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A Decentralized Application (DApp) on Trading Real Estate Assets using Blockchain and Artificial Intelligence

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Abstract:
Blockchain technology has gained a lot of attention in recent times due to its vast application in the field of Computer Science and Technology. This rapid development of blockchain technology has had an impact on the financial industry, resulting in the creation of a new crypto-economy and many crypto-currencies are used today. Then, thanks to the appearance of smart contracts, which creates trust among multiple untrustworthy parties, without involving a trusted third-party. Artificial intelligence is another trending technology which makes a machine decide on its own without the help of any human support. Blockchain along with Artificial Intelligence (AI) can help in making applications more secure and work without any third-party support (in most cases). Decentralized Applications also called DApps are applications that make both parties involved in a transaction to interact and do transactions directly with the help of Blockchain, without having a traditional intermediary who works for a predetermined amount of money or transaction charge.

Introduction:
Artificial intelligence (AI) and Blockchain have become two of the most trending and disruptive technologies especially with the rise of the Web 3.0 which is going to make the internet more secure and reliable than its predecessors.

AI combined with Blockchain technology [12] [13] provides access to a shared ledger of data, transactions, and logs in a decentralized, secure, and trusted manner with a Distributed Artificial Intelligence making the algorithms have a distributed yet common goal. Decentralized applications (DApps) are digital applications or programs that exist and run on a blockchain or peer-to-peer (P2P) network [6] of computers instead of a single computer. DApps are outside the preview and control of a single authority. An effective Decentralized application (DApp) which will help in trading physical assets with the help of Blockchain and Artificial Intelligence is discussed here. This system will store the transaction details in a Blockchain which will make it more secure from hacking or tampering of the data or information.

1) Literature Survey:

Blockchain

Blockchain is a rapidly evolving technology that is quickly becoming a major component in a wide range of industries. Blockchain technology has grown at a rapid pace in recent years, captivating the attention of numerous researchers and institutions.

Blockchain is a distributed database technology with immutable records of information [6] whose most well-known application has been to support the digital currency Bitcoin [8]. A blockchain is a chain

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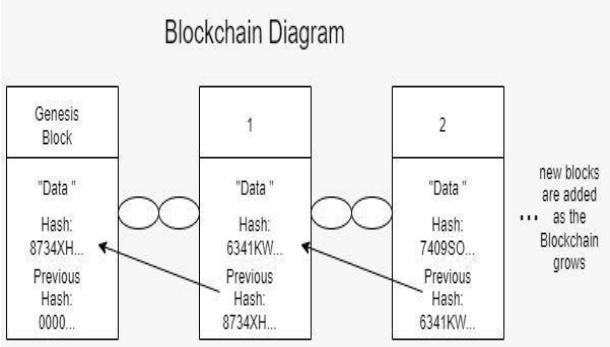
of blocks that is constantly growing, with each block containing a cryptographic hash of the previous block, a time stamp, and the data [1]. The initial block is called the Genesis block. Ethereum is the world's second most popular cryptocurrency, distinguished by its ability to deploy and run complex distributed applications on top of the blockchain. Ethereum accomplishes this using Turing complete smart contracts, which are run within the Ethereum Virtual Machine.

Blockchains have previously been used in healthcare [2], the Internet of Things [3][10], smart cities, and a variety of other fields [9]. Furthermore, blockchains are likely to transform society's foundations by replacing outdated mechanisms with updated infrastructures fit for a virtualized world.

Blockchain technology has numerous advantages, including speed, dependability, immutability, traceability, transparency, decentralization [7], and trust [4]. These benefits position blockchains as a replacement for outdated technologies in a variety of domains where such factors are critical requirements. [4]



Artificial Intelligence

Artificial intelligence (AI) is the ability of a computer, or a robot controlled by a computer to do tasks that are usually done by humans because they require human intelligence and discernment. Real estate companies are increasingly using artificial intelligence in every aspect of buying, selling, renting and house financing. Algorithms can now go through millions of data in seconds, looking through property values, even the user's information to provide better service and delivery [13]. Artificial Intelligence (AI) paired with Blockchain can result in amazing possibilities for a better user centric interface. Machine learning models can use the data stored in the blockchain network for making the prediction or for the analysis of data purposes to enable various user services [14]. The different machine learning models can help build blockchain based smart applications that involve various use cases that can be used in various forms of industries especially in Real estate. Web 3.0 being the future of the internet enables blockchain based applications using ML models to diversify and create a secure user environment [12].

The AI integrated with the blockchain-based DApp includes the various features that use multivariate regression for price range prediction [15]. Thus, the real estate properties can be subject to automated price evaluation and house price forecasting [16] using certain models. Also, with the addition of the recommender engine systems in the real estate market [18] are enabled through algorithm models that help in the user judgment and ease the platform to view relevant information. Unification of all the services using conversational AI based on IBM Watson Assistant [17] provides the shortcut to great customer service especially for users to navigate the process flow.

Real Estate

The value of all the world's real estate reached $326.5 trillion in 2020, a 5% increase on 2019 levels and a record high.[5]. It is regarded as one of the safest investment options, with comparatively higher returns than other investment options; however, real estate, like other businesses, is facing several challenges. These difficulties include the use of a third party for verification, the associated monetary and time costs of administration, access, and verification of records, the use of commission-based agents, transparency issues regarding property ownership, and reliance on centralized systems that are vulnerable to security breaches. Blockchains can provide smart contracts that help to eliminate any third-party involvement in real estate transactions.

Furthermore, the blockchain ledger's immutability can provide a secure environment for the real estate industry. Blockchains can also aid in validating the process by speeding up background checks and

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providing personal digital security keys to parties involved, which in turn lowers the risk of fraud.

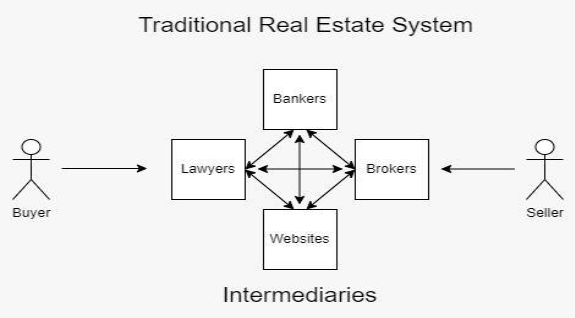
The primary goal of this work is to determine how blockchain technology and the real estate industry can interact to develop a mechanism that records all important transactions on a private blockchain.

Working of a traditional real estate industry

In a traditional real estate industry, a potential buyer looking to purchase property will either visit a listing website, a property brokerage website, or a real estate broker in person. These intermediaries (websites, brokers, etc.) recommend some sellers who are selling their properties that match the buyer's criteria based on the buyer's requirements. These intermediaries then contact the seller to discuss and negotiate the legal terms and terms of the transaction.

Problems faced in the traditional real estate industry:

Regardlessof whoever the intermediaries or middlemen be, they are always subject to the following limitations:



Transparency

A traditional transaction method is not transparent enough for the customers to trust [11]. All these middlemen or the intermediaries which are available in the market are working to make a profit and they don't care about either the seller or the buyer. They all have a common goal or a business strategy that steers them toward deals that generate the most profit. Such transactions are not always advantageous to buyers. These intermediaries have the option of limiting the options visible to the seller or prioritizing those that are more profitable to them. As a result, there is a good chance that the buyers will miss out on the property that is the best fit for them. The other main issue is the false promises given by the intermediaries, which in turn creates excitement among the buyers and it ends up in a loss for the buyers.

Reliability

There are numerous online scams happening these days. Buyers can easily be duped into purchasing a property that is not available or does not even exist if they have an impressive website and a few scam artists. Not all buyers are cautious enough to check these, and many do not have the funds to conduct background checks on these intermediaries. As a result, many legal suits have been filed, and a significant amount of money has been lost in these processes.

Transaction/ Intermediary cost

If the seller wishes to sell the property and the buyer wishes to purchase it, they should pay extra money to the middlemen or to the intermediaries as the fees or commission for their services. Often the fees charged by the intermediaries do not even justify the services offered by them. And instead of getting better deals and making the entire buying experience easier for the buyer and the seller, they end up doing more harm than good. Furthermore, in many cases, the broker collaborates with the seller to sell a property at a higher price than the market standard.

Slow overall process

It takes a few months for the buyer to decide and confirm the property which they are going to buy. If some intermediaries help in finding the right property, they will charge some money for helping them find which is unnecessary.

Even after finding the right property for them, it will take a few more months for them to complete the registration procedure due to the inefficient workflow which involves a lot of paperwork and manpower making it slow which can be avoided.

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2) Proposed work:

Real estate and asset transactions require a ton of paperwork to verify financial information and ownership and then transfer deeds and titles to new owners. Using blockchain technology and AI to record real estate transactions can provide a more secure, fast, and accessible means of verifying and transferring ownership. This can speed up transactions, reduce paperwork, remove the need of middleware or commissions, and save money. There is no possibility of downtime as it is decentralized and not dependent on a central server or a single entity.

The main concept of the proposed system is to provide an efficient, secure and user centric platform that focuses on the trading of physical assets like house, land, etc, to buy/sell/rent/lease through a decentralized network that is peer-to-peer (P2P) implemented using the blockchain technology. This blockchain technology can be paired with the indisputable use cases of the highly sought-after technology, Artificial Intelligence, to boost and enhance the user experience by providing smarter outcomes for users. By integrating the AI features of automatic price range prediction, chatbots and recommendation engine with the Blockchain based DApp for trading physical assets can provide a secure, transparent, smart, and peer-to-peer user experience. It enables the data of the users to be placed in a decentralized server instead of a centralized server managed by any organization which can manipulate the data.

Since it is not managed by any centralized server or organization, the data and the payment transactions made are decentralized and cannot be manipulated or even tampered. This blockchain system does not involve any extra transaction fee/commission. As it is integrated with AI for enhanced features it can result in an overall effective decentralized network handling (DAI) for this software platform. Distributes information-processing workloads across multiple devices instead of relying on a single central server. Each of these separate devices serves as a mini central unit that interacts independently with other nodes. Every buy/sell/rent/lease transaction is stored in a block which is linked with the previous block making it almost impossible to tamper due to the concept of hashing, providing security, confidentiality, and integrity.

Provides more security and privacy to the user's resources and data as it does not place user data in a server managed by a single entity. It instead stores data in blockchain or a peer-to-peer network which runs autonomously.

2.1)System Architecture:

The buyers and sellers must sign up for the platform to use the system, which includes various AI features such as price range prediction, a recommendation system, and a chat bot for queries. These AI features help the user with productive process flow.

Lessor and lessee will meet on the online platform, where everyone will have access to verified information about the property, such as ownership details, geographic location, chain of custody/ownership, and many other details. The marketplace or online platform can also be integrated with government systems, banks, or third-party verification companies to ensure the authenticity of the information and identity verification. This is a distributed peer to peer system which enables the user a unified interface to access throughout the process of buying/selling/renting real estate properties.

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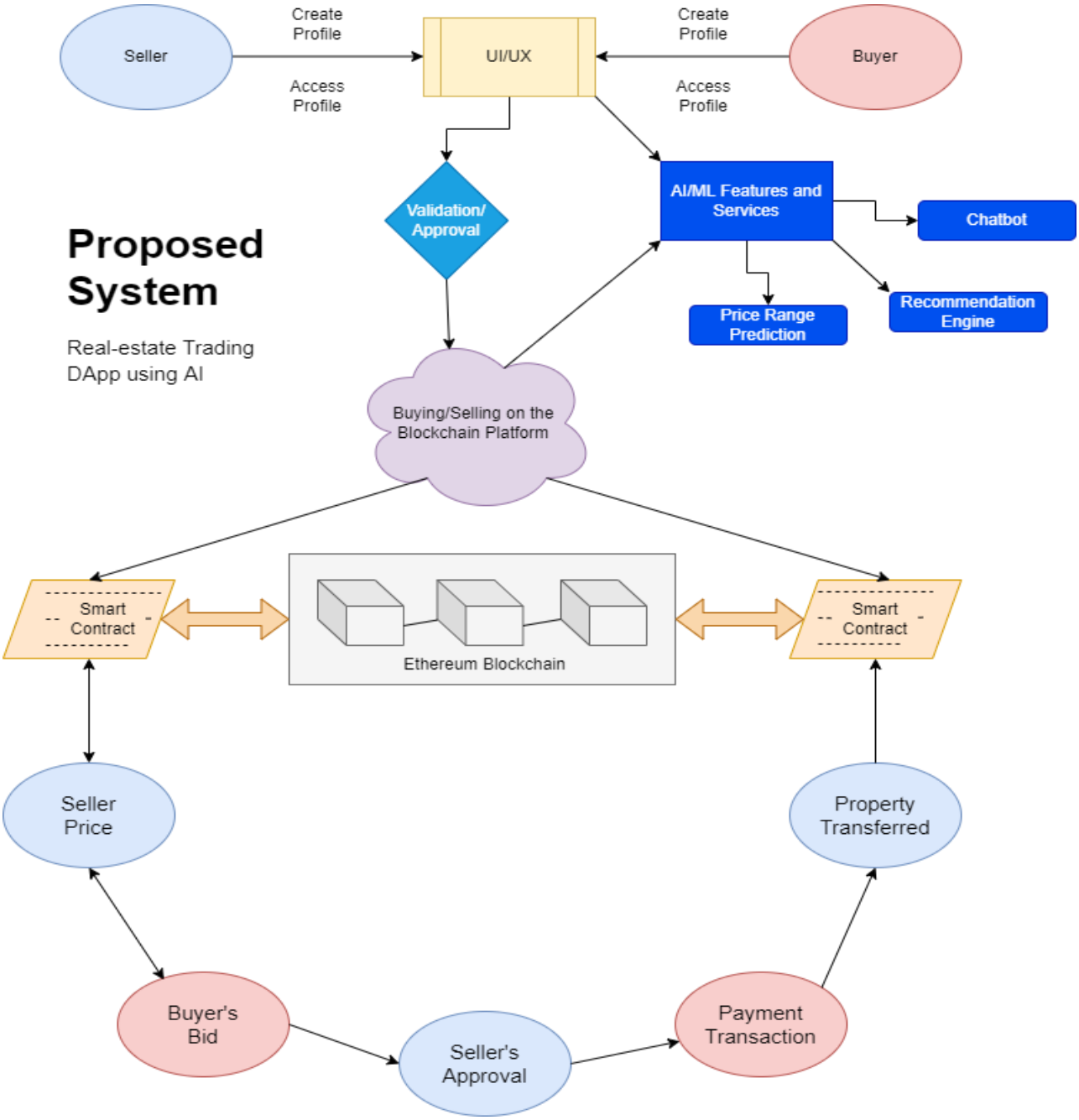

The DApp which can be accessed using various devices help in connecting the account of the users to the distributed network and enable a secure environment for the processes. The terms and conditions will be recorded in the Smart Contract once both parties accept the terms and agree to proceed with the agreement. Finally, the lease payout will be credited to the lessor's account based on the terms and conditions stored in the Smart Contract. All data will be time-stamped and recorded on the Blockchain network and is handled by the decentralized network. Thus, the newer blockchain real estate system with all these services and secure features is more efficient than the traditional real estate system depicted in the above diagrams.

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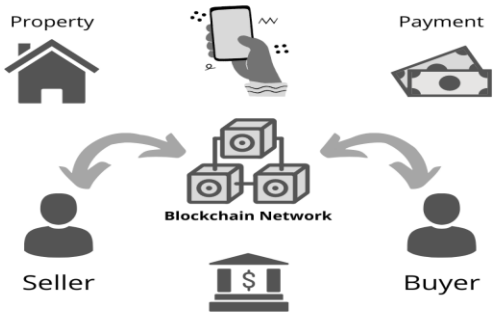

3) Implementation and Results:

Few of the platforms, tools and resources that can be used for the implementation of the outcome of the project are mentioned below: -

Domain: Blockchain and Artificial Intelligence (ML/DL)

Platforms: Vscode Editor, Colab, Ethereum Platform, DApp Build and Test Platforms

Languages: Python, C++, Javascript, Solidity, etc

Tools: AI/ML frameworks (TensorFlow, Pytorch, Keras, etc), React/Django/Flutter, Ganache, Metamask, Geth, Remix IDE, Truffle and other Blockchain Tools, NodeJs Project Management Tools (Trello, Jira, etc)

3.1)Implementation

3.1.1) Implementing the Blockchain Technology:

In our proposed system, the blockchain technology is used in terms of smart contracts.

Smart contracts:

One of the most significant issues with a traditional contract is the requirement for trusted individuals to carry out the contract's outcomes. Smart contract is a concept that implies that work can be completed and audited automatically without the need for a middleman. It is an agreement reached by two or more parties. It uses predefined functions to store data, process inputs, and write outputs. Most of the smart contracts are built on Ethereum Virtual Machines using high-level programming languages such as Solidity.

We can automate the transfer of assets between parties using smart contracts when a predefined set of conditions is met. Smart contracts define guidelines and associated penalties that are automatically imposed on process participants, eliminating the need for a third party. In our proposed system, smart contracts are used to automate the transfer of ownership between a buyer and a seller. It also uses the tokenization concept which allows the smart contracts to work more efficiently. As previously stated, several conditions which are mentioned in the smart contract must be met before the transfer of ownership can take place, such as the transfer of funds from a buyer to a seller etc.

3.1.2) Integrating Artificial Intelligence and Blockchain:

Artificial Intelligence in Real Estate has become inevitable in the recent past with advancement of the field and the ease of use for users. The AI features such as automatic price range prediction, chatbots and recommendation engine are implemented using the various algorithms such as conversational AI, regression, and dimensionality reduction algorithms. These features not only enhance the user experience but also provide a smart environment for the users.

The integration of AI and Blockchain affects many aspects, including Security – AI and blockchain will offer a double shield against cyber-attacks, provide better security, privacy, trust, management, and efficiency. AI can effectively handle a huge dataset and create newer scenarios, also can discover patterns based on data behavior and enhance the user experience of the DApp. Blockchain helps to effectively remove bugs and fraudulent data sets. New classifiers and patterns created by AI can be verified on a decentralized blockchain infrastructure and verify their authenticity, such as transactions. Integration of the Blockchain and AI is done by adding the features of the ML/DL algorithms into the base software system and combining them with the distributed P2P architecture of blockchain resulting in the outcome of the DApp.

3.1.3) Implementing the AI Price Range Prediction:

The price range prediction using the artificial intelligence (AI) algorithm that uses regression and LSTM techniques to predict the price ranges of the house properties or other real estate assets. Predicting the price of real estate assets is a tough challenge since very similar aspects have minute differences

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such as different specifications, resource, area, quality, demands, services, and facilities available etc. This AI/ML algorithm uses datasets, various packages that structure the data to create an efficient model to predict the price ranges. The algorithm will be able to predict the price more effectively as it learns from the inputs given by the users (both buyers and sellers).

3.1.4)Implementing the AI Recommendation System:

An artificial intelligence recommendation system (or recommendation engine) is a class of machine learning algorithm used to predict the users' choices and offer relevant suggestions to users based on the previous searches and activity of the user to suggest relevant real estate property choices. It is built as an information filtering system, uploading information tailored to users' interests, preferences, or behavioral history. It is able to predict a specific user's preference based on the data analysis of collective filters.

3.1.5) Implementing the AI Chatbot (Conversational AI):

Chatbot, in short for chatterbot, is an artificial intelligence (AI) feature that can be embedded and used to provide a support system through text-based help to the user's various queries and doubts regarding the purchase or renting of the real estate properties, platform related queries, services, etc. It is built with the IBM Watson Assistant which is based on deep learning, machine learning, and Natural Language Processing (NLP) models to facilitate the virtual agent trained using multiple data to provide the service.

3.2)Results

The outcome of the DApp on Trading Real Estate Assets platform using blockchain technology and artificial intelligence to buy/sell/rent the various real estate assets or properties using a unified user interface and user experience. The project platform interface is built in a structured manner such that the user can navigate through the DApp to access the various real estate, housing properties in the decentralized blockchain and interact with AI tools like the price range predictions for the properties, user centric recommendation system and chatbot by signing into the user account. This allows the user to access all the information and services to handle the processes.

This DApp will provide a unified platform that will enable the users for secure and privacy-based peer to peer network transactions, be it in payments, transfer of the properties, etc. Since it is based on Ethereum, it is secure, and each block of information handled by the smart contracts is literally impenetrable to external interference. The system is straightforward and efficient. Web 3.0 being the future of the Internet and this DApp will provide an excellent platform for real estate asset trading and transactions for many years to come in a secure, transparent, and decentralized aspect for the sellers and buyers. This could provide a tool for various other forms of broker-less, resource independent, other physical assets, new decentralized transactions by being a completely user centric and secure user environment due to its high reliability and no central control over the user data and information.

4) Conclusions

The Traditional Real Estate system is replaced with the Decentralized Application (DApp) through which the transactions and agreements can be made in a more efficient way. Moreover, it provides transparency and security which is of utmost importance in the present times. Some of the conclusions that can be made are listed below.

1. Blockchain provides a secure, fast, and reliable means of transferring the assets.

2. Artificial Intelligence makes it possible for the user to see the expected price and provides better suggestions based on the input from the user.

3. The overall process can be more environmentally friendly than the traditional system as it doesn't involve the transportation, manpower and paperwork that the traditional system needs. But it is equally important to know that the Blockchain needs a considerable amount of computational power to store

the transactions in each block which might be the only downside of a system using Blockchain.

4. Building DApps will take some time and effort but the outcome of a DApp is a purely peer to peer system that provides a secure way of transferring data without the intermediary which is always present in a traditional system.

5) Future Work

The implementation of Blockchain and Artificial Intelligence in the field of real estate will attract both the buyers and sellers due to the various advantages it comes along with.

Some of the work which will be done in the future is mentioned below:

1. Implementation of identity, document verification within the DApp with the help of Government agencies, services which further authenticates user legitimacy.

2. Creation of a new payment method which would use digital currencies to do transactions. It can be converted back into real money.

3. A token-based approach by which the sellers or buyers can also sell/buy a part of the property instead of getting it as a whole based on customer demand.

References:

[1] M. Nofer, P. Gomber, O. Hinz, and D. Schiereck, ‘‘Blockchain,’’ Bus. Inf. Syst. Eng., vol. 59, no. 3, pp. 183–187, Mar. 2017.

[2] Q. I. Xia, E. B. Sifah, K. O. Asamoah, J. Gao, X. Du et al., “MeDShare: Trust-less medical data sharing among cloud service providers via blockchain,” IEEE Access, vol. 5, pp. 14757–14767, 2017

[3] O. Novo, “Blockchain meets IoT: An Architecture for scalable access management in IoT,” IEEE Internet of Things Journal, vol. 5, no. 2, pp. 1184–1195, 2018

[4] A. Narayanan, J. Bonneau and E. Felten, Bitcoin and Cryptocurrency Technologies: A comprehensive Introduction. 1st ed. Princeton, New Jersey: Princeton University Press, 2016

[5] The total value of global real estate.https://www.savills.com/impacts/market-trends/the-total-value-of-global-real-estate.html

[6] Blockchain smart contracts: Applications, challenges, and future trends
ShafaqNaheed Khan, Faiza Loukil,ChirineGhedira-Guegan, ElhadjBenkhelifa&Anoud Bani-Hani. Peer-to-Peer Networking and Applications volume 14, pages2901–2925 (2021)

[7] Decentralized Applications: The Blockchain-Empowered Software System, Digital Object Identifier 10.1109/ACCESS.2018.2870644, WEI CAI 1,2, ZEHUA WANG2,3, JASON B. ERNST3, ZHEN HONG2, CHEN FENG 4, AND VICTOR C. M. LEUNG 2 (Members and Fellows, IEEE)

[8] S. Nakamoto. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System. [Online]. Available: https://bitcoin.org/bitcoin.pdf

[9] S. Raval, Decentralized Applications: Harnessing Bitcoin’s Blockchain Technology, 1st ed. Newton, MA, USA: O’Reilly Media, 2016.

[10] K. Christidis and M. Devetsikiotis, ‘‘Blockchains and smart contracts for the Internet of Things,’’ IEEE Access, vol. 4, 2016.

[11] A. Jeppsson and O. Olsson, ‘‘Blockchains as a solution for traceability and transparency,’’ Packag. Logistics, Lund Univ., Lund, Sweden, Student Paper, Tech. Rep., Jun. 2017.

[12] Machine Learning adoption in Blockchain-based Smart Applications: The challenges, and a way forward, Sudeep tanwar ,Qasimbhatia , Pruthvipatel , Aparna kumari , Pradeep kumarsingh , Wei-chianghong , Senior member, IEEE.

[13] Artificial Intelligence and Machine Learning: Current Applications in Real Estate
by Jennifer Conway, 2010, University of California, Berkeley.
https://dspace.mit.edu/bitstream/handle/1721.1/120609/1088413444-MIT.pdf

[14] How Machine Learning can be used with Blockchain
Technology:https://analyticsindiamag.com/how-machine-learning-can-be-used-with-blockchain-technology/

[15] R. Manjula, Shubham Jain, Sharad Srivastava and Pranav Rajiv Kher, Real estate value prediction using multivariate regression models, Materials

Science and Engineering Conference Series, volume 263, issue 4, Posted: 2017 https://iopscience.iop.org/article/10.1088/1757-899X/263/4/042098

[16] House Price Forecasting Using Machine Learning, Proceedings of the 3rd International Conference on Advances in Science & Technology (ICAST) 2020, Posted: 3 Apr 2020, Alisha Kuvalekar, Shivani Manchewar, SidhikaMahadik, ShilaJawale. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3565512

[17] Conversational AI - Watson Assistant: The Shortcut to Great Customer Service. IBM, Published: 2018. https://www.ibm.com/watson/au-en/call-center-ai/thought_leadership/pdf/White-Paper-Watson-Assistant-2018.pdf

[18] Recommender Systems in the Real Estate Market—A Survey. Gharahighehi, A.; Pliakos, K.; Vens, Appl. Sci. 2021, 11, 7502. https://doi.org/10.3390/app11167502