DECENTRALIZED REAL ESTATE MANAGEMENT DAPP

FINAL REPORT

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Prepared For

Design and Development of Blockchain Application(BKT3001)
THEORY ASSIGNMENT

Submitted To

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VIT®
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

Abstract

By cutting out intermediaries like real estate agents, lawyers, and banks, blockchain technology has the potential to transform the real estate industry. Costs could be cut, and productivity could rise, as a result. Property ownership can be tokenized using non-fungible tokens (NFTs), allowing for a speedier and more secure transfer of ownership.

The advantages of blockchain technology in real estate transactions can be improved through smart contracts. The specifics of the contract are directly written into lines of code, enabling self-execution upon fulfilment of predetermined conditions, such as payment transfer or due diligence.

Real estate apps built on the blockchain can do away with the need for middlemen by allowing buyers and sellers to communicate directly. Using cryptocurrencies, which offer rapid and affordable payment methods, can make the transaction process quicker, smoother, and more secure.

The development of a blockchain-based real estate app is essential to realising the potential of blockchain technology in real estate. A greater variety of buyers and sellers may benefit from a real estate market that is more open, efficient, and accessible as a result.

There are many advantages of blockchain technology for the real estate industry. First, by producing an immutable record of every transaction and assuring that there is no chance of fraud, it can increase transparency. Second, by removing the need for intermediaries who can be subject to cyberattacks and data breaches, it might improve security. Instead, the blockchain, which is renowned for its strong security features, can be used to process and store transactions directly.

Also, by making the real estate market more accessible to a wider spectrum of investors, blockchain technology can improve accessibility. By breaking a property into smaller tokens, it is possible to offer fractional ownership, allowing investors to buy and sell pieces of a property. Those who otherwise wouldn't have been able to afford to invest in a full property may now find it easier to invest in real estate.

Ultimately, blockchain technology has a lot to offer the real estate business and has the ability to completely change the sector. It can save costs, boost productivity, increase transparency, boost security, and open up real estate investing to a wider spectrum of people. A critical first step in bringing about this transition is the development of real estate platforms and apps built on the blockchain.

Introduction

Our team is creating a decentralised application that will enable purchasers to directly buy homes through their Blockchain wallets and sellers to display their properties online. By utilising NFTs and escrow transactions, this novel approach provides a higher level of security and transparency to the real estate transaction process.

A distinct NFT will function as a digital ownership certificate for each property and serve as its representation. This NFT will be held in escrow until the transaction is finished, preventing fraud or dishonesty on the part of either party. Escrow agreements give another degree of security by holding the buyer's money in trust until the property has been legally transferred.
To keep track of all the various attributes and the NFTs that go with them, we will establish an NFT collection. The blockchain will make this collection accessible to the general public, giving yet another level of transparency to the real estate market.

Also, our platform will support the implementation of smart contracts during transaction processing. This will enable the contract to automatically execute once certain conditions are met by encoding the specifics of the agreement between the buyer and seller into lines of code. Our decentralised real estate application, which makes use of blockchain technology, has the potential to revolutionise the industry by giving buyers and sellers all over the world a fast, secure, and transparent way to deal. Since fewer middlemen will be required as a result of this strategy, transaction costs will be reduced and the real estate market's efficiency will rise.

Additionally, the decentralised nature of our platform eliminates the limitations of conventional techniques by enabling global real estate transactions. It makes international real estate investments possible, giving investors a great chance to diversify their portfolios.

As a result, our decentralised real estate application has the potential to completely transform the sector by offering a safe, transparent, and effective way to conduct transactions that allows for widespread involvement in the market.

Literature Review

Paper name	Key features	Drawbacks	Summary
"Blockchain in Real Estate: A Review of Applications," 2019, George Bosilca	**The article offers insights into the hurdles and constraints that must be addressed to realise blockchain's full potential in the real estate industry. It also gives a thorough and exhaustive examination of that potential.**	**The paper's publication date limits its applicability and may prevent it from reflecting recent advancements in blockchain technology.**	**The study examines how blockchain technology might be used in the real estate industry to speed up transactions, cut costs, improve transparency, and permit fractional ownership.**
"Blockchain for Real Estate: A Survey of the State-of-the-Art,"2022 Oliver Zick	**The paper offers a thorough examination of the state-of-the-art in real estate blockchain technology today, as well as a summary of the major issues that must be resolved before the technology can reach its full potential. Also, it offers information on the different uses of blockchain in the real estate industry, such as crowdfunding, title transfers, and property administration.**	**As the paper was published in 2022, there is no obvious major downside.**	**The article offers a thorough analysis of the most recent blockchain technology uses in the real estate industry. It looks at the potential advantages of blockchain in real estate, such as improved security, transparency, and transactional efficiency.**

"Blockchain-Based Real Estate Transactions: A Conceptual Framework,"Ravi Dhar Ravi Dhar	**The paper offers a thorough and in-depth conceptual framework for blockchain-based real estate transactions, which can serve as a roadmap for developers, real estate experts, and other stakeholders. It examines the potential advantages of blockchain technology in real estate, such as heightened security, openness, and effectiveness, and offers details on the essential elements of a successful blockchain-based real estate system.**	**There isn't a significant flaw in the study because it thoroughly develops the conceptual framework for blockchain-based real estate transactions.**	**The study suggests a theoretical foundation for using blockchain technology to real estate deals. The framework comprises a thorough examination of the issues that the real estate sector must deal with, the advantages that blockchain technology might offer, and the essential elements of a blockchain-based real estate system.**
"Blockchain for Real Estate: A Systematic Review,"2020 Mahtab Ahmed,	**Important finding: The study offers a thorough analysis of the literature on blockchain technology in real estate, which may be used as a reference by researchers, developers, and real estate experts. It outlines the potential advantages of blockchain technology for the real estate industry and points out the**	**The paper's limitation to a study of works published up to 2020 means that it may not reflect the most recent advancements in blockchain technology.**	**The article offers a thorough analysis of the literature on blockchain technology's uses in the real estate industry. It looks at the potential advantages of blockchain technology for real estate, such as better security, lower costs, and more transparency.**

	major obstacles that must be overcome for it to reach its full potential.		
"Blockchain in Real Estate: Opportunities, Challenges, and Future Directions,"2021,Yu Wang,	**The paper provides a comprehensive overview of the opportunities and challenges of implementing blockchain technology in real estate, which can serve as a useful guide for real estate professionals, policymakers, and researchers. It highlights the potential benefits of blockchain technology in real estate, and identifies the key challenges that must be addressed to overcome barriers to adoption.**	**The lack of a thorough technical explanation of blockchain technology in the article may limit its applicability to developers.**	**The study examines the advantages and drawbacks of using blockchain technology in the real estate industry. In addition to outlining the fundamental obstacles that must be overcome in order for blockchain technology to reach its full potential, it also emphasises the potential advantages of blockchain technology in real estate, such as better transparency, lower transaction costs, and improved security.**

DESIGN AND IMPLEMENTATION

Network actors include:

The project's participants include both direct and indirect actors. The seller who offers the property on the platform, the buyer who pays earnest money into escrow for the transaction, the inspector who inspects the property, the lender who lends cash and approves the transaction, and the appraiser who estimates the worth of the property are all direct actors. Indirect actors include developers who create smart contracts and build the application, as well as investors who put money into the project's development.

Involved Activities:

The operations involved in the project include the seller placing the property on the platform, the buyer entering earnest money into escrow, the inspector inspecting the property, the lender lending funds and approving transactions, and the appraiser valuing the property. Developers are in charge of building smart contracts and creating the application, whilst investors put money into the project's development.

Languages and tools employed:

Solidity for creating smart contracts and tests, Javascript for React and testing, Hardhat for development framework, Ethers.js for blockchain interaction, and React.js for frontend framework are among the languages and tools used in the project. These languages and

technologies are essential for project development and execution.

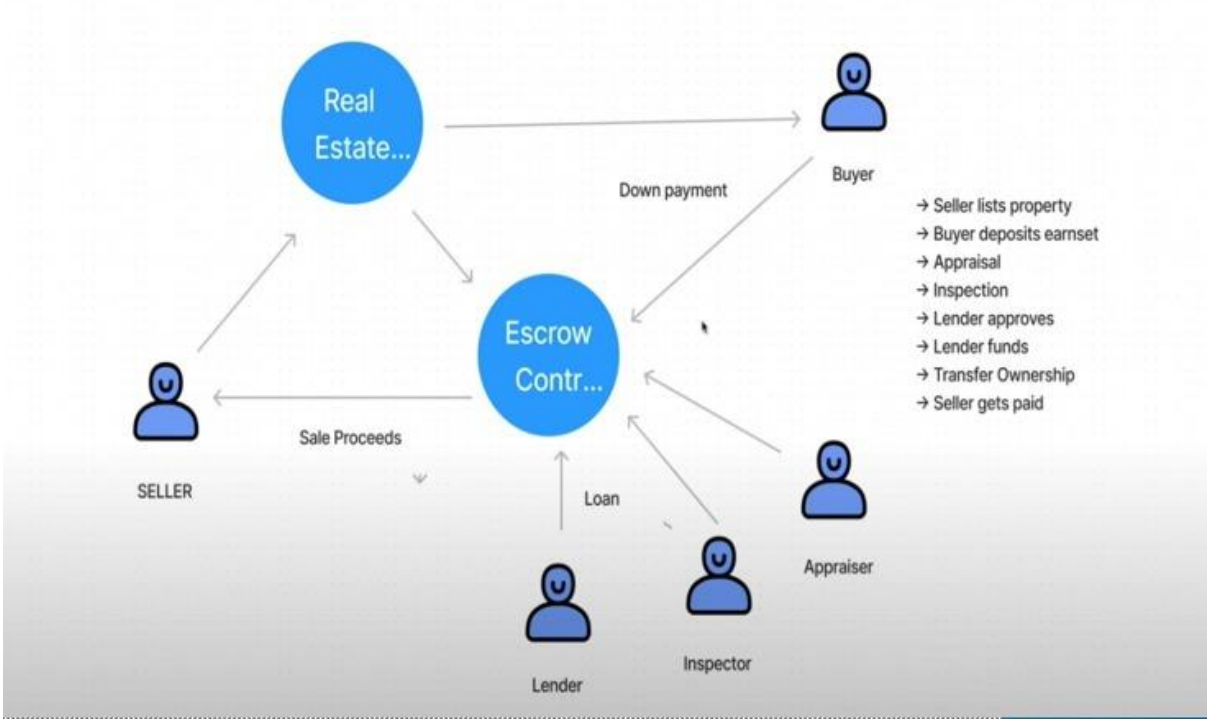


Fig 1.Interaction between smart contract in the Dapp.

INPUTS REQUIRED:

In order to use our real estate platform, customers must first create a bitcoin wallet. This is critical since all transactions will take place in digital currencies.

THE PLATFORM'S OPERATION

Users will interact with the website, and the website's backend will interact with the smart contracts. Smart contracts are code-based contracts that may be programmed to run automatically when specific criteria are satisfied. The blockchain network will host these contracts, and the website will connect with them to facilitate real estate transactions.

APPLICATION OF IPFS

The InterPlanetary File System (IPFS) will be used to maintain the metadata and properties of individual non-fungible tokens (NFTs) distributed on the blockchain network. IPFS is a peer-to-peer protocol that enables file storage and access across a distributed network of computers. We can use IPFS to ensure that NFT metadata and properties are stored decentralised and securely, making it difficult for anyone to modify the data.

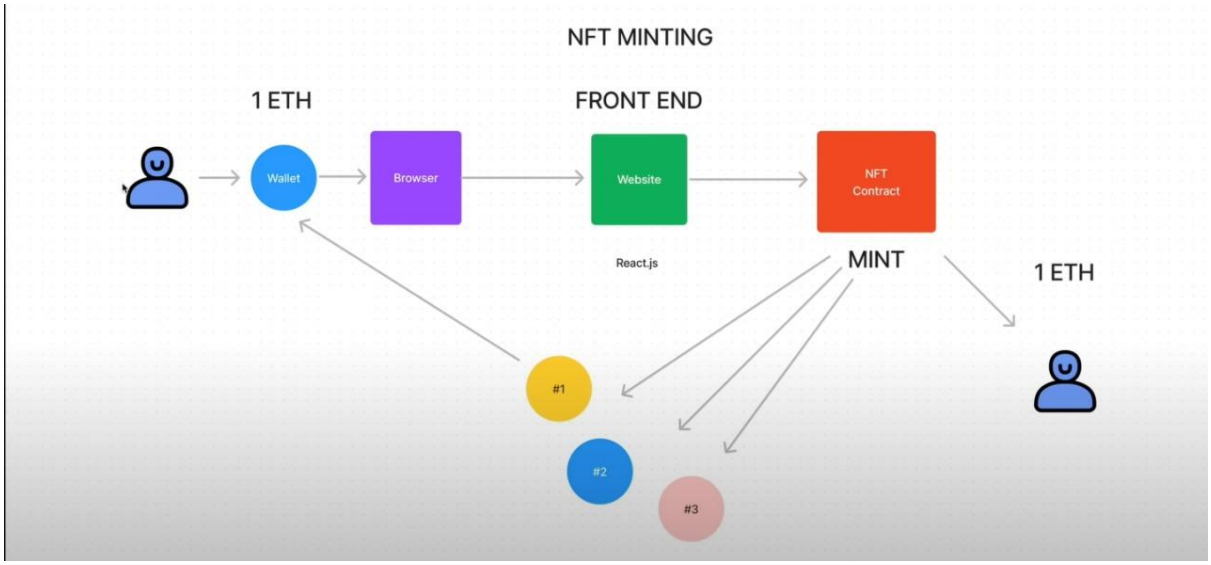


Fig 2．(ERC721 token transfer)

AN ARCHITECTURE FOR WHOLE PROJECT:

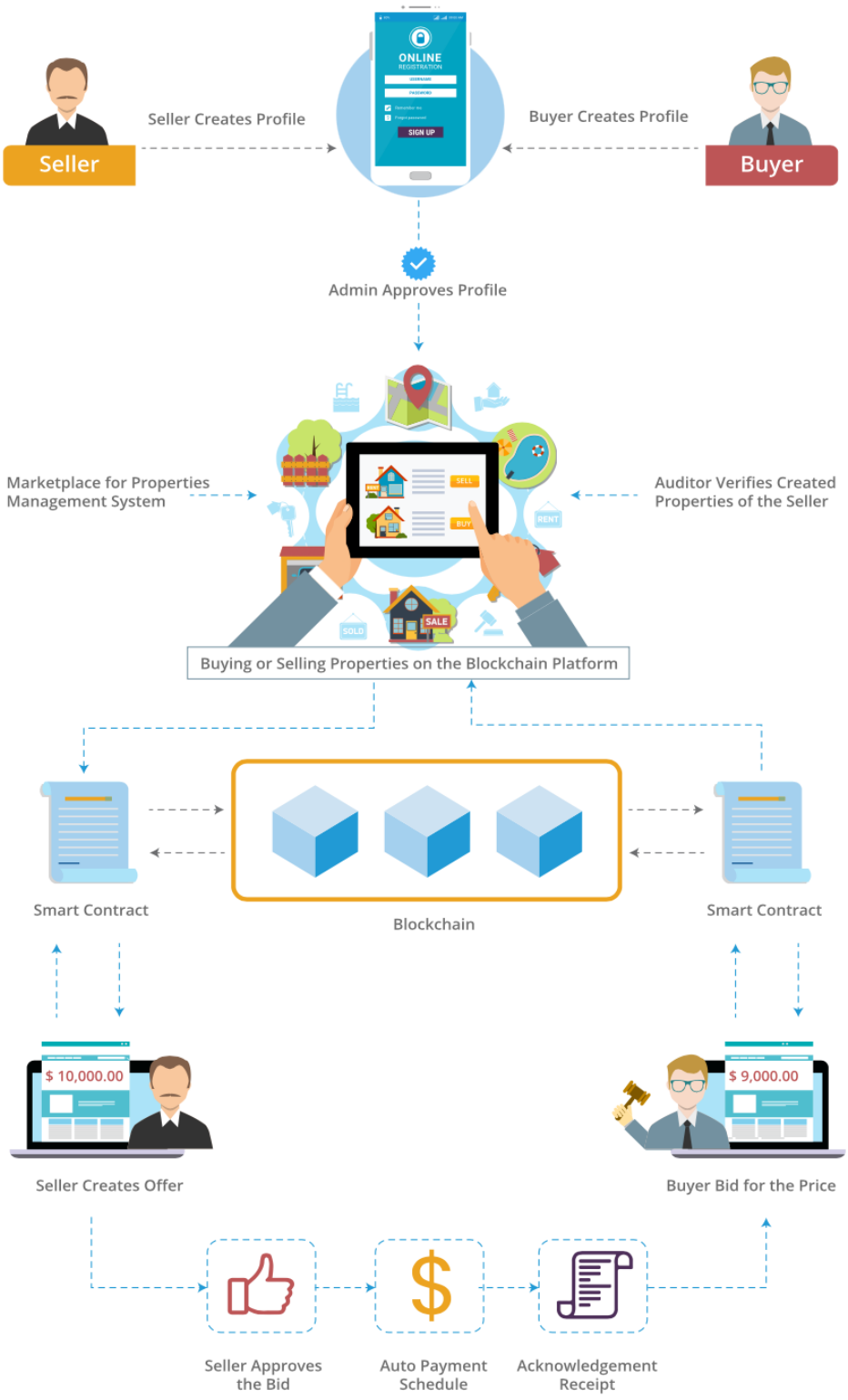


Fig 3. Architecture

DATA PROCESSING

We will develop two smart contracts: one to oversee escrow transactions and one to control the properties in order to deploy our decentralised real estate application. A unique non-fungible token (NFT) that adheres to the ERC-721 standard will be used to represent each property on the blockchain network. The NFT that represents the property is placed into an escrow account when a user wants to purchase it, where it is approved by the miners before being funded by the buyer. Once the deal is complete, the buyer acquires ownership of the asset or NFT from the seller. The non-fungible ERC-721 token smart contract is in charge of validating and moving tokens across wallet addresses.

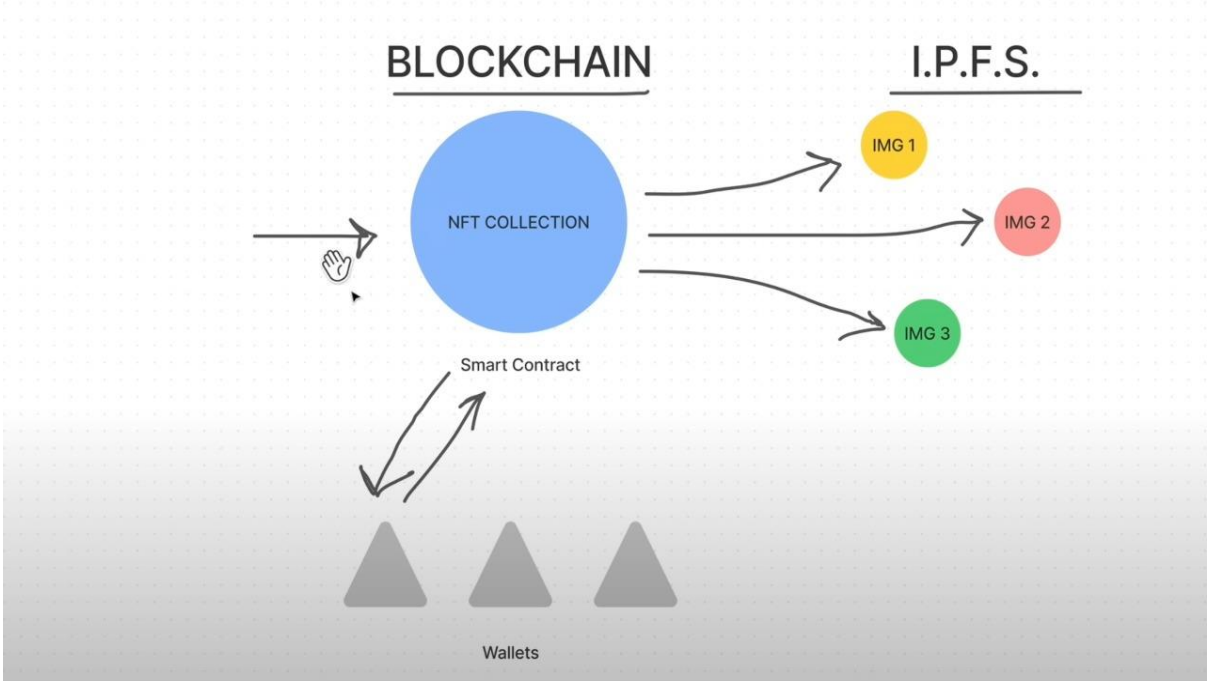
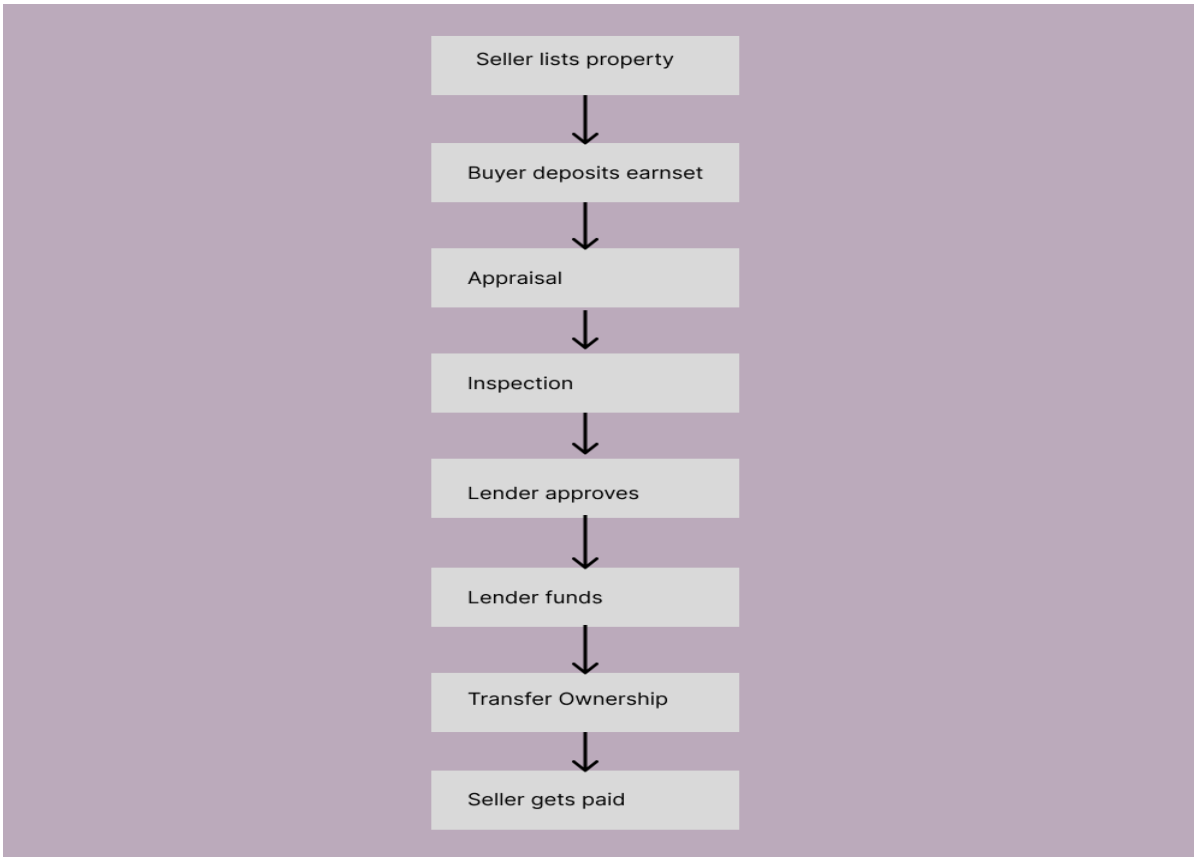


Fig 4. Diagrammatic representation of Input and Data Processing

OUTPUT FLOW:



Result and Discussion

On developing a full-stack React application with a backend powered by smart contracts Your application appears to be an intriguing platform that allows users to list their properties on the website, each of which is represented as an NFT.

The buy button, which allows customers to purchase the NFT properties mentioned on the website, is an important part of your application. The property is transferred to an Escrow account when a user clicks the buy button. The Escrow account serves as a go-between for the buyer and seller, holding the property until all parties involved in the transaction authorise and fund it.

To ensure secure and seamless transactions, your application must first receive permission from other parties or administrators. This phase ensures that the buyer gets the property they wanted and that the seller gets paid for the property they sold.

Your application also allows users to connect their MetaMask wallets through the site, which is an excellent feature for users who want to securely store and manage their cryptocurrency assets.

In summary, your full-stack React application is an innovative platform that leverages the power of smart contracts to enable users to list and purchase properties represented as NFTs. With its robust features, secure transactions, and easy-to-use interface, your application has the potential to revolutionize the way people buy and sell properties online.

CODE (SMART CONTRACTS):

ESCROW CONTRACT:

```
//SPDX-License-Identifier: Unlicense
pragma solidity ^0.8.0;

interface IERC721 {
    function transferFrom(
        address _from,
        address _to,
        uint256 _id
    ) external;
}

contract Escrow {
    address public nftAddress;
    address payable public seller;
    address public inspector;
    address public lender;

    modifier onlyBuyer(uint256 _nftID) {
        require(msg.sender == buyer[_nftID], "Only buyer can call this
method");
        _;
    }

    modifier onlySeller() {
        require(msg.sender == seller, "Only seller can call this method");
        _;
    }

    modifier onlyInspector() {
```

```
        require(msg.sender == inspector, "Only inspector can call this
method");
        _;
    }

    mapping(uint256 => bool) public isListed;
    mapping(uint256 => uint256) public purchasePrice;
    mapping(uint256 => uint256) public escrowAmount;
    mapping(uint256 => address) public buyer;
    mapping(uint256 => bool) public inspectionPassed;
    mapping(uint256 => mapping(address => bool)) public approval;

    constructor(
        address _nftAddress,
        address payable _seller,
        address _inspector,
        address _lender
    ) {
        nftAddress = _nftAddress;
        seller = _seller;
        inspector = _inspector;
        lender = _lender;
    }

    function list(
        uint256 _nftID,
        address _buyer,
        uint256 _purchasePrice,
        uint256 _escrowAmount
    ) public payable onlySeller {
        // Transfer NFT from seller to this contract
        IERC721(nftAddress).transferFrom(msg.sender, address(this),
_nftID);

        isListed[_nftID] = true;
        purchasePrice[_nftID] = _purchasePrice;
```

```
        escrowAmount[_nftID] = _escrowAmount;
        buyer[_nftID] = _buyer;
    }

    // Put Under Contract (only buyer - payable escrow)
    function depositEarnest(uint256 _nftID) public payable
onlyBuyer(_nftID) {
        require(msg.value >= escrowAmount[_nftID]);
    }

    // Update Inspection Status (only inspector)
    function updateInspectionStatus(uint256 _nftID, bool _passed)
        public
        onlyInspector
    {
        inspectionPassed[_nftID] = _passed;
    }

    // Approve Sale
    function approveSale(uint256 _nftID) public {
        approval[_nftID][msg.sender] = true;
    }

    // Finalize Sale
    // -> Require inspection status (add more items here, like appraisal)
    // -> Require sale to be authorized
    // -> Require funds to be correct amount
    // -> Transfer NFT to buyer
    // -> Transfer Funds to Seller
    function finalizeSale(uint256 _nftID) public {
        require(inspectionPassed[_nftID]);
        require(approval[_nftID][buyer[_nftID]]);
        require(approval[_nftID][seller]);
        require(approval[_nftID][lender]);
        require(address(this).balance >= purchasePrice[_nftID]);
```

```
        isListed[_nftID] = false;

        (bool success, ) = payable(seller).call{value:
address(this).balance}(
            ""
        );
        require(success);

        IERC721(nftAddress).transferFrom(address(this), buyer[_nftID],
_nftID);
    }

    // Cancel Sale (handle earnest deposit)
    // -> if inspection status is not approved, then refund, otherwise
send to seller
    function cancelSale(uint256 _nftID) public {
        if (inspectionPassed[_nftID] == false) {
            payable(buyer[_nftID]).transfer(address(this).balance);
        } else {
            payable(seller).transfer(address(this).balance);
        }
    }

    receive() external payable {}

    function getBalance() public view returns (uint256) {
        return address(this).balance;
    }
}
```

REAL ESTATE TOKENIZATION CONTRACT:

```
//SPDX-License-Identifier: Unlicense
```

```
pragma solidity ^0.8.0;

import "@openzeppelin/contracts/utils/Counters.sol";
import "@openzeppelin/contracts/token/ERC721/ERC721.sol";
import
"@openzeppelin/contracts/token/ERC721/extensions/ERC721URIStorage.sol";

contract RealEstate is ERC721URIStorage {
    using Counters for Counters.Counter;
    Counters.Counter private _tokenIds;

    constructor() ERC721("Real Estate", "REAL") {}

    function mint(string memory tokenURI) public returns (uint256) {
        _tokenIds.increment();

        uint256 newItemId = _tokenIds.current();
        _mint(msg.sender, newItemId);
        _setTokenURI(newItemId, tokenURI);

        return newItemId;
    }

    function totalSupply() public view returns (uint256) {
        return _tokenIds.current();
    }
}
```

App.jsx:

```
import { useEffect, useState } from 'react';
import { ethers } from 'ethers';

// Components
import Navigation from './components/Navigation';
import Search from './components/Search';
import Home from './components/Home';

// ABIs
import RealEstate from './abis/RealEstate.json'
import Escrow from './abis/Escrow.json'

// Config
import config from './config.json';

function App() {
  const [provider, setProvider] = useState(null)
  const [escrow, setEscrow] = useState(null)

  const [account, setAccount] = useState(null)

  const [homes, setHomes] = useState([])
  const [home, setHome] = useState({})
  const [toggle, setToggle] = useState(false);

  const loadBlockchainData = async () => {
    const provider = new ethers.providers.Web3Provider(window.ethereum)
    setProvider(provider)
    const network = await provider.getNetwork()

    const realEstate = new
ethers.Contract(config[network.chainId].realEstate.address, RealEstate,
provider)
    const totalSupply = await realEstate.totalSupply()
    const homes = []
```

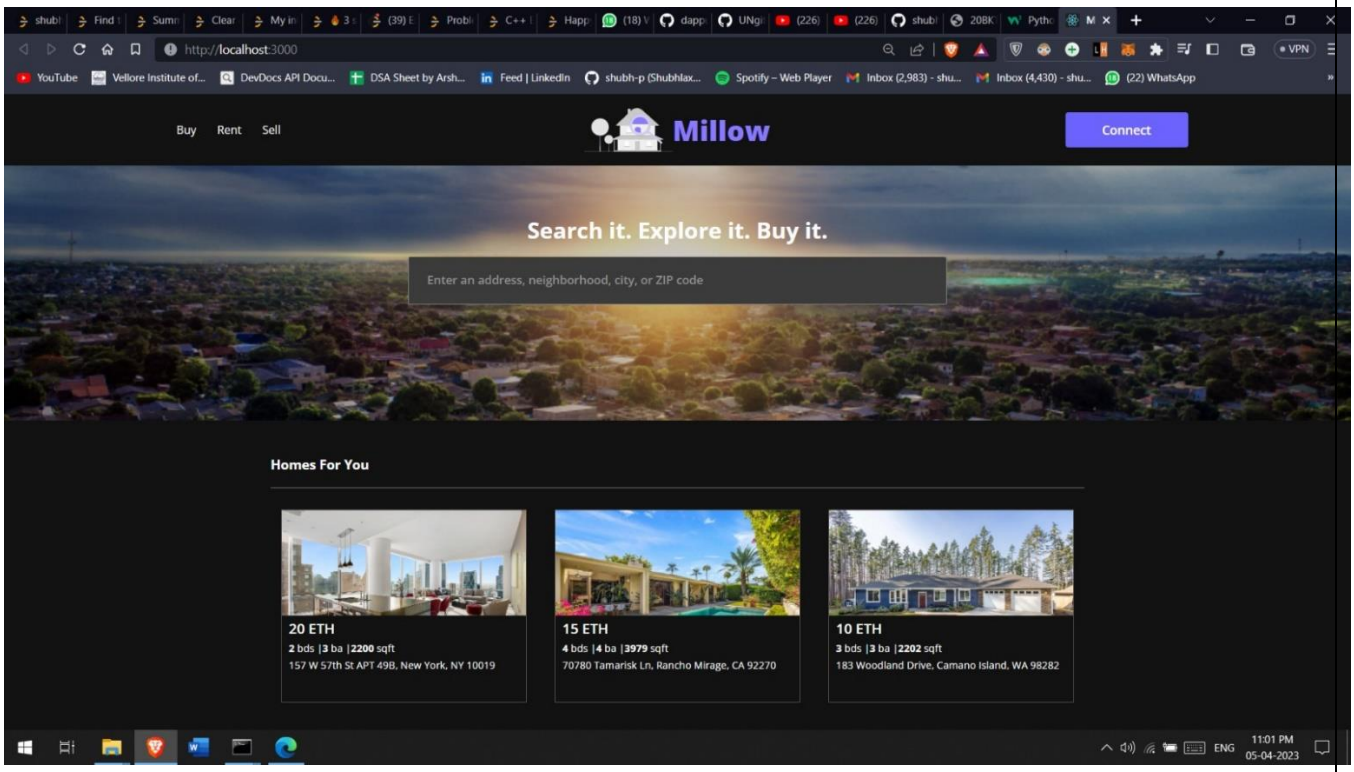
```
    for (var i = 1; i <= totalSupply; i++) {
      const uri = await realEstate.tokenURI(i)
      const response = await fetch(uri)
      const metadata = await response.json()
      homes.push(metadata)
    }

    setHomes(homes)

    const escrow = new
ethers.Contract(config[network.chainId].escrow.address, Escrow, provider)
    setEscrow(escrow)

    window.ethereum.on('accountsChanged', async () => {
      const accounts = await window.ethereum.request({ method:
'eth_requestAccounts' });
      const account = ethers.utils.getAddress(accounts[0])
      setAccount(account);
    })
  }

  useEffect(() => {
    loadBlockchainData()
  }, [])

  const togglePop = (home) => {
    setHome(home)
    toggle ? setToggle(false) : setToggle(true);
  }

  return (
    <div>
      <Navigation account={account} setAccount={setAccount} />
      <Search />
```

```
      <div className='cards__section'>

        <h3>Homes For You</h3>

        <hr />

        <div className='cards'>
          {homes.map((home, index) => (
            <div className='card' key={index} onClick={() =>
togglePop(home)}>
              <div className='card__image'>
                <img src={home.image} alt="Home" />
              </div>
              <div className='card__info'>
                <h4>{home.attributes[0].value} ETH</h4>
                <p>
                  <strong>{home.attributes[2].value}</strong> bds |
                  <strong>{home.attributes[3].value}</strong> ba |
                  <strong>{home.attributes[4].value}</strong> sqft
                </p>
                <p>{home.address}</p>
              </div>
            </div>
          ))}
        </div>

      </div>

      {toggle && (
        <Home home={home} provider={provider} account={account}
escrow={escrow} togglePop={togglePop} />
      )}

    </div>
  );
}
```

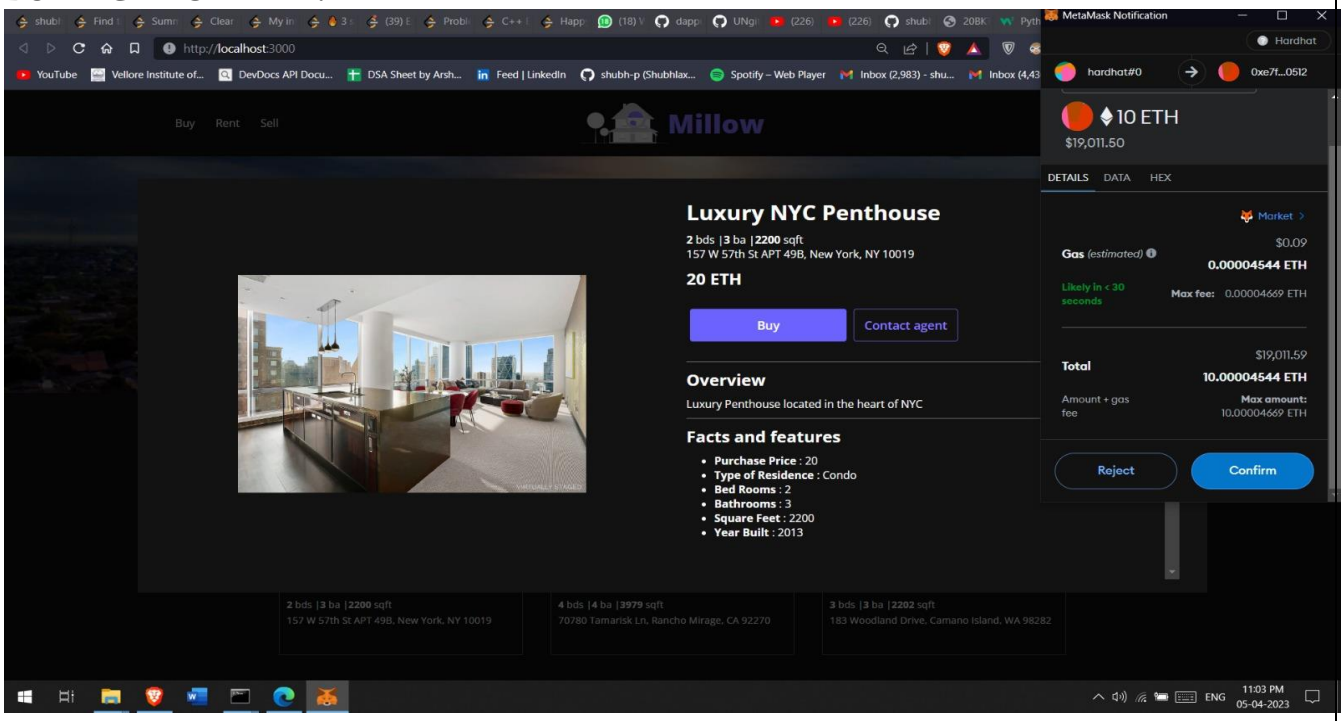
```
export default App;
```

WEBSITE OUTPUT:

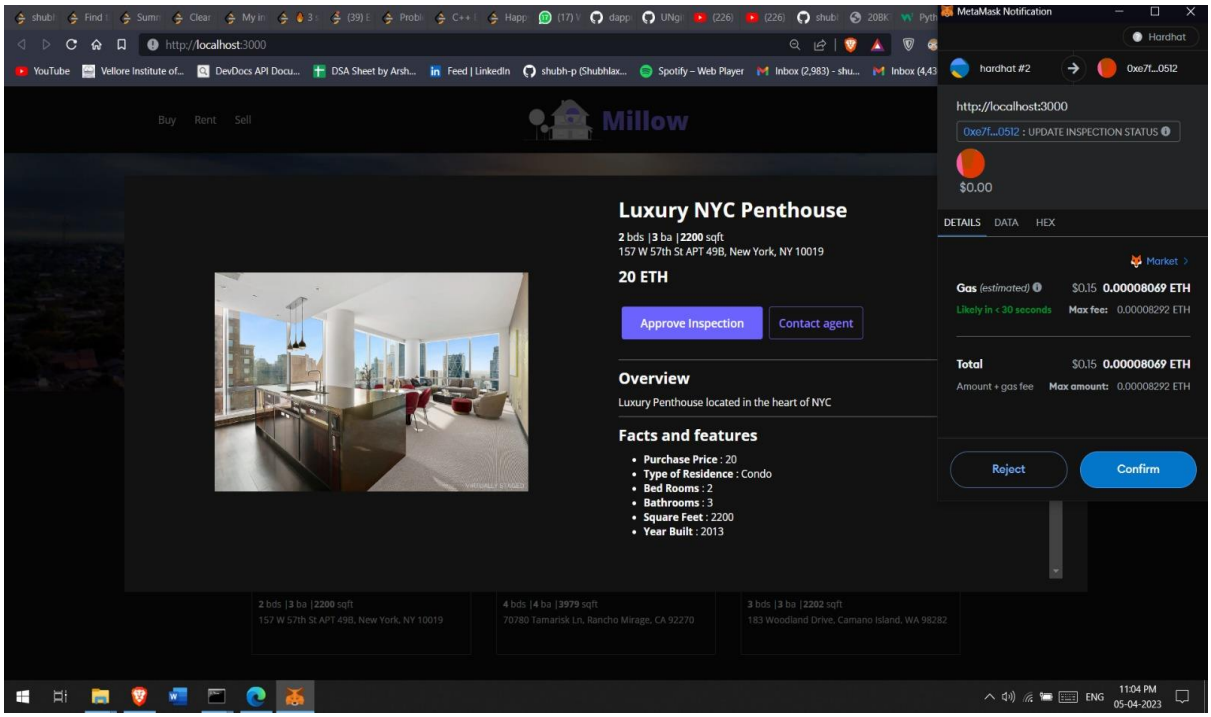
HOME SCREEN:



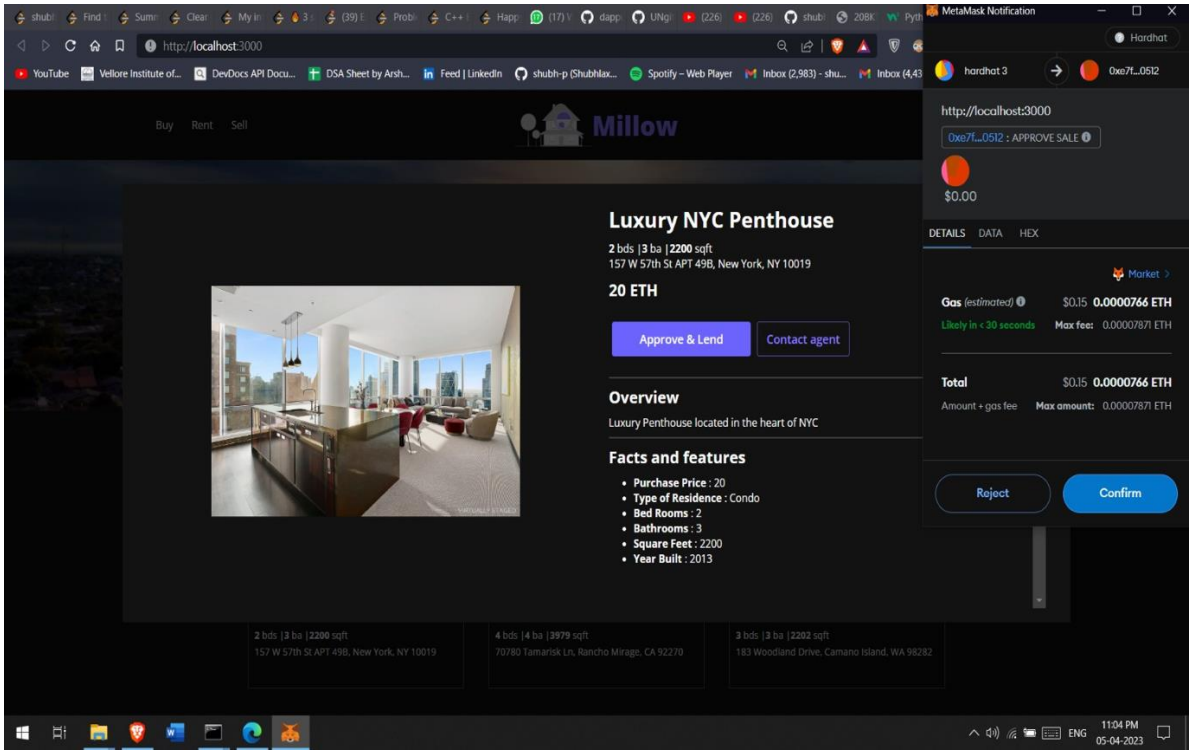
BUYING PROPERTY:



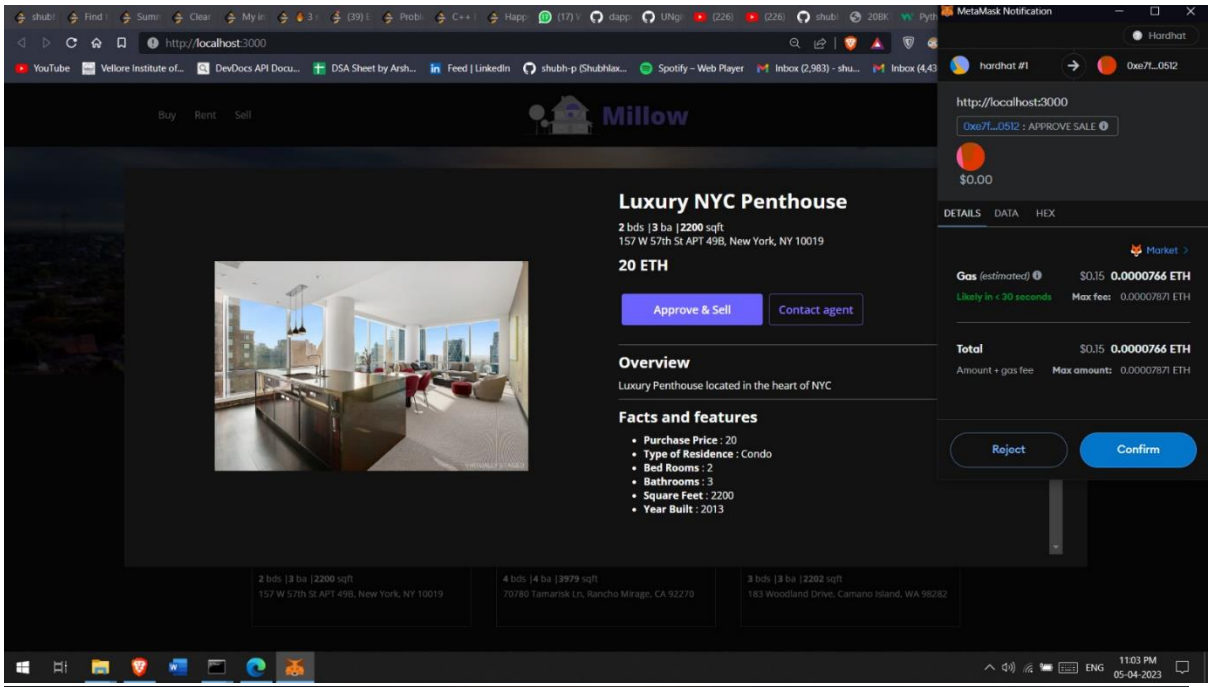
INSPECTION:

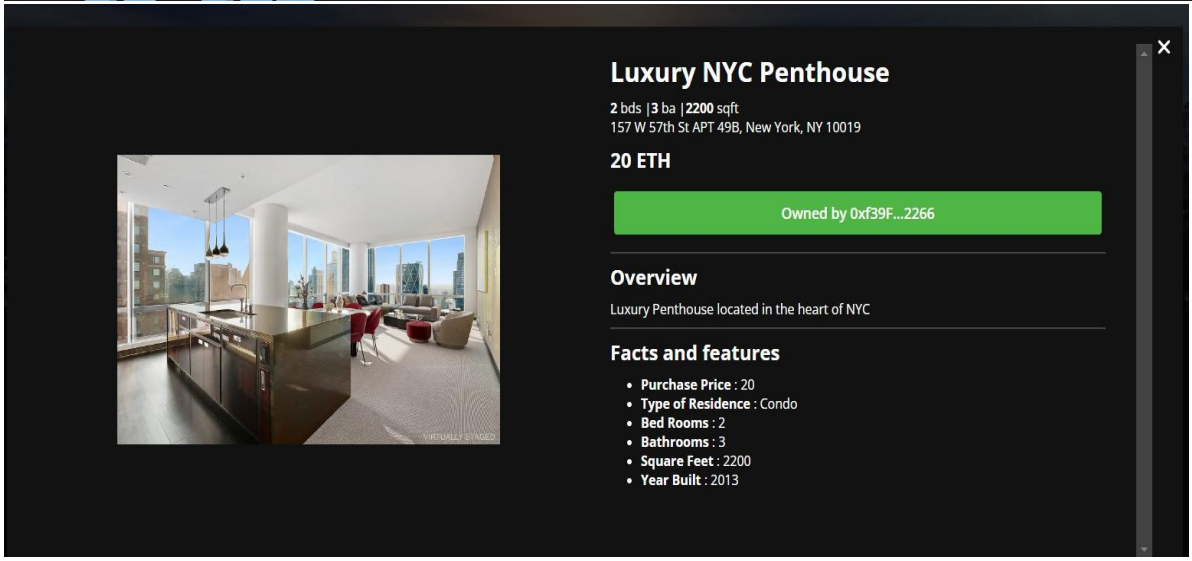


APPROVE AND LEND:

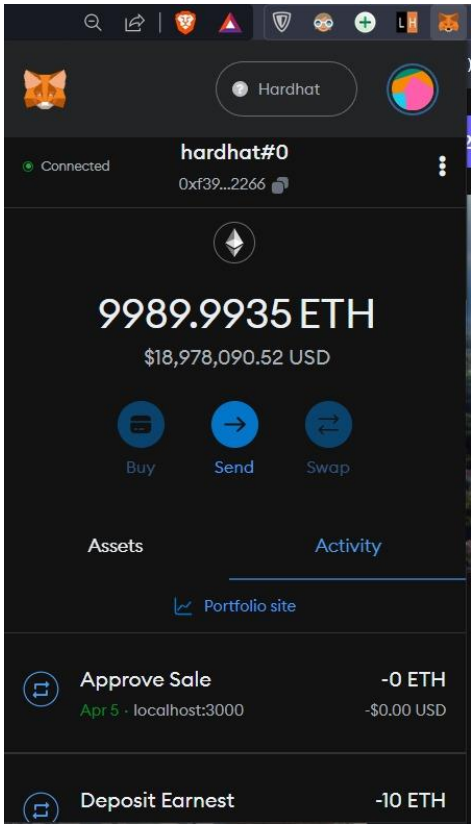


APPROVE AND SEND NFT:

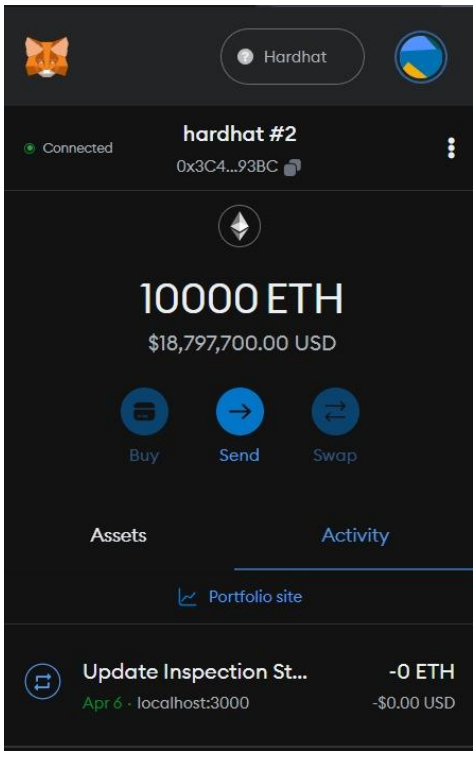




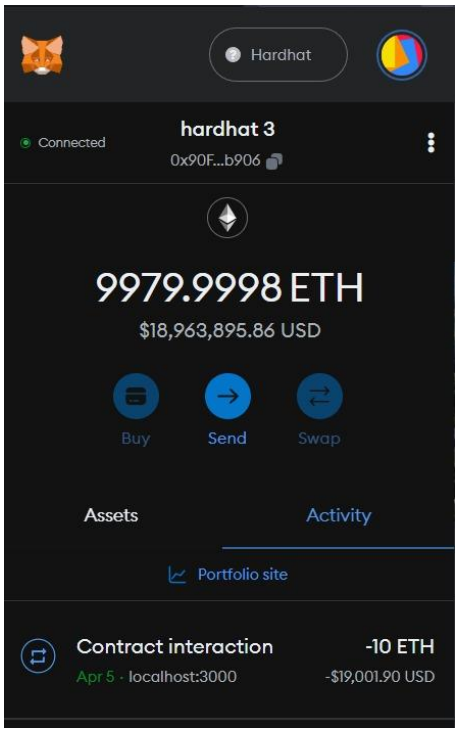
HARDHAT ADDRESS 0 (OF BUYER):



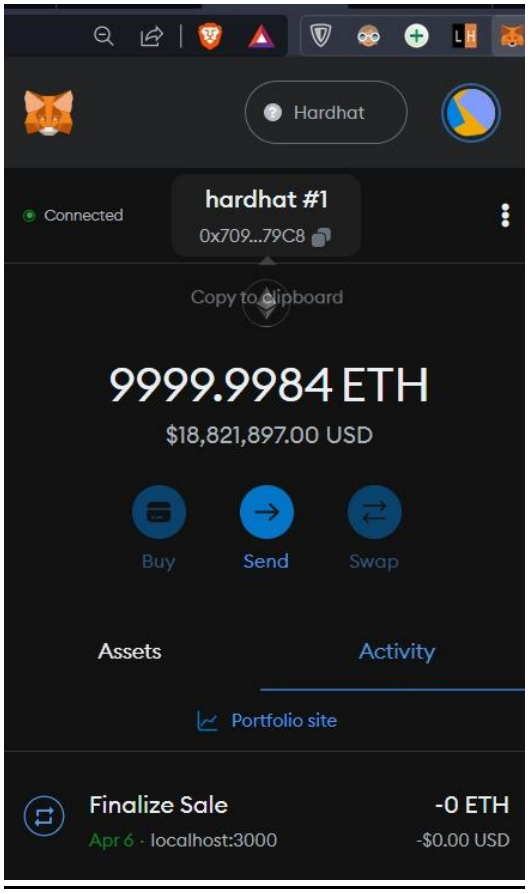
HARDHAT ADDRESS 2 (OF INSPECTOR):



HARDHAT ADDRESS 3 (OF LENDER):



HARDHAT ADDRESS 1 (OF SELLER):



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