Applicability of Smart Contracts for Real Estate: A literature review

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Abstract— Entering the world of blockchain and smart contracts by companies and institutions in electronic dealings at the international level has received extensive attention recently. smart contracts used to automate the execution of an agreement between participants without any intermediary's involvement. However, there are several security issues with existing smart contract platforms. In this paper, we conducted a literature review of current research within the area of smart contracts within blockchain technology to explore how it is implemented to improve security and Internet of Things (IoT). This study relies on the collection and analysis of identified literature from various scientific libraries such as IEEE, Elsevier, Emerald, etc. We presented nine specific topics regarding to how blockchain-based smart contracts are implemented to improve security and IoT. The most important of what we could get out of these scientific studies is that the smart contract based on blockchain technology became one of the most important characteristics of a modern economy and digital transformation in recent years, with the heavy reliance that is increasing day after day use blockchain and smart contracts.

KEYWORDS—Smart Contracts, Real Estate, Ethereum, Blockchain, literature Review, Securing real estate.

I.   Introduction

In the recent decade, there has been interested in applications Blockchain, and the concepts of bitcoin [1]. Blockchain was first proposed in 2008 by someone using the pseudonym Satoshi Nakamoto, who described how cryptology and an open distributed ledger can be combined into a digital currency application [2]. The driving force behind the interest in Blockchain research has been its key characteristics provide anonymity, security, and integrity without counting on trusted third-party organizations [3].

Digital transformation is an ongoing trend in all economies and financial systems [4]. In recent years, there has been an increasing interest in blockchain technology that based on cryptog

raphy. Blockchain is a distributed database and general ledger, on which information about all virtual currency transactions, contracts or assets are recorded and made publicly available [1]. The data are stored and sealed with a timestamp, encrypted together, and then a hash value will also be generated and stored in a data block [5]. Blockchain can not be changed or erased easily because of a cryptography technology that blockchain based on. Blockchain is a chain of blocks that contain information which is completely open to anyone. The sender sends encrypted messages by Public key which can be decrypted only by the use of a private key of the recipient.

Entering the world of blockchain, and smart contracts is one of the most important characteristics of a modern economy and digital transformation in recent years. With the heavy reliance that is increasing day after day use blockchain and smart contracts [6].

In this paper we hold out a literature review to identify and examine the existing researches specifically related to Blockchain-based smart contracts for real estate, to explore how it is implemented to improve security and IoT.

II.   Background

Blockchain usage was restricted to cryptocurrencies only, however, with coming of Ethereum that supports the creation and execution of smart contracts, applications beyond cryptocurrencies are being developed and explored. [7] Smart contracts is a self-executing contract with the terms of the agreement between buyer and seller, the contract specifies pre-programmed contractual rules so that its execution takes place when input data meets the stated conditions. Smart contracts are electronic contracts can be described as the digital replacement of the traditional verification of legal documents. Contracts are written in one of the programming languages directly suited for such computer programs, such as Solidity [8]. Use a cryptographic hash algorithm (SHA 256), across a distributed, decentralized blockchain network, the code controls the execution, and transactions

are irreversible and trackable, smart contracts permit trusted transactions and agreements to be distributed among disparate, parties without the requirement for a legal system or central authority.

The following is a list of the architectural components presented in Figure (1).

- Transaction is requested.
- Block that represents the transaction is created.
- The block is sent to every node in the network.
- Node validates the transaction.
- The block is adding to the existing blockchain.
- The transaction is complete.
- Bloch header consisting of block number, metadata such as identification number, reference number, creation-time, date.
- Previous Bloch number, every block refers to the preceding block within a chain and enables all associated blocks to view the complete history.
- Nonce is the result of the transaction with the assistance of a cryptographic hash algorithm (SHA 256) after encryption and data validation.
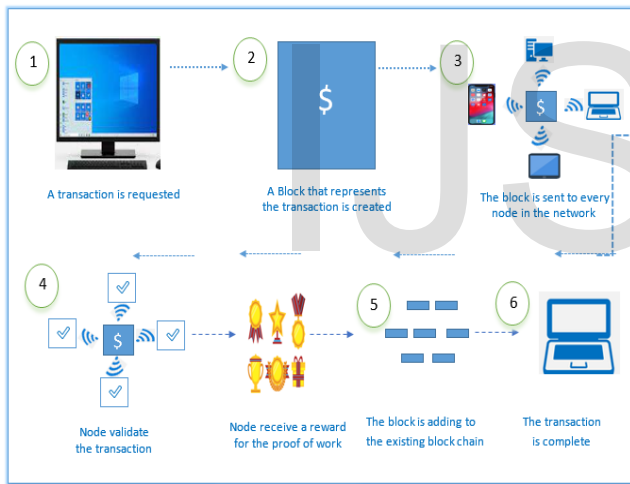

Figure (1): Blockchain ARCHITECTURE DIAGRAM

Smart contracts have proved to be a huge success for real estate, smart contracts have allowed properties to be digitally transferred from one internet user to another in a way that the assets remain safe and secure, it very difficult for any outsider or hacker to hack it or manipulate the message, anybody can buy or sell any real estate asset and sign all the legal documents from your screens, blockchain technology could play a vital role in real estate, Smart cities in future [9].

III.   Research methodology

The aim of this research is to carry out a literature review of current research within the area of smart contracts within blockchain technology. We aim to analyze and discuss existing studies, collect their findings, and summarize the empirical evidence

regarding the applications of blockchain and smart contracts, to identify the importance of blockchain- based smart contracts.

Some previous studies related to the subject of the research have been reviewed and discussed (e.g., dissertations, conference proceedings) and the most important of what we could get out of these scientific studies is showing how to make an integration between this study, and the previous studies are arranged from the newest to the oldest.

The Literature review relies on an electronic advanced search conducted in 2021 using IEEE, Elsevier, Emerald, Science Direct, Springer Link, and the available books related to the study.

The search criteria focused on blockchain-based smart contracts and the review was limited to articles published between 2018 and 2021. For this research, a Boolean search strategy developed using keywords related to smart contracts OR real estate OR land registration OR Ethereum, blockchain OR systematic literature review OR securing real estate.

A study was included in this review if it met the following inclusion criteria: (1) full-text research or review paper published in English between 2018 and 2021, (2) The paper should study, the effect of real estate registration using blockchain technology and exchange of property and money and Regulation of the real estate market, the original owner's knowledge, and the unit's hierarchy.

IV.   Results

The full text of 300 articles was reviewed, and 270 articles were excluded. After several rounds of screening and selection, finally, 30 papers were relevant to the review.

Table 1 lists the summary of selected studies by phase, and table 2 lists the summary of articles reviewed by year.

We presented the meta-analysis regarding to how Blockchain smart contracts are implemented to improve security and IoT, and the different studies have been classified into nine categories as shown in table 3. Each paper is summarised by research objective, research methods, and the data is collected through the smart contract's actors. Tables from (4) to (12) summarizes the results regarding to each category of the selected studies.

Table (1): Summary of selected studies by phase.

Source	Returned	Filter 1	Filter 2
IEEE	2,856	115	9
Science Direct	1,526	60	2
Elsever	821	35	4
SpringerLink	671	55	6
Emerald	326	24	5
CMC	60	5	1
MPRA	56	4	1
IOT	34	2	2
Total	**6,350**	**300**	**30**

Table (2): Summary of articles by years

Years	Articles	Percentage

2018	6	20%
2019	11	36.5%
2020	11	36.5%
2021	2	7%

Table (3): Categories of resrach studies

No.	Category	References	No. of articles
1	Smart Contracts and Management	[10] [11] [12] [13] [3] [14] [4] [15]	8
2	Smart Contracts and IOT	[16] [17] [18] [1]	4
3	Smart Contracts and Arcnhitecture	[19]	1
4	Smart Contracts and legality	[20] [21]	2
5	Smart Contracts and security	[22] [23] [24] [25] [6] [26]	6
6	Smart Contracts and Constraints	[27]	1
7	Smart Contracts and Machine Learning	[28] [29]	2
8	Smart Contracts and Use Cases	[30] [9] [31] [32]	4
9	Smart Contracts and Platform	[33] [34]	2

4.1 Blockchain: Smart Contracts and Management

[10] studied the impact of applying blockchain technology to the real estate sector in Karachi, Pakistan, concentrates on the blockchain being used for real estate record-keeping, since most geographies have different procedures for record-keeping. The authors utilized a questionnaire that filled by subjects who are either working in the real estate sector in Karachi or are investors, people who are currently working on blockchain technology in Pakistan also as people within the fintech space working. The results showed that the use of the blockchain has an impact on the real estate sector in Karachi, Pakistan. The authers provided recommendation to the government of Pakistan which should take serious note and should apply blockchain technology

to the real estate sector so that it is transparent for the general population of the country as well as departments who are stakeholders in the real estate sector.

[11] highlighted blockchain technology and various important aspects of property transactions like transparency, security, and price reduction. The authers used quantitative research method, the questionnaire was distributed to 1,000 people from buyers and sellers. The authers analyzed the connection between the blockchain technology and other research variables like transparency, security, cost reduction and measured the impact of independent variables (IV) like the rise of knowledge availability and accessibility of land transactions, reduction of data asymmetry, easy verification of transactions, comprehensibility of the transaction, data accuracy and reliability, data inalterability, exclusion of false information from contractual. Study results indicated that the buyers and sellers perceive that transparency and price reduction have the highest influence on adopting blockchain technology during a property transactions system, followed by the safety of transactions.

[12] presented a summary of the agreement pipeline and compared the implementation of auction agreements purely on the blockchain with a hybrid approach where markets are active agents. The authors utilized an agent Process Modeling (APM) framework to deploy a multi-agent simulation-based business process modeling and a cloud-native environment. They used more complex templates for various domains such as smart grids, logistics, and transportation. The authers also have proposed a hybrid approach combining multi-agent systems and smart contracts that could allow placing regulation mechanisms. Their result showed that the value of the contract increasing with the amount of negotiations for the fat contract, but not for the hybrid, which maintains an almost linear cost throughout the experiment.

[13] highlighted that the important estate transaction process in South Africa is ineffective and causes more problems thanks to increasing reliance on third parties and manual processes, which ends up in high transaction costs and a prolonging of the time during which property transactions are completed. The researchers used two models, the primary model illustrates the current (traditional) South African property transaction process and the second model illustrates the way to use blockchain technology. Their results showed that using land with blockchain leads to more efficient transactions, reduces costs and third parties, and reduces transaction time.

[3] performed a systematic literature review, and presented solutions to tackle software engineering specific challenges related to the development, test, and security assessment of blockchain-oriented software. The authers reviewed papers (that appeared in international journals and conferences) concerning six specific topics: smart contract testing, smart contract code analysis, smart contract metrics, smart contract security, Dapp performance, and blockchain applications. The authors analyzed 96 articles (written from 2016 to 2020), and used Google Scholar,

IEEE Xplore, Papers published in scientific international journals, and proceedings of international conferences. The different studies are classified into six categories, the primary four concern smart contracts and consider the aspects of testing, security, analysis, and metrics concerning the source code after analysis for each paper that passed the quality assessment.

[14] studied and summarized the Russian and foreign practices of using blockchain technology, as well as determining the main ways and options for its further development and improvement, as a highly effective and financial and economic mechanism for participants in real estate transactions. The authors utilized general scientific research methods, such as analytical economic and statical methods, methods of complex economic and logical analysis, system approach, comparison of generalization. Their results showed that the rationale for the use of blockchain in real estate arises from the advantages of the technology itself, namely high transaction speed, low costs, and security, the need for realtors, lawyers, and companies to deposit funds are reducing, therefore, fees and payments to intermediaries, as well as the possibility of other people's mistakes is excluded.

[4] investigated the security issues of blockchain based transactions in 5G mobile networks and proposed a methodology for policy specification and verification of financial transactions based on smart contracts in next generation mobile networks to protect customer data from possible compromise and threats. The authors designed a formal model FPM-RBAC and analysed policies for smart contracts based on security policy rules, by using smart contracts in 5G networks. Their results showed importance of study which use the cryptocurrency application, mobile digital payment, by blockchain applications and smart contracts in 5G networks in the financial transactions.

[15] proposed and designed formulation to record real estate transactions in a private blockchain, using smart contracts. The authors highlighted registration real estate problems such as high transaction fees, a lack of transparency, fraud, and the effects of a middleman including undue influence and commissions, and one such area that's ready to reap the advantages of blockchain technology is that the property industry. The authors utilized a layered architecture approach in their system, which consists of four layers: User interface layer, Control layer, Service layer, and Data layer which consists of a blockchain, and acts as a database for the whole system. Their results showed that the immutability of the blockchain ledger and transactions can provide a safe space for the real estate business, personal digital keys are provided to parties that are involved during a contract, thus minimizing the danger of fraud as well, and digital payment mechanisms.

4.2 Blockchain: Smart Contracts and IOT

[16] discussed how smart contracts and blockchain technologies create the potential for a viable solution, and presented smart contract-based solutions that improve security and information management, and identified new opportunities and challenges.The authors designed a model for smart contracts based on blockchain technology which is a programming language class with fields and methods users can interact with the public fields and methods of this class by sending transactions to their "address" in the blockchain. Study results showed that developers should be able to integrate internet of Things (IoT) into their systems and processes, as well as to offer innovative, sustainable services, expected to live in different "domains" and "contexts" during its lifetime, (IOT) will create opportunities for new, exciting applications which will interweave the physical with the cyber world, creating of significant amounts of information.

[17] developed a decentralized application (DApp) based on blockchain technology for sharing Internet of Things (IoT) sensors' data, and demonstrated various challenges addressed during the development process, and the application is a platform for sharing (selling and buying) for measurements of IoT weather sensors and operates on the Ethereum blockchain, which is an IoT sensor data marketplace.Their results showed that blockchain technology provides the users with the ability to perform P2P transactions on the Ethereum blockchain using cryptocurrencies and finding ways to maximize the value of data generated by IoT sensors.

[18] designed a Framework and registration a decentralized way to manage internet of Things (IoT) applications data, in smart cities and to shed light on the challenges, risks, and opportunities of using blockchain in environments where intensive data collection. The authors analyzed the risks and challenges that IoT data management currently faces, including privacy issues and data security problems, smart contracts could be flexibly designed and implemented to achieve different data management policies, a condition that is critical to complex interorganizational environments in the public sector. Their results showed IoT data, in particular, enable the smart city vision by allowing for the collection, storage, integration, analysis, and mining of great volumes of data and secure and manage data produced by sensors, cameras, and other devices, produce a variety of intelligent applications.

[1] performed a systematic literature review to realize the specified goals and, highlight some challenges and future research directions within the field of Blockchain smart contracts application in securing Internet and IoT. The authors collected a pool of 77 primary studies associated with Blockchain smart contracts application in securing Internet generally and IoT especially published until early 2020 within the major databases were: IEEE, Springer, ScienceDirect, ACM Digital Library. Their results showed findings reveal that the foremost common smart contract-driven security services include access control, authentication, integrity assurance, data protection, secure key management, and non-repudiation. This study also revealed that Ethereum was the foremost commonly used Blockchain platform for designing smart contract-driven security solutions, followed by Hyperledger Fabric.

4.3 Blockchain: Smart Contracts and Arcnhitecture

[19] proposed an elastic, and cost-effective data carrier architecture for smart contracts in a blockchain-enabled IOT environment that needs communication with external off-chain data, without subscribing any filter at Ethereum node. The proposed architecture helps developer to deploy decentralized and secure blockchain application, provide an Oracle contract on the blockchain. The authors designed data carrier architecture for a smart contract in a blockchain-enabled IoT environment to interact with the surface data sources, consists of three components: Mission Manager, Task Publisher, Worker. Mission Manager consists of front and rear, Task Publisher will perform four phases action for every block pended, including collect transactions on Ethereum node, filter the unconcerned transaction, decoding, and send generated task for publishing, and Worker is liable for retrieving data consistent with the task sent by Task Publisher, encoding data with application binary interface. Their results showed that the proposed data carrier system is demonstrated more efficient, elastic, and cost effective.

4.4 Blockchain: Smart Contracts and legality

[20] highlighted how to use blockchain tokens to represent real estate titles, tokens on the blockchain as a technological concept is the closest solution to the legal concept of titles because it provides evidence of ownership.   The authors developed the concept of a high-level design of the technology, capable to manage title rights on the blockchain which includes three-level mechanisms.
(1) Smart-contract templates which are based on smart laws, that allow people to manage their title rights online. (2) E-voting, which provides for a democratic implementation of governing algorithms.
(3) Smart Laws, as the concept of high-level "smart" algorithms. Their results showed that there are certain issues that need to be addressed like inheritance procedures, litigation, guardianship, a delegation of rights and rights of third parties (liens and encumbrances) as well as the legal concept of a bundle of rights (possession, disposition, enjoyment, etc.), which requires a strong mathematical model.

[21] explored prospective challenges, limitations, and opportunities in the real estate sector and how the traditional intermediaries have to face a possible implementation of this technology. In a standard European wide real estate transaction as a consequence these agreements are usually time-consuming and involve extra difficulties to cross-border operations. The authors performed analyses of the current intermediaries in the real estate sector in the European Union (EU), their functions, and how can blockchain strengthen the security of these transactions while reducing their time, uses a legal methodology to approach. Their results showed that Blockchain, combined with smart contracts may improve procedures, allow EU transactions and the interconnection between public administrations, however, to not reduce parties rights, this blockchain should have some special features, such as the possibility of being amended.

4.5 Blockchain: Smart Contracts and security

[22] presented a blockchain-based solution and framework for a proof of delivery (PoD) of digital assets. The authors designed, implemented, and fully tested the proposed framework with various mechanisms and algorithms to automate payment in Ether, handles disputes and sets penalties to incentivize participants to act honestly, and use the IPFS decentralized file system to ensure the integrity of the agreement form between the parties is well maintained. The results showed that the blockchain-based solution leverages key features of blockchain and Ethereum smart contracts to provide immutable and traceability Ethereum smart contracts, and addresses key security requirements, and how it is secure against popular attacks such as Man In The Middle (MITM) and replay attacks.

[23] discussed the shift towards the digitization of registering lands, and so the requirement to use Blockchain instead of traditional storage technologies. The authors implemented a buyer and seller's protocol on ethereum platform via utilization of smart contracts using blockchain technology and the programming language called Solidity and store documents in a distributed file system like IPFS (InterPlanetary File System) and presented a user interface instead of a command-line application to make these transactions. Their results showed that ethereum platform where the transaction of land has happened between sellers and buyers ensures the immutability of data and hence the transaction records can be used to trace the history of the land.

[24] designed decentralized storage system Interplanetary File System (IPFS), Ethereum service, and presented the system architecture and design details with entity relations, sequence diagrams, and algorithms used for Ethereum smart contracts to control transactions among participants.The authers highlighted that spread fake digital contents recent years, fake footage, images, audios, and videos could be a frightening and dangerous phenomenon, possibly modifying truth, and eroding confidence by making false realities. Their results showed that the proposed blockchain-based solution and a generic framework ensures the proof of authenticity of digital assets that may include videos, audio, images.

[25] studied smart contracts as a key component of distributed ledger technology, and conducted a systematic review of smart contracts history, supporting platforms, programming languages, security, performance, and decentralized applications. The authers searched for papers from different online databases based on the designed research questions and selected 90 papers based on their relevance and quality. The authers performed a survey of decentralized applications, and they have presented seven different categories for smart contract-based applications, the problems with the focus on smart contract structure and purpose. the research studies have been presented in three main categories: 1) decentralized applications based on smart contracts 2) security methods and tools; 3) security methods and tools. Study results highlighted smart contracts, analysis, and measuring the performance of different blockchain platforms.

[6] focused on smart contracts vulnerabilities and analyzing attacks and protections. The authors utilized the approach of analyzing the 7 most important attack techniques to determine the real impact on smart contract technology (reentrancy – smart contract overflow and under overflow – short address attack – delegate call – default visibilities – transaction ordering dependence – timestamp dependence). Their results showed the vulnerability occurred due to bugs in the code where the developers did not consider the potential for a recursive call and study contributions and they explored 10 major security analysis tools which are in place to end vulnerabilities in the smart contract (Slither – MythX – Manticore – security analyzer – SmartCheck – Echidna – Oyente- Vandal - Zeus).

[26] reviewed the different shortcoming, to resolve the issues of traditional manual systems like delay in transaction, fraud, security, and persistence of records, with a focus on authentication threats in the traditional land registry system, analyzing how blockchain and blockchain-based authentication schemes can be applied to solve the issues related to land transaction and authentication. The authors proposed a blockchain-based authentication scheme for secure real estate and land transactions for the records provided by the registry, and more transparent that does not require a different mechanism for trust management, the trust is achieved by making the land records accessible and cataloged for each user, any user can ask for record details, and the registry will provide the user with digital signatures. Their results showed that the proposed scheme introduces an open catalogue of accessible land registry records that will resolve the authentication issues in the land registry system.

4.6 Blockchain: Smart Contracts and Constraints

[27] studied possibilities of use blockchain and distributed ledger technologies (DLT) and the applicability of those technologies for various purposes in property, with the main focus on title rights and property registration publicly databases. The authors designed a framework that focuses on property rights, land registration regulatory framework and knowledge and communication technologies innovations, analysis of blockchain, and DLT within the context of land and land title registration. Their results showed the constraints of the technology's properties and land registration even though technological limits are known in more specific technical sources the presented outcomes can be laid down as requirements for the technical protocols aimed at addressing the issues of DLT and public policies to put blockchain at the service of society.

4.7 Blockchain: Smart Contracts and Machine Learning

[28] introduced a data trading mode based on the smart contract using blockchain and machine learning and traceability of blockchain, the programmability of smart contract, and the verification of data availability and proposed a challenge-response mechanism between the info purchaser and therefore the data owner, an off-chain download mechanism between the info purchaser and therefore the data storage service provider. The authors designed a smart contract using the Solidity programming language and implementation and testing of the smart contract, and data owner's authentication and authorization, data purchaser's authentication and authorization of downloading data off-chain, dispute handling during data trading, automatic payment of trading completion, penalty setting of dishonest behavior are all controlled by various mechanisms and algorithms, which have been programmed in the Remix IDE and tested in the Ethereum wallet. The results showed that the proposed solution and framework of the data trading model based on smart contracts using blockchain and machine learning is able to protect the rights and interests of the data owner and promote the development of data trading.

[29] proposed an optimization algorithm for generating business process smart contracts for reducing the consumption of gas during the execution of smart contracts. The authors designed (BPMN) business process modeling notation for existing executable business processes, write the optimized Smart contract template while ensuring the integrity of the original business process, using new mapping rules from business process modeling notation solidity language, BPMN model is generated into Ethereum Smart contract model. The proposed method can effectively reduce gas consumption of business process intelligence contracts on the blockchain.

4.8 Blockchain: Smart Contracts and Use Cases

[30] proposed a detailed design of smart contract and then and examined a use case for renting business and residential buildings. Development of different use cases using blockchain technology was conducted through three things (analysis, design, implementation). In the analysis phase, the authers collected and analyzed the requirements of the blockchain application to be developed, Identified the entities/parties involved, their roles, and relationships. In the design phase, they modeled the entity attributes as state variables and functions. In the implementation phase, the authers implemented the smart contract in a high-level programming language such as Solidity. Study results showed that the smart contract provides a secure, distributed, and shared decentralized ledger of all assets and transactions between landlord and tenants, the blockchain becomes the enabler for the development of a paperless layer for all city transactions, in a secure fashion for the optimum management of the smart city's assets.

[9] highlighted smart contracts within blockchain technology because traditional transactions are costly, and may result in security problems since they're one point of failure. The authors provided a broad perspective on their problems and corresponding solutions presented the research trends within the world and compiled the 64 papers identified, grouped by top publication sources, channels, methods, and approaches. Their results showed the foremost commonly discussed problems and solutions within the literature are associated with the safety, privacy, and scalability of blockchain so as to mitigate those problems, and therefore the programmability of smart contracts.

[31] studied and analyzed the various use cases of Smart

Contracts in different domains like digital Identity storage, Healthcare, Finance, Self-Sovereign Identity, Governance, Logistics Management. The authors designed a model which may be used in the future. Records are stored in a database using smart contracts which are safe and secure using encryption algorithms like the AES 128, 192, or 256-bits algorithm and using digital signatures. The proposed model incorporates the features of digital Identity storage, Healthcare, Finance, Self-Sovereign Identity, Governance, and Logistics Management to reduce the amount of paperwork involved, and also help invalidation of data. The authors also proposed one solution for natural disaster management by integrating digital identity, policies, and blockchain technologies by smart contracts, which can be used effectively for providing relief to victims during times of natural disaster. Their results showed that smart contracts in healthcare domain provide a secure, fixed, and open environment for all the participating parties and help in the development of the digital healthcare industry using new advanced communication tools.

[32] developed a blockchain application that can improve the transaction process of office buildings in the Netherlands because the registration in the past takes a lot of time due to difficulty to define the characteristics of a property, lack of data structure, and quality. Multiple parties were interviewed to define major details within the method and therefore the interview findings are used to design a blockchain solution and validate the proposed model. Their results showed blockchain solution overcomes weaknesses in traditional registration and improves the transaction process of office buildings in the Netherlands and the way specific assets are understood by structuring physical and contractual information in one place. Using blockchain mechanisms ensures the quality of data, and indicates that blockchain technology which could lead to improvements in efficiency, transparency, and trust within the transaction process, through cryptography, consensus mechanism, and validity rules.

4.9 Blockchain: Smart Contracts and Platform

[33] provided an approach for Real Estate Asset tokenization by using Ethereum, thus making it secure, and efficient, the tokens are issue initially through a security token offering and using smart contracts. The authors proposed a common platform where the asset owners can be connected with the investors every Real estate owner, as well as the investors, will have to register on the platform. A Know Your Customer (KYC) and Anti-money laundering (AML) verification for each user registered on the platform would be conducted through a third-party provider basic details regarding the User's identity need to be submitted by the user electronically to the platform, once the KYC and AML requirements are satisfied, the user will be ready to access the services of the platform. Their results showed that the tokenization of assets which refers to the process of issuing a blockchain token, specifically, a security token, that digitally represents a real tradable asset, introduces many benefits which are: – Liquidity by tokenizing assets – Faster and cheaper transactions – Transparency – Accessibility.

[34] analyzed the current status of real estate transactions in China and put forward some shortcomings. The authers proposed a real estate transaction platform based on blockchain. The Hyperledger Fabric platform is used to effectively connect sellers, purchasers, government departments, and financial institutions. Their results showed that the seller can directly release information about the real estate sale, the information about real estate is obtained from the registration department system database, which ensures the accuracy and comprehensiveness of the information viewed by the purchaser through the platform because of the decentralization of the blockchain, purchasers, and sellers can directly trade, the traceability and irreversibility of the contract can be guaranteed, which makes it possible to find out the real estate in the future

Table (4): Summary of smart contracts and management category

SUBJECT	AUTHORS	JOURNAL	YEAR	OBJECTIVE	METHOD, TOOLS, TECHNIQUE	RESULTS AND CONTRIBUTES
Real Estate Management via a Decentralized Blockchain Platform	Ahmad, I et al.	CMC	2021	Design a model to record real estate transactions in a private blockchain, using smart contracts.	A layered architecture approach which consists of four layers.	The immutability of the blockchain and transactions can provide a safe space, thus minimizing the risk of fraud, and digital payment mechanisms.
Policy specification and verification for blockchain and smart contracts in 5G networks	Devrim Unal, et al.	Elsevier	2020	Verification of financial transactions based on smart contracts in 5G.	Designing FPM-RBAC model and analyzing of policies for smart contracts based on security policy rules, by using smart contracts in 5G.	Proposes to utilize the cryptocurrency application, mobile digital payment.
A systematic literature review of blockchain and smart contract development: Techniques, tools, and open challenges	Vacca, A, et al.	Elsevier	2020	Reviewing international journals and conferences concerning smart contract testing, code analysis, metrics, and security.	A systematic literature review through analyzing 96 articles written from 2016 to 2020.	Consider the aspects of testing, security, analysis, and metrics relating to the source code.
The blockchain technology in real estate sector: Experience and prospects	Pankratov, E., et al.	IOT	2020	Studying and summarizing the Russian and foreign practices of using blockchain technology.	Scientific research methods, analytical and statical methods, and methods of complex economic and logical analysis.	Using blockchain in real estate leads to high transaction speed, low costs, and security.
Business Process Models of Blockchain and South Afrcan Real Estate Transactions	Jack Laurie, et al.	IEEE	2019	examines two approaches to executing real estate transactions; the South African case and an international blockchain technology use case.	Two conceptual models are presented using Business Process Modelling and Notation. (BPMN).	Using land with blockchain leads to more efficient transactions, reduce costs and third parties, and reduce transaction time
Study of factors influencing the decision to adopt the blockchain technology in real estate transactions in Koso	Hoxha, V., & Sadiku, S.	Emerald	2019	Study the relationship between blockchain technology and various important aspects of real estate transactions such as transparen-	A questionnaire was distributed to both buyers and sellers and the study included 1,000 people.	Blockchain technology can increase the trust between parties and improve real estate transactions.

Subject	Authors	Journal	Year	Objective	Method, Tools, Technique	Results and Contributes
				cy, security, and cost reduction.		
Regulating Blockchain Smart Contracts with Agent Based Markets	Thiago R., et al.	Springer	2019	presenting an overview of the agreement pipeline and comparing the implementation of auction agreements purely on the blockchain	A hybrid approach combining multi-agent systems and smart contracts (APM) that could allow placing regulation mechanisms.	Solve many problems involved in digital property recognition, and enabling the traceability of transactions.
The Impact of Blockchain Technology on the Real Estate Sector Using Smart Contracts	Muhammad Mansab., et al.	MPRA	2018	Determine the impact of applying blockchain technology to the real estate sector in Karachi.	A questionnaire was filled, and the data collected and analyzed using SPSS.	The use of the blockchain has an impact on the real estate sector in Karachi so that these transactions can be taxed accurately.

Table (5): Summary of smart contracts and legality category

Subject	Authors	Journal	Year	Objective	Method, Tools, Technique	results and Contributes
Applicability of Blockchain smart contracts in securing Internet and IoT: A systematic literature review	Lone, A. et al.	Elsevier	2021	Collect and summarize the empirical evidence regarding the application of Blockchain, smart contracts, and securing IoT.	A systematic literature review through collecting 77 studies based on the quality assessment criteria, and meta-analysis Blockchain, smart contracts.	Ethereum platform is the most commonly used designing smart contract, security solutions, and Hyperledger Fabric.
Using Blockchain Technology to Manage IoT Data for Smart City Initiatives: A Conceptual Framework and Initial Experiments Based on Smart Contracts	Fan, L., , et al.	Springer	2020	Providing a decentralized way to manage (IoT) applications data, in smart cities, sheds light on the opportunities, risks, and challenges of using blockchain technology.	A Conceptual Framework and Initial Experiments Based on Smart Contracts	IoT data allow the smart city for the collection, storage, integration, analysis, security, data produced by sensors, cameras.

Smart Contract for the internet of things: Opportunities and challenges	Fotiou, N., et al.	IEEE	2019	discusses how smart contracts and blockchain technologies create and the potential for a viable solution and improving information management.	Designing smart contract-based solutions that improve security and information management.	Developers are able to integrate internet of Things (IoT) into their systems and processes, as well as to offer innovative, sustainable services.
Implementation of smart contracts for blockchainbased IoT applications	Papadodimas, G., et al.	IEEE	2018	Creating a decentralized application (DApp) based on blockchain technology for sharing Internet of Things (IoT) sensors and operates through smart contracts that are executed on the Ethereum blockchain.	Designing decentralized applications (DApp) based on blockchain technology.	Ability to perform P2P transactions on the Ethereum blockchain using cryptocurrencies, finding ways to maximize the value of data generated by IoT sensors.

Table (6): Summary of smart contracts and arcnhitecture category

SUBJECT	AUTHORS	JOURNAL	YEAR	OBJECTIVE	METHOD, TOOLS, TECHNIQUE	RESULTS AND CONTRIBUTES
Elastic and cost-effective data carrier architecture for smart contract in blockchain	Jack Xiaolong Liu, et al.	Elsevier	2019	Proposes an elastic and cost-effective data carrier architecture for smart contracts inside IOT environment.	Designing data carrier architecture for smart contracts in a blockchain-enabled IoT environment.	The proposed data carrier system is demonstrated more efficient, elastic, and cost-effective.

Table (7): Summary of smart contracts and legality category

SUBJECT	AUTHORS	JOURNAL	YEAR	OBJECTIVE	METHOD, TOOLS, TECHNIQUE	RESULTS AND CONTRIBUTES

Legal challenges and opportunities of blockchain technology in the real estate sector	Rosa, et al.	Emerald	2020	Exploring challenges, limitations, and opportunities of blockchain technology in the real estate sector.	Analyzing the current intermediaries in the real estate sector in the European Union (EU) and their functions.	Blockchain, combined with smart contracts may improve procedures, allow EU transactions and the interconnection between public administration.
Comparative Analysis of the Legal Concept of Title Rights in Real Estate and the Technology of Tokens: How Can Titles Become Tokens?	Konashevych, O., et al.	Springer	2018	Highlightes how to use blockchain tokens to represent real estate titles, and tokens on the blockchain.	Design of blockchain Tokens technology which includes three-level, E-voting, Smart Laws, and Smart-contract templates.	There are certain issues that need to be addressed like inheritance procedures, litigation, guardianship, which requires a strong mathematical model.

Table (8): Summary of smart contracts and security category

SUBJECT	AUTHORS	JOURNAL	YEAR	OBJECTIVE	METHOD, TOOLS, TECHNIQUE	RESULTS AND CONTRIBUTES
Smart contract: Attacks and protections	Sayeed, S., , et al.	IEEE	2020	Designing a Framework and registration a decentralized way to manage internet of Things (IoT) applications data, in smart cities.	Approach of Analyzing the 7 most important attack techniques.	The vulnerability occurred due to bugs in the code and there are 10 major security analysis tools which are in place to end vulnerabilities in the smart contract.
Improving the Authenticity of Real Estate Land Transaction Data Using Blockchain-Based Security Scheme	Shuaib, M., et al.	Springer	2020	Reviewing shortcoming, to resolve the issues of traditional systems and analyzing how blockchain solves the issues related to land transaction.	A Blockchain-Based Security Scheme model for land registration and application of various cryptographic protocols.	Saving the records in digital format, record accessibility, and its consistency with legal regulations.
A Buyer and Seller's Protocol via Utilization of Smart Contracts Using Blockchain Technology	Kumar, P., et al.	Springer	2019	discusses the shift towards the digitization of registering lands, and therefore the necessity to use Blockchain rather than traditional storage technologies.	implementing a buyer and seller's protocol on ethereum platform via utilization of smart contracts using blockchain technology and Solidity programming language.	The ethereum platform ensures the immutability of data and hence the transaction records can be used to trace the history of the land.

Combating Deep fake Videos Using Blockchain and Smart Contracts	Haya R., et al.	IEEE	2019	Controls transactions among participants and provide secure and trusted traceability to the original video published online.	Designing decentralized storage system called Interplanetary File System (IPFS).	A blockchain-based solution ensures the proof of authenticity of digital assets that may include videos, audio, and images.
Security, performance, and applications of smart contracts: A systematic survey	Rouhani, S., et al.	IEEE	2019	Studing smart contracts as a key component of distributed ledger technology and exploring the performance of different blockchain platforms.	A systematic survey through 90 papers selected based on their relevance and quality.	Highlight smart contracts, analysis, and measuring the performance of different blockchain platforms.
Proof of Delivery of Digital Assets Using Blockchain and Smart Contracts	Hasan, H. R., et al.	IEEE	2018	presents a blockchain-based solution and framework for the a proof of delivery (PoD) of digital assets to ensure the integrity of the agreement form between the parties.	The smart contracts were designed, implemented, and fully tested with various mechanisms and algorithms to automate payment in Ether and use the IPFS Model.	the blockchain-based solution leverages key features of blockchain and Ethereum smart contracts to provide immutable and traceability Ethereum smart contracts

Table (9): Summary of smart contracts and constraints category

SUBJECT	AUTHORS	JOURNAL	YEAR	OBJECTIVE	METHOD, TOOLS, TECHNIQUE	RESULTS AND CONTRIBUTES
Constraints and benefits of the blockchain use for real estate and property rights	Konashevych, O.	Emerald	2020	Study possibilities of use blockchain and distributed ledger technologies (DLT) for different purposes in real estate, with the focus on title rights and property registration in public databases.	A framework focuses on property rights, land registration and information, communication technologies innovations.	There are constraints of the technology's properties, registration, and public policies to put blockchain at the service of society.

Table (10): Summary of smart contracts and machine learning category

SUBJECT	AUTHORS	JOURNAL	YEAR	OBJECTIVE	METHOD, TOOLS, TECHNIQUE	RESULTS AND CONTRIBUTES
Smart contract based data trading mode using blockchain and machine learning	Xiong, W., et al.	IEEE	2020	Data trading mode based on the smart contract using blockchain and machine learning and traceability of blockchain, and the verification of data availability.	Designing smart contracts using blockchain, machine learning and the Solidity programming language.	The proposed framework is able to protect the rights and interests of the data owner and promote the development of data trading .
Research on Smart Contract Optimization Method on Blockchain	Wen Hu, et al.	IEEE	2019	proposes an optimization algorithm for generating business process smart contracts for reducing the consumption of gas during the execution of smart contracts.	Designing of business process modeling notation (BPMN).	The proposed method can effectively reduce gas consumption of business process intelligence contracts on the blockchain.

Table (11): Summary of smart contracts and use case category

SUBJECT	AUTHORS	JOURNAL	YEAR	OBJECTIVE	METHOD, TOOLS, TECHNIQUE	RESULTS AND CONTRIBUTES
A Study of Use Cases for Smart Contracts Using Blockchain Technology	R. Mani, et al.	International Journal of Information Systems	2019	Analyzes the various use cases of Smart Contracts like digital Identity storage, Healthcare, Finance, Self-Sovereign Identity, Governance, and Logistics.	Designing a model, for records are stores in a database using smart contracts which are safe and secure using encryption algorithms.	Smart contracts provide a secure, fixed, and open environment for all the participating parties.
Blockchain technology in commercial real estate transactions	Hugo Pieter Wouda,et al.	Emerald	2019	the development of a blockchain application that can improve the transaction process of office buildings in the Netherlands.	Multiple parties were interviewed to define major main points within the process and the interview findings are used to design a blockchain solution.	Blockchain overcomes weaknesses in traditional registration, improves the transaction through cryptography.
Design of the Blockchain Smart Contract: A Use Case for Real Estate	Ioannis Karamitsos., et al.,	Journal of Information Security	2018	Present the Blockchain and smart contract for a specific domain which is real estate residential and business.	Development of different use cases using blockchain technology through three phases (analysis, design, implementa-	The smart contract provides a secure, distributed, and shared decentralized ledger of all assets and transactions

						between landlord and tenants.
					tion).	
Smart contract applications within blockchain technology: A systematic mapping study	Macrinici, D., et al.	Elsevier	2018	highlights smart contracts within blockchain technology because traditional transactions are costly, and may result in security problems.	A systematic mapping study presented the research trends within the area through compiling and identifing 64 paper.	The most commonly discussed problems and solutions in the literature are related to the security, privacy, and scalability of blockchain.

Table (12): Summary of smart contracts and platform category

SUBJECT	AUTHORS	JOURNAL	YEAR	OBJECTIVE	METHOD, TOOLS, TECHNIQUE	RESULTS AND CONTRIBUTES
Research on Real Estate Transaction Platform Based on Blockchain Technology	Yang, L, et al.	IOP	2020	Analyzing the current status of real estate transactions in China and puts forward some shortcomings.	Designing a platfrom based on the Blockchain Technology and Hyperledger Fabric.	The traceability and irreversibility of the contract can be guaranteed.
Tokenization of Real Estate Using Blockchain Technology	Shanbhag,S. et al.	Springer	2020	Providing an approach for Real Estate Asset tokenization by using Ethereum, thus making it liquid, secure, and efficient.	A Blockchain platform where the asset owners can be connected to the investors, once the KYC and AML requirements are satisfied.	tokenizing of Real Estate introduces many benefits: Liquidity by tokenizing assets, Faster and cheaper transactions, Transparency, and Ac-

						cessibility

V. Discussion

The summary of review studies are shown in Tables from (4) to (12) attempted to analyze some of the previous studies related to the subject of smart contracts and registration through blockchain technology. This section presents a discussion of the most important thing can get out of these scientific studies and shows the complementarity between these studies and the proposed study.

The previous researchs attempted to highlight real estate, registration, and real estate problems such as high transaction fees, a lack of transparency, fraud, and securing, protect customer data from possible, and threats, opportunities for financial, lending, insurance, money transfer, and some challenges in the traditional registration.

Research in this area mainly focused on: static analysis framework. The researchers used different models for using smart contracts with blockchain solutions for overcoming weaknesses in traditional registration.

Some of researchers Designed formal model FPM-RBAC and analysed policies for smart contracts based on security policy rules [4],[26],[35],[19],[36],[37], [38].

Some of researchers Designed Platforms such as Hyperledger Fabric [34], a Know Your Customer (KYC) and Anti Money Laundering (AML) verification [39], (BPMN) business process modeling notation [29], [13], A decentralized storage system Interplanetary File System (IPFS) [24] , Use the Agent Process Modeling (APM) [40], A decentralized application (DApp) [17], and IPFS model [22].

Some of studies Recommended making an application to use real estate registration through smart contracts [15], [27], [16, 28].

Some of the previous studies conducted a survey and questionnaire to find out people's acceptance of transferring from traditional registration to registration through smart contracts [1], [3, 21],[14, 36],[41],[25, 40] , [9].

Some researchers studying and analyzing the risks and challenges that IoT and use IoT through blockchain [16-19].

The researchers in [6] Focused on securing real estate data and, analyzing the 7 most important attack techniques to determine the real impact on smart contract technology, as follows (reentrancy – smart contract overflow and under overflow – short address attack – delegate call – default visibilities – transaction ordering dependence – timestamp dependence).

Factors contributing when using real estate with blockchain will more efficient transactions reduce costs, third parties, reduce transaction time, verification of financial and legal documents as well as updating, to significantly reduce chances of fraud because payments and settlements occur concurrently.

VI. Conclusion

This paper presented a literature review of the existing researches in Smart Contracts within the Blockchain technology area. Out of 300 articles, 30 articles were identified and classified according to nine categories. the objective of this research is to highlight the opportunities for blockchain in real estate and Smart Contracts. Records of blockchain data is immutable and thus not subject to arbitrary manipulation. Smart Contracts revolutionize real estate transactions by enabling lower costs, and better accessibility and speed. Cost alleviation through 1) less reliance on external third parties and quicker turnarounds. 2) Concurrent execution of payments and transfers. 3) Reduction of paper-based processes. Accessibility and Speed information is readily available to all parties with real-time tracking and status updates in a single system. Transparency and information is publicly availa ble to all parties at the same time with a single agreed version of data. Regulation of the real estate market Prevent fraud, difficult tax evasion. Blockchain technology will become a system that will be able to minimize the percentage of human errors and that will make it possible to optimize transactions within the property market. Using this technology, real estate transactions will be faster, safer, and cheaper than they are now. Blockchain can be considered one of the most significant financial innovations that can make revolutionary changes both in the real estate sector and in the stock market.

VII. Acknowledgment

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