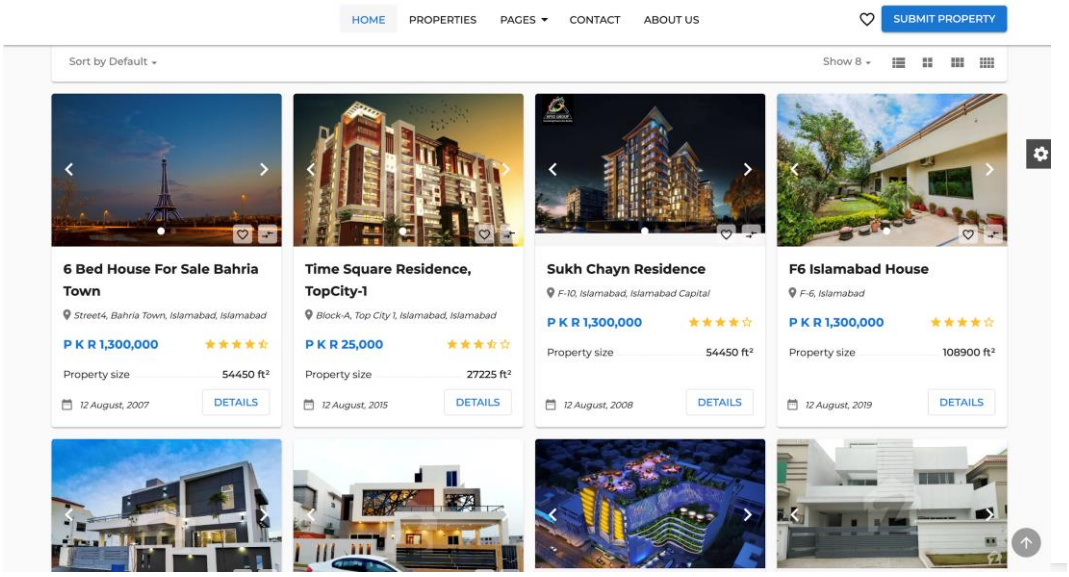
Front End

The following snapshots give a brief overview of the Front-End:



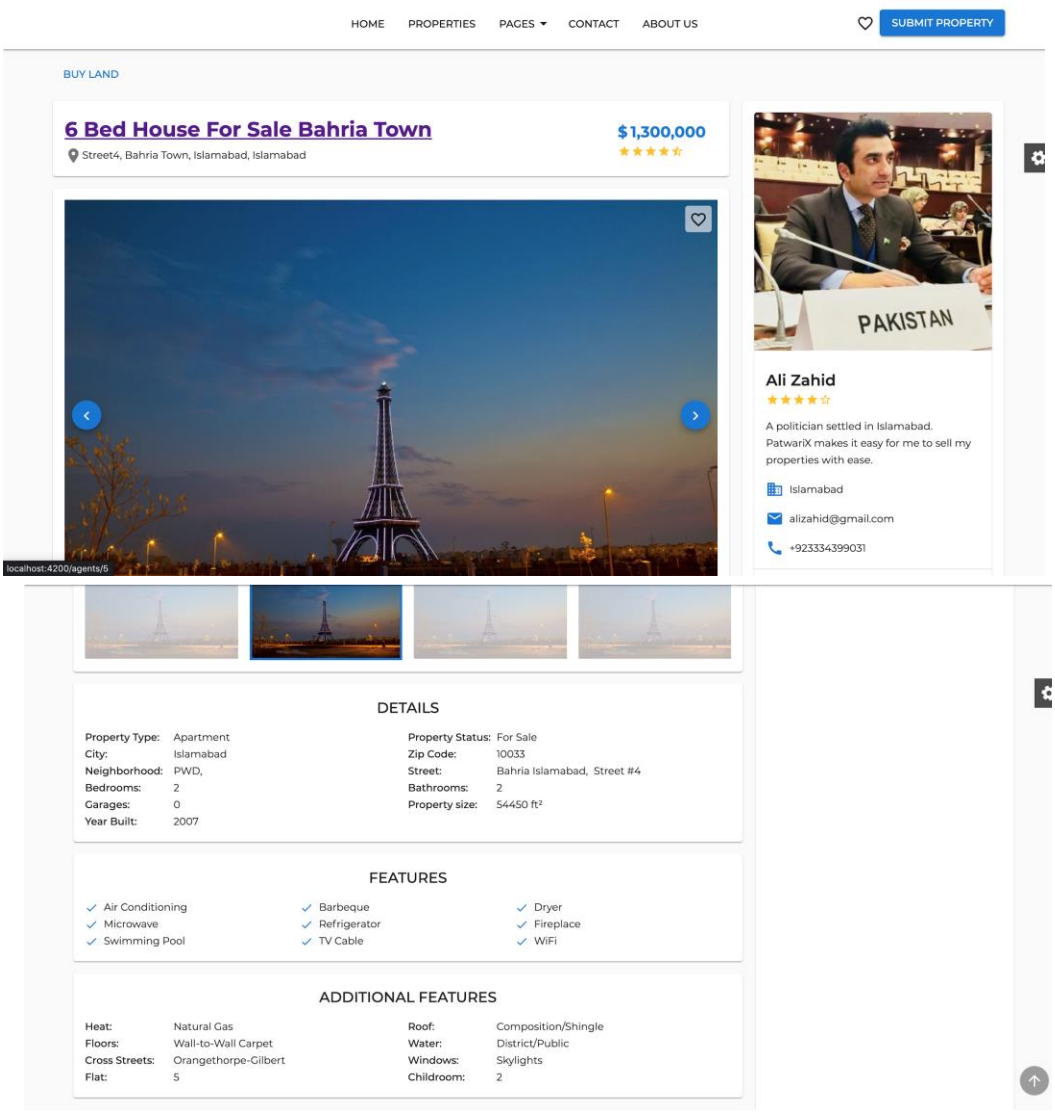
Landing page for PatwariX

The landing page consists of the marketplace properties. This becomes the portal where the buyer and seller can perform various operations for transfer of land/properties.



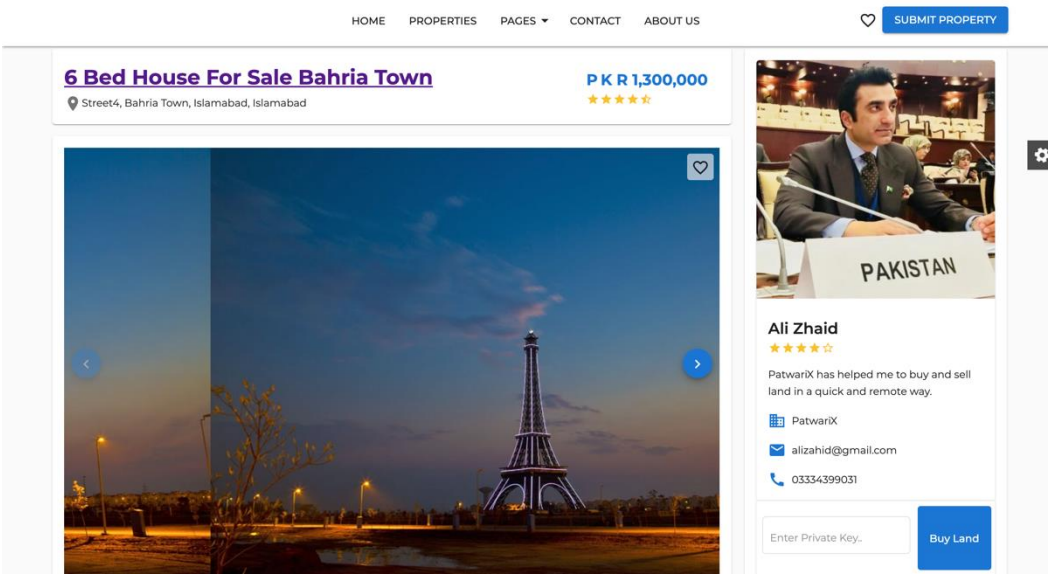
Marketplace for properties displayed.

The property cards containing information of various properties that are to be sold by the buyers.



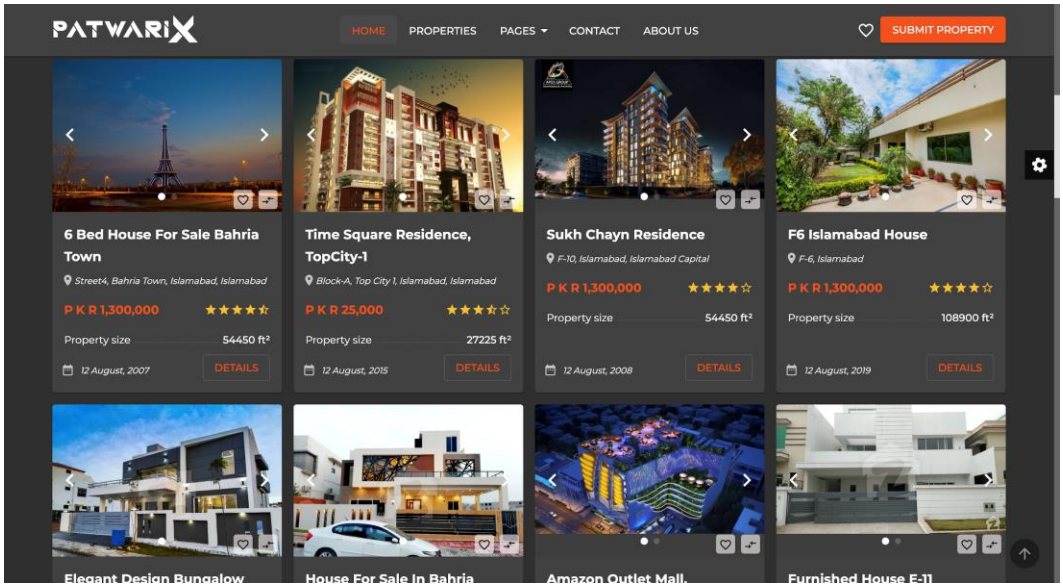
Detail Page for Properties

The property cards redirected to the detailed page on which the main details are to be fetched from blockchain while the remaining are to be fetched from the database. This also presents the owner of the property along with contact information in order to contact for details.



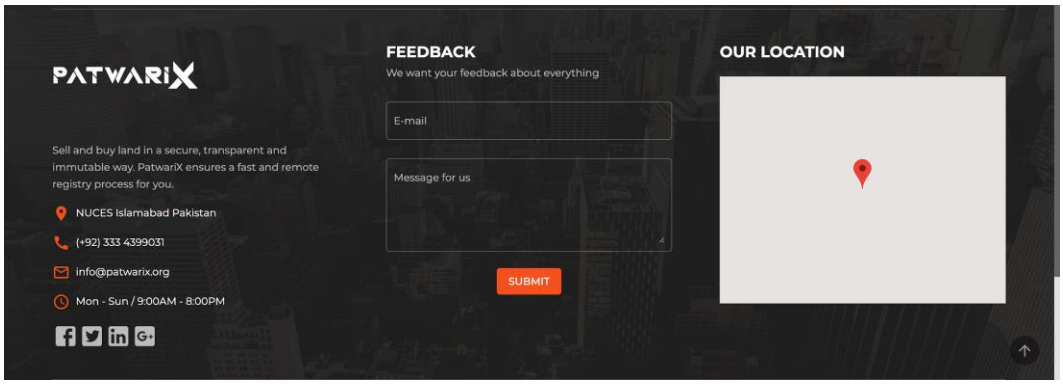
Buy Land Initiation

The buyer visits the detailed page and when decides to buy the property, can initiate the process by entering the private key. The private key as a digital signature signs the smart contract to buy the land.



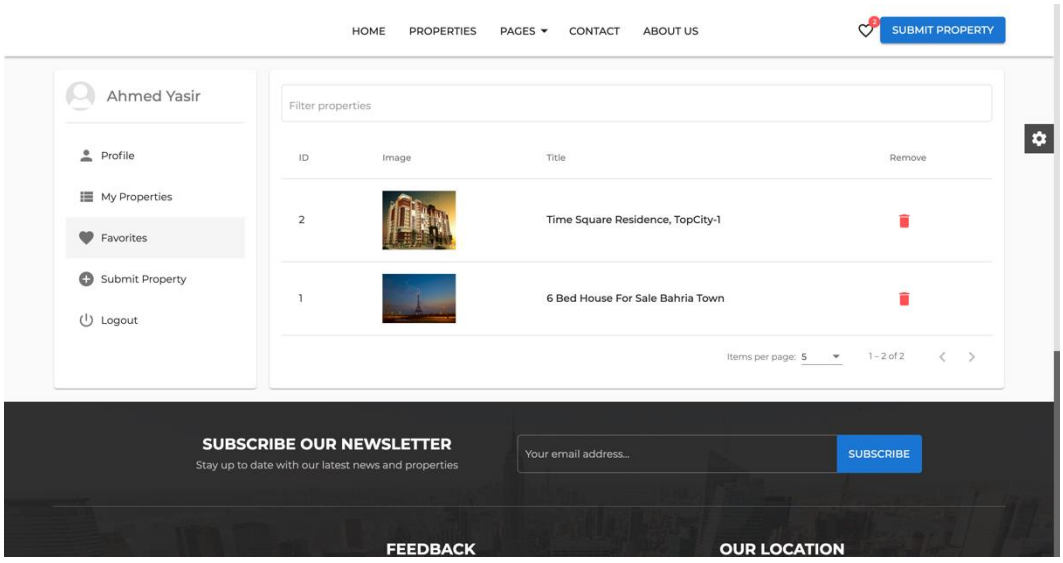
Dark Mode

Dark mode feature according to the trending interfaces for a unique and soothing experience for people who have a better experience with dark themed websites.



Footer

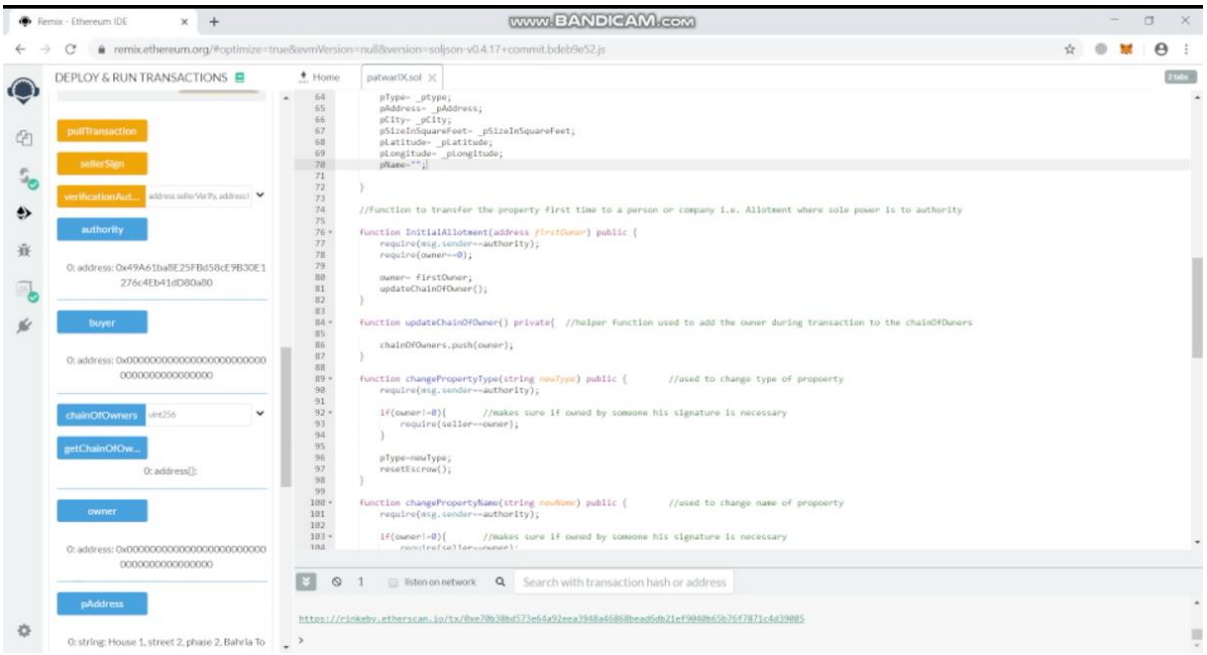
The footer contains the information of the portal and where to contact for support in future.

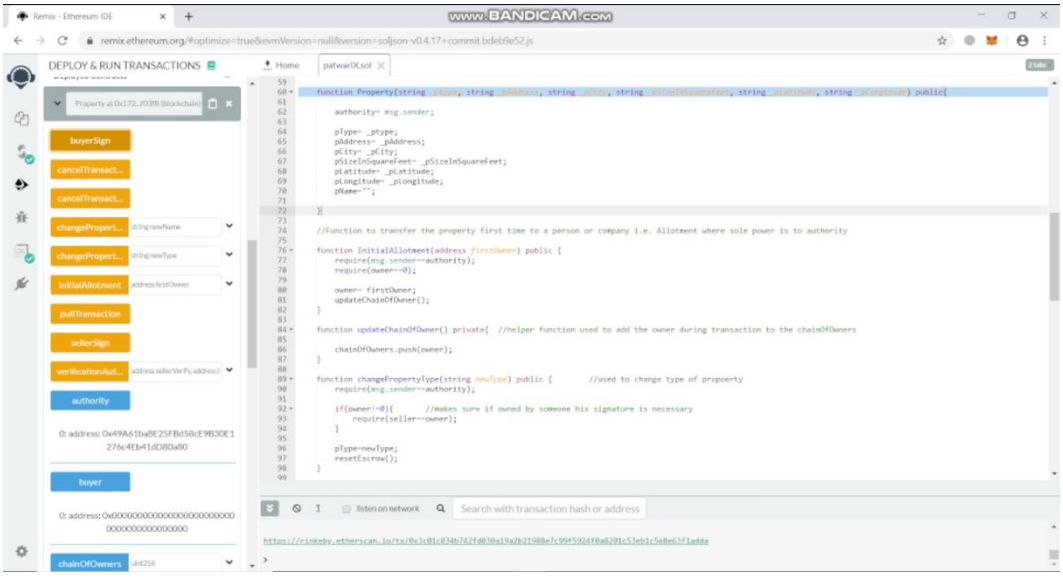


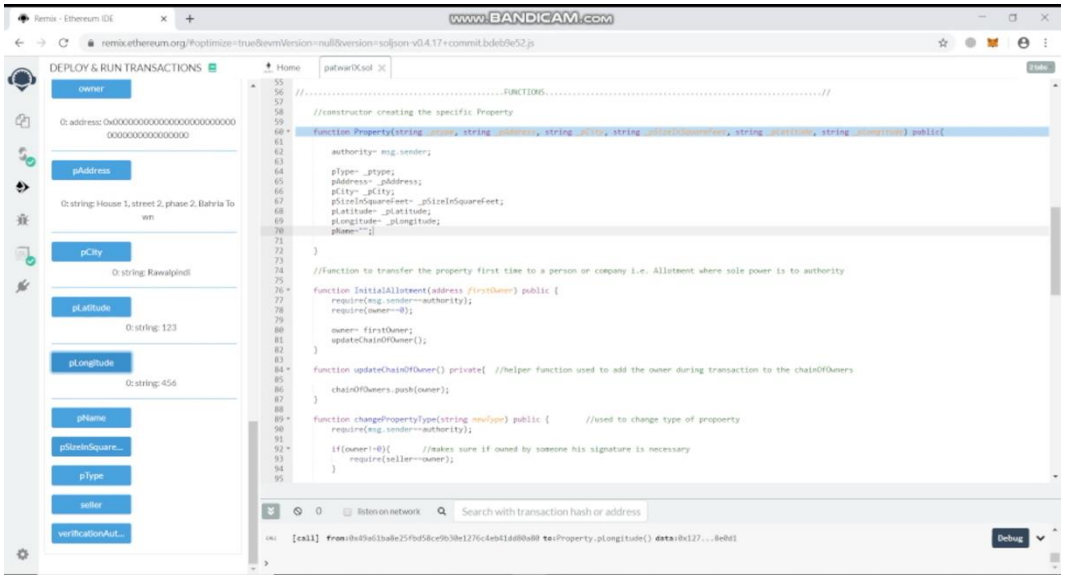
Favorites for properties

The potential buyer can add the properties to the favorites list which can then be accessed in future in order to proceed to buy the property.

Remix Test Cases






www.BANDICAM.com
DEPLOY & RUN TRANSACTIONS
owner
pAddress
pCity
pLatitude
pLongitude
pName
pSizeInSquare...
pType
seller
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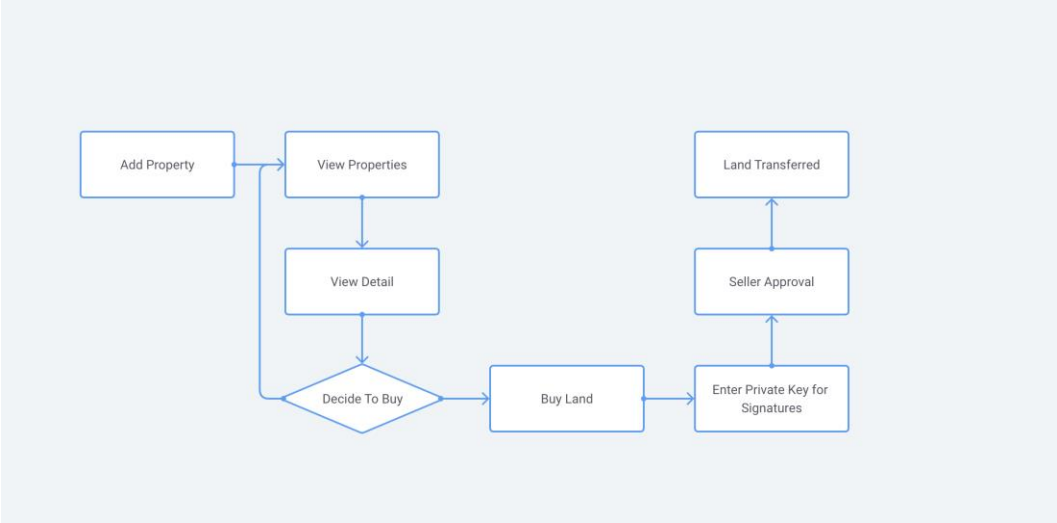
Process Flow



Challenges

- Connecting angular with Web3.js since it would've been suitable to use a Javascript platform such as Vue.js or ReactsJS.
- Communication gap due to isolation during COVID-19.
- Mapping the real world information like CNIC with public keys.
- If a land is changed from residential to commercial, a new node will be added to the blockchain with updated information which will be having a reference to the previous node.
- Connecting the front end with backend using Express.
- Map the land according to the longitude and latitude given.

Implementation Details

- The aim is to make a smart contract of land records containing the relevant fields.
- A web3 boilerplate and using truffle to interact with the smart contract
- And a web3 adapter on truffle to use 12-word seed given to user to unlock accounts which are then used to perform transactions.
- Compiling the smart contract on solidity compiler and then deploying the bytecode to Ethereum. A request will be sent Ethereum deployed contract from which the data will be used accordingly.
- Angular will be used for front end with NodeJS and Express as middleware. Custom scripting on NodeJS to perform transactions or call objects functions from the on chain smart contract.
- Side Data like CNIC will be mapped to the public keys in order to make it practical which will be stored in MySql.

References

https://tribune.com.pk/story/1986863/1-understanding-dying-patwari-culture/