

BlockYards: A Blockchain-Powered System for Secure Real Estate Transactions

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Abstract—The real estate industry holds a paramount position within Pakistan, propelled by the surging trends of urbanization and globalization. Despite its growth, challenges persist, encompassing property scams, fraud, and unauthorized property claims, transactions, and holdings. Consequently, ensuring the security and credibility of real estate dealings remains pivotal. Various web and app solutions have emerged to market real estate properties, yet none has established an online platform for verified transactions. Presently, sellers and buyers are compelled to navigate cumbersome property registration and ownership documentation procedures, typically in-person, lacking instantaneous and authenticated online validation. BlockYards has devised a solution to address these limitations by immersing comprehensive property information and transaction data within a publicly accessible Ethereum Blockchain. This innovation benefits all stakeholders, including users and law enforcement agencies, facilitating tracking of an individual's or organization's assets. Public transparency is achieved as a public Blockchain exposes the activity and history of asset transfers associated with a specific hash on the network. Employing a consensus mechanism, this technology safeguards the integrity of asset transactions by ensuring that once a transaction record garners verification from the majority of nodes on the network, it becomes unalterable and resistant to updates or hacking, thus establishing immutable logs. BlockYards integrates a tool fueled by Machine Learning decision models that accurately predict the real value of a property based on comprehensive property attributes. This feature eradicates inaccurate real estate price estimations, empowering users to list their property values confidently. BlockYards empowers users to trade properties at their genuine worth once certain conditions are met, normalizing transparency within the online property market by applying Blockchain's potent capabilities.

Index Terms— Blockchain, Ethereum, Machine Learning, Real-estate.

I. INTRODUCTION

In Pakistan, a huge problem faced by the buyers and the sellers of property is the authentication of their real estate property. In multiple scams, investors face fraud while performing property transactions. There can be multiple registries of a single property, and people have to face many problems claiming their

property and marking the boundaries of their lands. Millions of rupees worth of life's savings can be lost without proof of property registration. The issues include; but are not limited to; scams in buying and selling properties, multiple registries, illegally occupied lands, lack of options while recommending properties to buyers, unwanted search results and many more. BlockYards seeks to keep a record of properties, ownership deals and transactions over Blockchain. Blockchain will not allow fabrication in the properties' original documentation (origin). It is to provide a safe and sound means to own one's real estate assets. Furthermore, BlockYards system aims to help people find the property at its current market estimated price through the Price prediction feature. The goal is to ensure hassle-free registration of a real estate asset while maintaining the accuracy and integrity of all transactions. It aims to give an owner-to-buyer direct link to avoid middle-men intervention and the possible threat of fraud. The original property information remains safe and unchangeable due to Blockchain technology. It also aids in providing price prediction for the users at the time of property sale.

II. LITERATURE REVIEW

Various sources provide a distinct definition of the technological phenomenon known as Blockchain. The blockchain is a globally dispersed ledger that expedites the swift transfer of assets globally in seconds, incurring only nominal transaction costs. These assets encompass any form of value that can be digitally represented. Blockchain can be conceived as a distributed database of records or a public ledger encompassing all transactions or digital events executed and shared among involved parties. In simpler terms, Blockchain functions as a worldwide distributed ledger, enabling the frictionless movement of assets globally, with minimal transaction fees and rapidity. This digital peer-to-peer framework enables direct transactions between two entities without the mediation of a central institution. Satoshi Nakamoto (2008), the originator of Blockchain, presents Blockchain's introduction as a solution to the double-spending issue through



a peer-to-peer network. Nakamoto elaborates that transactions are timestamped through hashing, forming an unalterable chain of hash-based proof-of-work, establishing an immutable record. This concept extends beyond transactions to encompass various agreements where value can be denoted [1-6].

Real estate investments on a global scale surpass the stock market's magnitude by over double. Nonetheless, the count of investors engaging in real estate remains notably lower due to challenges concerning liquidity and worldwide accessibility. The existing system often needs to improve in satisfying tenants, proprietors, and investors. This document aims to explore the implementation of blockchain within the real estate market and illustrate the potential advantages it can bestow upon this sector. The current body of research leads to the subsequent deductions: Blockchain technology and intelligent contracts can effectively address the conventional predicaments that the real estate arena confronts, presenting considerably more impactful tools for establishing a stable-priced market guided by game theory principles [7].

Various existing web applications need to consider sufficient secure asset transactional features. BlockYards adds many new features like property recommendations based on decision models of Machine Learning, buy-sell transactions of real estate using Blockchain, market trends, investment opportunities using Machine Learning, home recommendations based on attributes like old-new properties, furnished-unfurnished properties etc.

The paper [1] describes various approaches and methods used in recommendation systems. It dives deep into them by describing a detailed analysis on each of the approaches. It describes content-based filtration, collaborative filtration, memory-based, model-based technique and multiple hybrid approaches. The paper [2] helped to lay the basis of generating a search filtering mechanism in BlockYards.

This paper [3] details the use of Machine Learning in real estate and asset investment. It describes the methods in which the analytics and predictions are being used in the real estate industry; helping real-estate investors in making investment decisions, property management and property development. The paper helped BlockYards to achieve its aim to aid real-estate investors in making decisions based on the systems' sentence, as in recommendations and predictions in the context of the current market value of the property [4]. However, the paper horizontally deals with multiple domains; to aid investment decisions in a broader scope; not applicable to local Pakistan's context. It by no means makes sure that the transaction that will occur will be secure and safe.

The papaer [4] sheds light on how the user-profile based recommendation system works. Three main steps are used in the process; i) Prediction of item to be purchased is generated by using Logistic regression, ii) Prediction of category to purchase from is done by using support vector machine (SVM), and lastly convolutional neural networks (CNN) is used to generate predictions of user's ratings. They have surpassed usage of base models user dataset that they obtained from amazon. They conclude by mentioning of video signaling techniques to get recommendations through user's facial expressions [5]. This system is highly relevant to BlockYards in the setting of

recommendation generations. However, it focuses more on user-based items and goes vertically beyond item recommendations by recommending the sub-categories of the items that BlockYards does not require.

Dobira - Middle Eastern Application helps its users find the property of their choice by asking users for their preferences such as property type, virtual viewing, price, number of bedrooms, property size, completion status and amenities. However, this system is only accessible and usable to the citizens of Middle Eastern states. It still needs some further distinctive features that BlockYards deals with.

The popular zameen.com online property transaction system is unique in its distinctive offered features, e.g. available options for users to choose the type of property; (house, land, and apartment), number of bedrooms, the size or area of house or land, location, and price. It further helps one to filter down results search by adding a time-window since e-property was listed on the online system, the choice of the user to get the photo(s) of the property he/she is interested in and involved third-party agents in having them as an intermediary in their transaction.

The system used by realproperty.pk has many attributes used to seek search results. OLX.com is one of the most popular and oldest platforms for buying and selling services and products, including assets. OLX does not allow us to select from new or renovated property, choose to buy on installments, security features, etc. TABLE I shows the detailed difference between the existing solutions and BlockYard.

TABLE I
Comparative analysis blockyards and existing solutions

Attribute	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆	S ₇	S ₈	S ₉
P	✓								
B	✓								
T	✓	✓	✓	✓	✓	✓	✓	✓	✓
L	✓	✓	✓	✓	✓	✓	✓	✓	✓
A	✓	✓	✓	✓	✓	✓	✓	✓	✓
P ₁	✓	✓	✓	✓	✓	✓	✓	✓	✓
S	✓	✓	✓	✓					
T ₁	✓								
I	✓								
H	✓								
B ₁	✓								
V	✓								
F	✓					✓			
H ₁	✓					✓			
F ₂	✓								
I ₁	✓	✓							

P = Price Prediction using Machine Learning, B = Verification of Properties Using Blockchain, T = Property Type, L = Location, A = Area, P₁ = Price. S = Structure, T₁ = Sale Trends and Price Fluctuations in an area using Machine Learning, I = Investment Opportunities using Machine Learning, H = Home Type Recommendation using Machine Learning, B₁= Best Time and Price to Sell Your Property using Machine Learning, V = Visiting Time Through Online Registration (Contact Forms), F= Luxury Items/Furnished/Non-Furnished, H₁=

Old, New, Complete, Grey Structured Home, F_2 = Facilities like Electricity, Gas, Water, I_1 = Properties on Installments. Systems are: S_1 = BlockYards, S_2 = Zameen.com, S_3 = realproperty.pk, S_4 = granna.com, S_5 = lamudi.pk, S_6 = olx.com, S_7 = aarz.pk, S_8 = homes-pakistan.com, S_9 = middle eastern app

III. BLOCKYARDS OVERVIEW

The underlying technology powering the system BlockYard is Blockchain. The fundamental structure of Blockchain comprises distributed consensus, cryptography, and immutability. Regardless of the nodes within the network, the architecture of Blockchain is dispersed and decentralized. This design aims to eliminate any singular point of failure within the network. Moreover, cryptography constitutes another pivotal concept within Blockchain, wherein data is safeguarded using sophisticated encryption algorithms. Lastly, the paramount aspect of Blockchain technology is its immutability, ensuring that once data is validated on the Blockchain, it can only be reversed if a majority consensus across the network is achieved. For these reasons, BlockYards has opted to implement Blockchain [8-10].

BlockYards aims to ensure hassle-free registration of any real estate property while maintaining the accuracy and integrity of the transactions. It aims to give an owner-to-buyer direct link to avoid middle-men intervention and the possible threat of fraud. The original property information remains safe and unchangeable due to Blockchain technology. Additionally, using Machine Learning algorithms also aids in providing price prediction for the users while selling their properties. Furthermore, it will ensure the properties are valued at their estimated market prices.

A. BLOCKCHAIN COMPONENT OF BLOCKYARDS

Buyers and sellers can sign up on BlockYards (Blockchain-based application software). The details and attributes of estate assets of individuals are recorded on the Blockchain network as contracts. These attributes include Property Type, Location, Area, Structure, Luxury Items, Home Status, Facilities, and Installments. This information will be used to verify the property under transactions. Buyers and sellers on BlockYard system can view the history of all the properties' transaction(s) status in context. Once users begin to finalize their decisions and initiate their transactions on the Blockchain network, the network requires verifications from Blockchain miners.

All users registered on BlockYards will be able to view property details. Once an estate asset is added to the network, it becomes immutable to maintain its integrity and prevent unfair practices. As any of the monetary and property-transfer transactions will occur, it will be recorded on the Blockchain network for the users to seek. All users can view the dashboard by using the web interface of the system. Admin dashboard will display user profiles, properties by categories and added property listings.

B. MACHINE LEARNING COMPONENT OF BLOCKYARDS

BlockYards operates by leveraging Machine Learning algorithms and data analysis techniques to provide personalized property suggestions to users. Buyers and Sellers can predict the estimated market price of the asset in the spotlight using decision models of Machine Learning. Property Value prediction

is done to eradicate false, inaccurate and varying prices of properties so the properties on sale will be valid on their actual and accurate value to be bought at so no one can pay/get paid unfairly.

The system gathers vast data from the Blockchain, including property listings, user preferences, historical transaction data, location information, property features, and more. Relevant features of properties and user profiles are extracted and transformed into numerical representations. This allows the system to compare and match user preferences with property attributes effectively.

For Price prediction, BlockYards approached the problem via supervised Machine Learning algorithms. Three algorithms, Linear Regression, Decision Tree Regressor and Computational Neural Networks Regressor, were tested on the available dataset.

Algorithms were tested on Mean Squared Error (MSE), ROC curve and Confusion Matrix. The accuracy results show that the Decision Tree Regressor had the highest accuracy percentage. These libraries were used to calculate the aforementioned parameters: sklearn, matplotlib and seaborn. Flask and Pickle libraries display the output of the recommendation module of BlockYards onto the web interface.

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Based on the calculated similarities, the system generates a list of property recommendations that closely match the user's preferences. These recommendations may include properties that the user might not have discovered otherwise. As users interact with the recommendations and provide feedback (likes, dislikes, preferences), the system learns and refines its recommendations over time. This iterative process enhances the accuracy and relevance of future suggestions. BlockYards continuously updates its database with new property listings, user interactions, and market trends. This ensures that the recommendations remain current and reflective of changing preferences and market dynamics. Figure 1 shows the complete work flow of both modules i.e. Blockchain and Machine Learning of BlockYards.

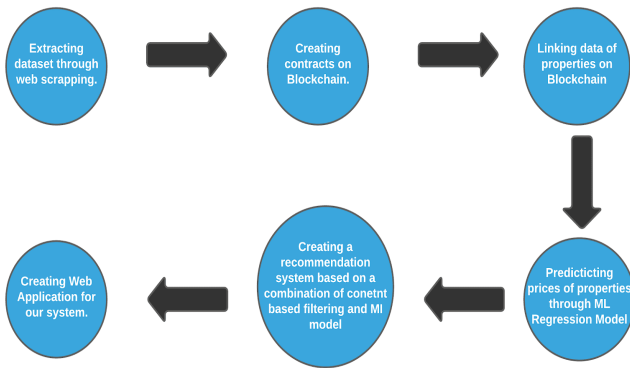


FIGURE 1. BlockYards Overview

ARCHITECTURE

Smart contracts can incorporate diverse types of clauses to facilitate the creation of more intricate transactions, like loan repayments. Operating within a blockchain framework, these transactions attain a high level of security, trustworthiness, and execution without the need for an intermediary. While Ethereum pioneered the introduction of smart contracts authored in the Solidity language, other protocols also present similar capabilities. Consequently, by interlinking multiple smart contracts, potentially with public administrative bodies, involved parties could verify a debtor's creditworthiness in public records, perform automatic payments tied to the contract, coordinate utility services, settle necessary taxes, and concurrently document the contract's details.

For Blockchain implementation Ethereum framework is being used because it is the most secure and widely used Blockchain technology. It is compatible with many frameworks for frontend and backend development. It also allows users to view the details of a particular asset on its ledger scanner. Truffle environment framework was selected as it has a compatibility module that makes connectivity easier [8].

MERN stack was used for the website development as it is modular and compatible with Ethereum. Firebase authentication was used for user authentication since it is safe and secure. Simple html/CSS/JavaScript could have been used, but node was important for integrating the databases and web3.js. Installing dependencies is also easier on node.js using the node package manager. It has a built-in server-side, meaning the website will open in the browser as if it were hosted.

Figure 2 illustrates system level architecture of BlockYards. It relates databases, web applications, Blockchain contracts, Flask components and data details. Figure 3 represents the sequential flow of the system for the defined functionalities.

Figure 3 of BlockYards exhibits a Machine Learning intelligent system that considers factors like area, size, conveniences, and market patterns to gauge a proper asset's exact and genuine cost. BlockYards is built to authenticate users according to their CNIC, email and wallet address. Figure 4 shows the admin of the web application will be verifying the property before logging it on Blockchain. Figure 5 and Figure 6 presents the graphical user interface of BlockYards. Figure 7 shows the sequence diagram.

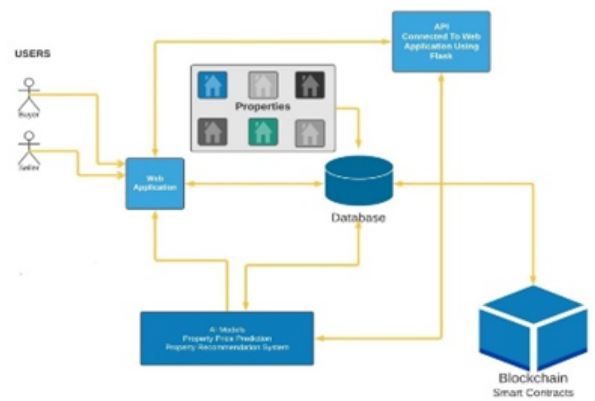


FIGURE 2. BlockYards Architecture Diagram.

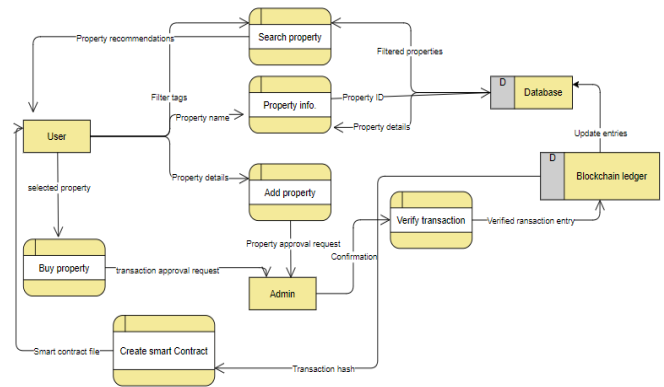


FIGURE 3. BlockYards Context Diagram

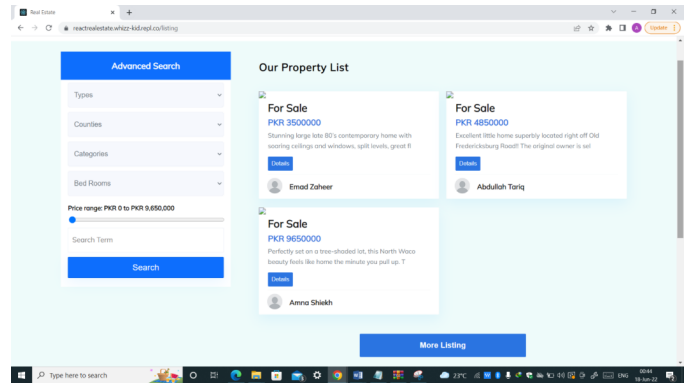


FIGURE 4. BlockYards Dashboard-I

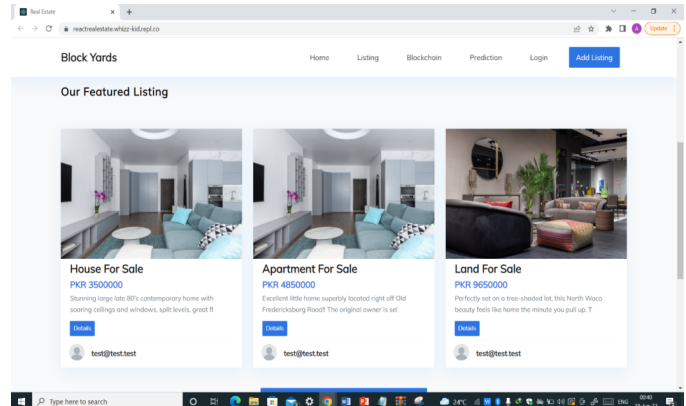


FIGURE 5. BlockYards Dashboard-II

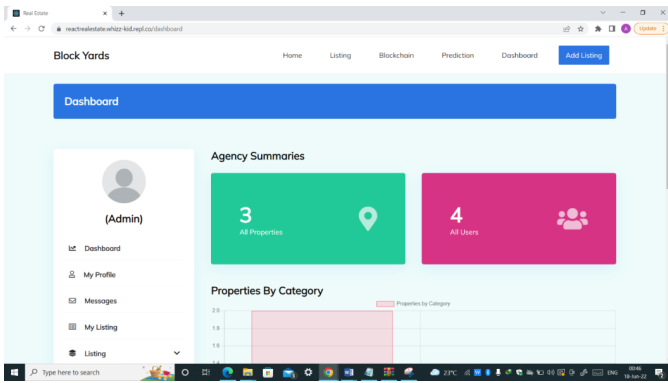


FIGURE 6. BlockYards Dashboard-III

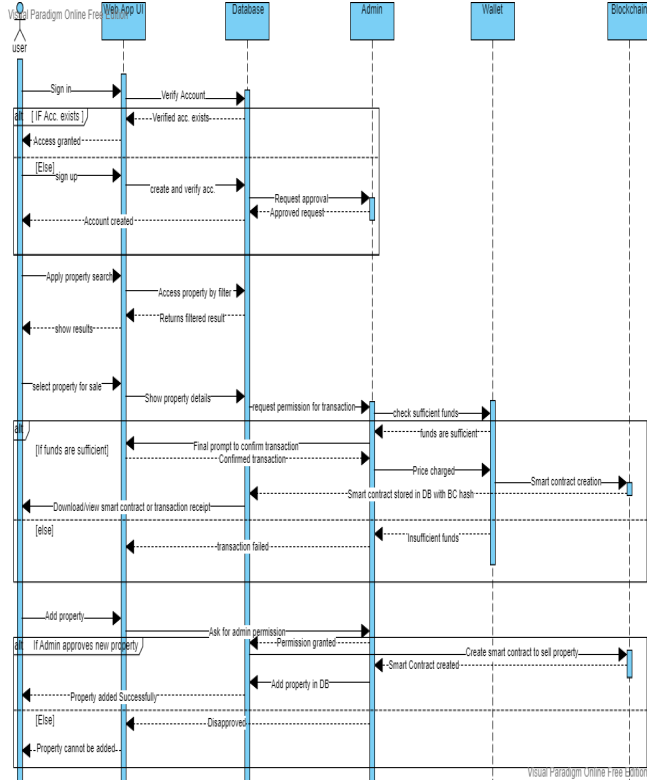


FIGURE 7. BlockYards Sequence Diagram

VI. CONCLUSION AND FUTURE WORK

BlockYards is developed to assist individuals conduct real estate transactions safely and smoothly without the fear of getting scammed. This system based on Blockchain has reassured people that whichever property they are buying is verified and authentic and their money will be sent directly to the owner safely. Fraudulent declarations of assets have also been eradicated through the usage of Blockchain technology in BlockYards. The

system has also made possible the practice of false claims of property near to zero. People cannot claim any property which they do not own. Furthermore, through the Property Price Prediction feature the sellers and buyers are dealing with the estimated market price of the properties.

The main problem was the need for more resources available for Blockchain especially in Pakistan. There is very less learning material available for implementations of different kinds of Blockchains. The main challenge was the integration of Blockchain with frontend web application.

It is intended to add more features to BlockYards. Firstly, a mobile version of BlockYards is the future need so that people can buy and sell properties at the palm of their hands. In addition to that, map inclusion in BlockYards will help the user to find the coordinates of one's property.

The past history of local assets needs to be part of BlockChain. The future logged data needs to be cleaned, organized, and preprocessed to remove inconsistencies, errors, and redundant information. This step ensures that the data used for recommendations is accurate and reliable.

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