Legal and technological frameworks for blockchain and smart contracts

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Abstract

The issue of smart contracts and blockchain technology is one of the most prominent issues resulting from the fourth industrial revolution, which is moving at an accelerated pace towards the digital revolution, which has played and still is of great importance in all areas of life, as it has permeated all sectors, causing a real boom in particular in the world of economy. And since it achieves great benefits for its various dealers, and since it is an innovative and flexible technology, exploration and prediction of its applications are still the subject of studies and research, each in terms of its competence, and since law is one of these concerned specializations, which necessitates the need for a realistic and pragmatic integration of all technology data and organizing them in a legal framework tight.

Blockchain ; Smart contract ; Automation ; hash ; erformance monitoring.

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1. INTRODUCTION

Today, the world is witnessing a rapid revolution in the field of communication and information technology, which is commonly referred to as the Digital Revolution. This revolution is the result of continuous and enormous progress in digital communication and technology. It has opened the door to important and radical transformations in the global economy and trade. We can describe it as the turning point from which the great development we are witnessing today in all aspects of human life has emerged. Humans have not left any aspect of life without harnessing this technology to play its role in progress and development. Electronic transactions have become a reality in the modern world and are rapidly evolving. The impact of information technology and advanced technologies has encompassed the most prominent branches of private law and has led to a real revolution in traditional written concepts. Electronic transactions have emerged as a result of the union between informatics and wireless communication means. Blockchain technology and smart contracts are one of the most important topics that have received worldwide attention and increasing interest in recent years, due to being one of the important technologies resulting from the components of the fourth digital revolution. It has contributed and will contribute to changing the features of the global economy. It is worth noting that the first appearance of blockchain technology was by its founder,

The emergence of blockchain technology can be traced back to its founder, Satoshi Nakamoto, who mined the first Bitcoin block, known as the Genesis block, in 2009. This was the result of a Bitcoin exchange between Nakamoto and American programmer Hal Finney on January 12, 2009. It was then that researchers and technicians realized that the technology and network behind this process offered a secure environment for conducting transactions or storing and exchanging assets. The most important feature of this technology is that it is

decentralized, open, distributed, and based on consensus and peer-to-peer technology. It is also immutable and sequential. Due to technological and programming advances, Russian programmer Vitalik Buterin founded the first second-generation blockchain application, the Ethereum platform, in 2013, which is considered the basis for smart contracts today. Based on the above, the following questions arise: What is blockchain technology? What are smart contracts? What is the position of legislation regarding these emerging technologies?

1-Blockchain: The Artificial Intelligence Revolution. 2- Smart Contracts as an Application of Blockchain Technology: The Beginning of the End for Traditional Contracts. 1.1-Blockchain Technology.

To shed light on the technology and concept of blockchain, it is necessary to first define it through terminology and legislation, and then move on to its types. Definition of Blockchain Technology. Legal jurisprudence in this area confirms that tackling any legal idea requires understanding its concept and parameters, which leads us to try to define blockchain technology and highlight its characteristics. To understand the meaning of blockchain technology, we will discuss its terminological definition, then explain its legal definition.

1.1. Terminological definition of blockchain technology.

Blockchain technology is considered one of the most important technologies that was initially developed as the technical basis for virtual currency, and then appeared as a technology in its own right. It is now considered a technological breakthrough that is unmatched. As it is a new technology that is difficult for legal and jurisprudential experts to comprehend, along with other emerging technologies such as cryptocurrencies, (Sève & Denis Le Sève, 2018) predictive justice, artificial intelligence, and robotics, it has become difficult to arrive at a unified definition for this technology. The term "blockchain technology" is not of

Arabic origin, and is a literal translation from the English language of the term "blockchain." In Arabic, it is referred to as the "chain of blocks," while in French, it means "Chaine de Blocs."

In the definitions provided, we can see that Michael Crosby defines it as: "A distributed database of records or a public ledger of digital transactions that have been executed and shared among participating parties. Each transaction is verified in the public ledger by the consensus of the majority of participants in the system. Once information is recorded in it, it cannot be erased." Others define it as: "A digital list of records in which transactions are recorded in blocks and connected using cryptography. When the blocks are filled with data, they are time-stamped chronologically and added to the chain of blocks in a way that can be verified and cannot be changed without the consensus of the majority of participants." Professor Aaron Wright views blockchain technology as a chronological database of transactions recorded by a network of computers. Meanwhile, Garrick Hileman and Michel Rauchs see blockchain technology as a type of distributed ledger technology consisting of a series of encrypted blocks that contain aggregated transactions. All data is publicly distributed to all participants in the network. (Sève & Denis Le Sève, 2018)

Blockchain technology is a digital ledger that records data for each digital transaction, such as a virtual purchase or an electronic vote. Instead of storing this data in one place, like paper or digital records, this data is distributed at the same time to thousands of computers via a peer-to-peer network. Algorithms are used to verify transactions, and each valid block is timestamped, added to a copy of each block, and creates a "blockchain". (Le Programme des Nations unies pour le développement) Satoshi Nakamoto presented this concept in a research paper titled "A Peer-to-Peer Electronic Cash System," where he described it as an electronic system for a ledger or accounting book used in commercial transactions that can record transactions not on one computer, but on a large group of

computers in a decentralized network. All records are published, and they can be accessed for free by anyone at any time, making hacking or modifying these records impossible. Thus, blockchain technology represents the digital application platform through which smart contracts are executed and completed, as it is an electronic record that contains all the data related to contracts and is encrypted and secure, making it difficult to manipulate or modify (Mounoussamy & Mounoussamy) (Garrick & Rauchs,, 2017).

2.1.1. Legal definition of Blockchain Technology: It is noted that the US legislature, specifically the state of Illinois, has addressed the concept and determinants of Blockchain technology in many places and even dedicated a law to it, called the Bloch Chain Technology Act (BTA), which came into effect on January 1, 2020. Blockchain technology is defined as: (205 ILCS 730/5): ""Blockchain" means an electronic record created by the use of a decentralized method by multiple parties to verify and store a digital record of transactions which is secured by the use of a cryptographic hash of previous transaction information." Washington State law in 2019 under SB 5638 defined blockchain technology as: "Blockchain' means a cryptographically secured, chronological, and decentralized consensus ledger or consensus database maintained via the internet, peer-to-peer network, or other similar interaction." 2.1. Characteristics of Blockchain Technology: Blockchain technology plays a crucial role in all areas of life, where it has become pervasive across all sectors, particularly in the world of digital economy, resulting from the technical features it possesses. 1.2.1. Decentralized ledger: The Blockchain Institute in France defines this technology as: "a technology for storing and transmitting information transparently, securely, and without a central controlling authority." (BENHALIMA & el Barça, 2022) It is noted that this definition includes a unique feature of this emerging technology, which is the ability to transfer information or assets without a central regulatory authority, thereby surpassing other similar systems as a disruptive technology. The

63

feature of a decentralized ledger means that it allows for the exchange of any type of transaction between two parties without the need for a central entity to regulate these transactions. In other words, there is no central entity to store all data and information and control it, as is the case in centralized systems controlled by a single central entity. For example, when a group of individuals open an account with a bank or financial institution and deposit a certain amount of money, you cannot directly and immediately access or use the funds in that account without the permission of the central entity that controls the account. However, with Blockchain technology, transactions can be conducted directly between parties without the need for an intermediary. (BENHALIMA & el Barça, 2022)

3.2.1. Distributed ledger: Since blockchain technology is an open, permanent ledger for the public, it allows all participants to access it at any time and from anywhere because the entire chain is distributed in many public points on the network called nodes. This means that there is a copy of the blockchain data held by all members, and any modification or transaction that occurs on the network is added synchronously to all members of the blockchain network. (BENHALIMA & el Barça, 2022)

4.2.1. Consensus-based ledger: by consensus, we mean that blockchain technology is based on the consensus property in decision-making within the network. There is no specific centralized entity assigned to make decisions within the blockchain network. Consensus is achieved by following specific protocols used to manage the network, which are exercised when making any decision regarding any changes to the network's state by its members. (BENHALIMA & el Barça, 2022)

5.2.1. Peer-to-peer ledger: Blockchain technology is characterized by being a peer-to-peer (P2P) network, which means that all relevant parties in the network can enter this system at any time to document transaction assets, record their data, proceed with them, and reach collective consensus according to the purpose of the

network. Then, all parties confirm it through a process called mining, and once all parties agree on the transaction, a new block is created and directly added to the chain of the rest of the blocks on the network without the intervention of a centralized authority to do so.

6.2.1. Immutable ledger: Blockchain technology has a unique feature compared to other systems, which is the hash function or the hashing algorithm that transforms the data entered into the blockchain network, regardless of its size and type, into a unique set of codes and numbers that represent this data and become immutable. Once the data is entered into the blockchain network, it becomes a permanent and immutable part of the ledger.

7.2.1. Chronological ledger: Since the blockchain technology is a set of blocks that must be sequential and interconnected in time, this indicates that each block and block contains a timestamp that sets and shows the time in which it was added to the block chain, and it is obvious that this cannot be changed or attempted Amending it, due to the encryption characteristic of the blockchain technology.

8.2.1. Transparent ledger: Transparent The transparency feature is one of the most important fruits of decentralization that the blockchain technology has, as it provides an opportunity for all members of the network to verify the validity of data, information and supporting documents in real time when they are placed directly in the network, as we explained above that the blockchain technology is a distributed and open ledger of accounts A copy of it is available to all members of the network, which indicates that the blockchain is a secure digital technology that involves credibility and transparency (BENHALIMA & el Barça, 2022).

3.1. Types of Blockchain Technology: There are four forms and types of Blockchain technology, the first of which is the public Blockchain, the private Blockchain, the Federal Blockchain, and finally the Mixed Blockchain. As for the models, there are many of them and differ between them in terms of the degree of decentralization, confidentiality of transactions, assets and access, and the identity

of the members of the Blockchain network, and ...etc (Garrick & Rauchs,, 2017).

1.3.1. Public Block Chain: It is called public because anyone can access it, it only has to be connected to the Internet in addition to downloading the relevant network protocols Consensus, to reach a decision about its state, especially the mechanism for consensus, mining and wages in cryptocurrency, in the public blockchain anyone can access it and participate In it without permission from anyone in the sense that it is open to everyone, which makes this type characterized as completely decentralized, and this is due to the fact that trust stems from the consensus of the network nodes and does not require the completion of the transaction by an intermediary, and for the sake of blockchain governance requires the approval of all nodes in the network to verify the validity of the data The most famous examples of this type are the Bitcoin block chain and the Ethereum Blockchain.

2.3.1. Private Block Chain: Unlike public blockchains, this type works with clearly defined, intentional, pre-selected proxy persons to gain access to the network in question and to validate transactions, such that no one can access them, without the permission of those responsible for them, meaning they are restricted to obtaining prior authorization. Permissiond, and economic and financial institutions and entities adopt this type to share the rules of their data internally in order to improve the speed of implementation and reduce the cost (Garrick & Rauchs,, 2017).

3.3.1. Consortium or federated block chain: This hybrid type is also known as a consortium, and the federal blockchain is characterized as a network that is operated and managed by several entities and networks, such as a number of financial institutions, for example, and not a single entity that includes a number of participants in the network as is the case in the private blockchain. Block Chain, so that each of these parties participates in the verification, approval, and

authentication processes within the federal Blockchain network, which entails that these latter operations are carried out by a predetermined group of people, which is similar to a private Blockchain, and the distinctive difference in this case is that The subscribers are a number of entities (eg financial institutions), unlike in a private blockchain They are a number of people and subscribers, and the most important feature that distinguishes them is that they are not open to the public in the sense that they are restricted to obtaining prior authorization. Examples of these types are the (R3) network in the field of banking, the (B3i) network in the field of insurance, and the (EWF) network. in the field of energy. (BENHALIMA & el Barça, 2022)

4.3.1. Hybrid block chain: It is the network that combines the features and characteristics of the public Block Chain and the private Block Chain, such as the Dragonchain Network.

2. Smart contracts as one of the applications of the blockchain: the beginning of the end of traditional contracts. Smart contracts are one of the most important applications of blockchain technology, which is witnessing a continuous increase. In this section, we will discuss its concept through exposure to the jurisprudential and legal definitions provided, as well as clarifying its characteristics and types, and then exposure to the legislative recognition of this technology. (Lauslahti & Mattila, 2017)

1.2. The concept of smart contracts.

1.1.2. Try to define smart contracts. Nick Szabo, a researcher and computer scientist, who devised a system for a virtual currency in 1998 called Bit Gold, but it was not implemented. Professor Nick Szabo defined the smart contract for the first time as: (the computerized transaction protocol that implements the terms of the contract), so that another definition was presented after a period of time as a

result of the development that took place, so that he sees that the smart contract is: (a set of covenants specified in a digital form that includes the protocols through which the parties implement these covenants). While Vitalik Buterin knew the founder of the Ethereum network

While some defined it as: (computer codes that operate on the blockchain and include a set of rules according to which the parties to that contract agreed to interact with each other, and if the pre-defined rules are met, the agreement is automatically executed). Investopedia defined it as "self-executing contracts programmed within a decentralized platform called the blockchain," while Professor Regis de Boise defined smart contracts as "digital contracts based on blockchain technology, where each party's obligations can be controlled under the contract." (Aurélie, 2017) .

Some also define them as (digital contracts that allow for conditions that depend on decentralized consensus, self-enforcing, and not subject to tampering or tamper-proof, through automated execution). It is noted that these definitions are relatively complex, and most of them revolve in describing and the mechanism of action of smart contracts, and as a result of this there is a definition based on the idea of the complementary or auxiliary contract, so that P. De Filippi defined smart contracts as: (software implemented in a decentralized manner on the Blockchain whose functions are run by fulfilling pre-determined conditions), and he believes that smart contracts do not replace contracts, but rather work to enhance them, which is what Professor Mansour Dawood went to, so that he sees that smart contracts are the ideal complement to the contract and support it and give it digital and societal strength. (Lauslahti & Mattila, 2017)

As for the legislative definitions, it is observed that the US legislation is most keen on setting limits and controls for the blockchain technology and smart contracts, so that the US Arizona House Bill 2417 of 2017 regarding the

blockchain network and smart contracts was defined as:

("Smart contract" means an event-driven program, with state, that runs on a distributed, decentralized, shared and replicated ledger and that can take custody over and instruct transfer of assets on that ledger), It was also defined by Tennessee Law No. SB1662 regarding blockchain technology The same definition was adopted by New York State Law under the name NY A08780 of 2017, as well as Ohio State Law under No. SB300 of 2018, as well as Nebraska State Law NE LB 695 of 2018.

While the State of Belarus, the legislator defined smart contracts through Decree No. 08 of 2017 related to the development of the digital economy as: (the program code intended to work in the distributed ledger (blockchain), which is another distributed information system for the purposes of automatically executing transactions or performing other legal work)

2.1.2. Shortage of smart contracts. Smart contracts have many advantages, the most important of which are the features provided by the blockchain technology - which were previously explained - in addition to that, we find that smart contracts are unique to some features, as follows, we will summarize them **1.2.1.2. The electronic nature of smart contracts.** Electronic nature This is an axiomatic feature, because the smart contract is inconceivable and can only exist in digital electronic form, so that the agreement of the parties is transformed and emptied into the programming language of the blockchain network in order to implement and enforce it.

2.2.1.2. Conditional nature of smart contracts: It is noted that the content of the smart contract is formulated by means of conditional sentences. For example, if the purpose of the contract is to buy Abdul Rahman a digital book from Mona, then the contract is formulated in this way: If Abdul Rahman delivers the digital

book to Mona, after that the amount of the book is transferred to His account, and this method is termed in English: If this then that (Gao, 2017)

3.2.1.2. Self-verifying smart contracts: This feature embodies the idea of decentralization of the blockchain technology, as there is no central party that carries out the investigation process and it does not depend on the desire of the parties, but rather it is subjective, and this happens through consensus mechanisms. (Lauslahti & Mattila, 2017)

4.2.1.2. Self-enforcing smart contracts: Once the conditions and data stipulated in the content of the contract are met, the implementation process takes place automatically, and does not require the intervention of any party in any manner. It is capable of implementation and self-enforcement. (Gao, 2017)

5.2.1.2. Tamper resistant: This feature is derived from the blockchain technology, as it is encrypted by the Hash mechanism, which means that any modification or change to the content of the contract will inevitably be discovered by any party.

In the following figure, the characteristics of smart contracts are presented in an actual practical scenario. (Gao, 2017)
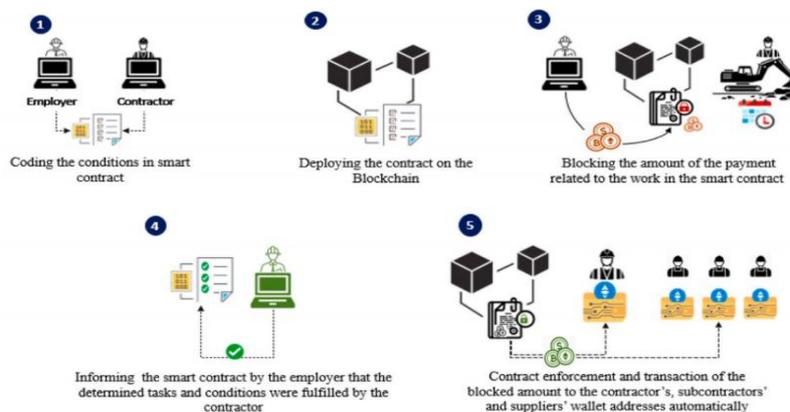

Source : Dewi Noorain bolhassan, Towards Adoption of smart contract in construction industry in malysia, Sience of Technology, science & technology, 141-160, 2022.

3.1.2. Types of smart contracts: One of the applications related to blockchain technology is what is known as smart contracts, which are developing rapidly until they almost replace traditional contracts. Smart contracts are divided into two types, namely specific smart contracts, and unspecified smart contracts.

1.3.1.2. Deterministic Smart Contract: It means the technology that is not based in its operation on data and information from outside the blockchain network, in the sense that it includes sufficient and sufficient information within the relevant blockchain network through which the smart contract operates, and this is in order to make the various decisions related to its completion.

2.3.1.2. Non-deterministic Smart Contract: Unspecified smart contracts are based on an external party called Oracle, in order to provide it with the information necessary to operate it, and to make various decisions related to the blockchain network, and this information is not owned by the latter, for example, weather conditions, currency exchange rates, or …etc. It is worth noting that the third party that uses the Oracle program to enter information into the blockchain platform must be impartial and objective because its intervention plays a pivotal role in the implementation, and this implementation depends on the truthfulness and falsity of the information entered in the platform using the Oracle program. (Mohanta, 2018)

2.3.1.3 Uses of smart contracts: Smart contracts are pieces of software that are executed in a blockchain system that uses a consensus protocol to run as a series of events. Smart contract can be used differently and saved to remove third party transaction as well as system automation. In this work, we have identified 7 different use cases for smart contract and blockchain-based application as shown in Figure [2]. (Gao, 2017)

71

Figure 02: Areas of adoption of smart contracts.
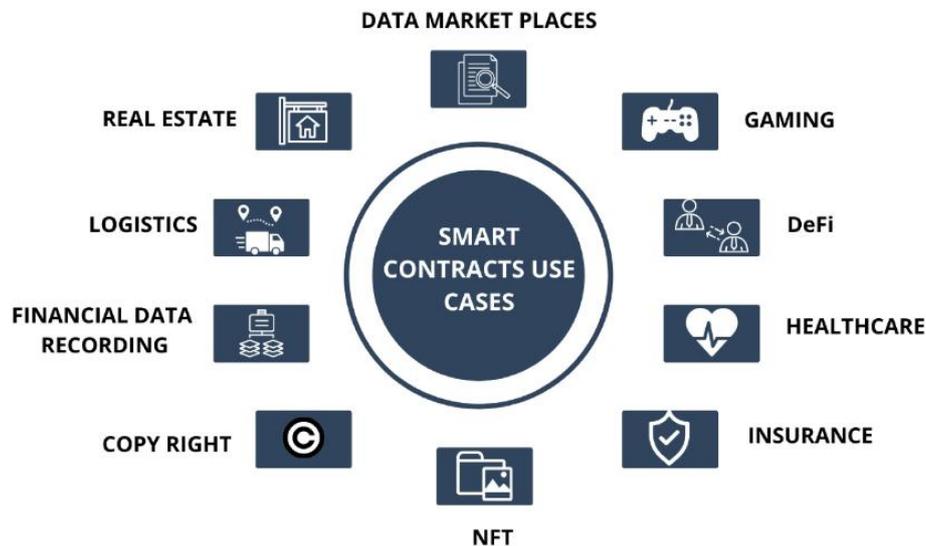
The different kind of field of application of blockchain technologies is discussed.

Supply Chains: Supply chain management system consists of different level of transaction. Each level consists of some terms and conditions. Multiple systems are involved in the supply chain system. Different sector of supply chain systems such as food processing system, transportation sector, shipping system. All in all this digital ledger database makes the system more transparent, reliable and most importantly without third party involvement. Blockchain system makes the supply chain sector more reliable and trustworthy, everything is in an open system in a distributed way. If a smart contract is used with a blockchain system as shown in Figure [4] then the system will become independent as well as secure. Some smart conditions need to be developed in the form of a program and put into the blockchain system, whenever any transaction takes place, the smart contract will be executed by the blockchain contract. By network node, smart node events are triggered. Finally, the transaction is recorded in the blockchain system. Making supply chains more transparent through smart contracts, helping to facilitate the movement of goods, and restoring confidence in trade (Mohanta, 2018).
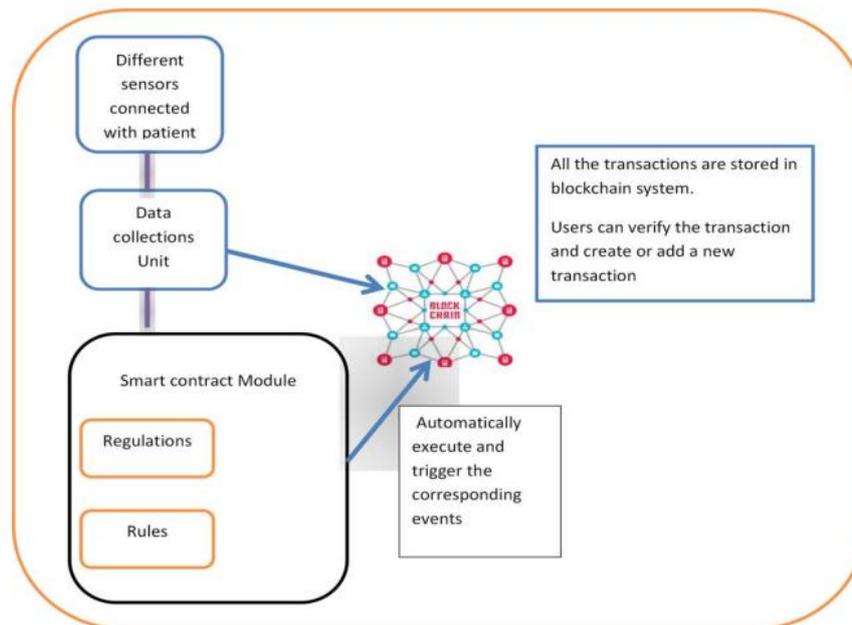
Figure [4] The smart contract-based supply chain system
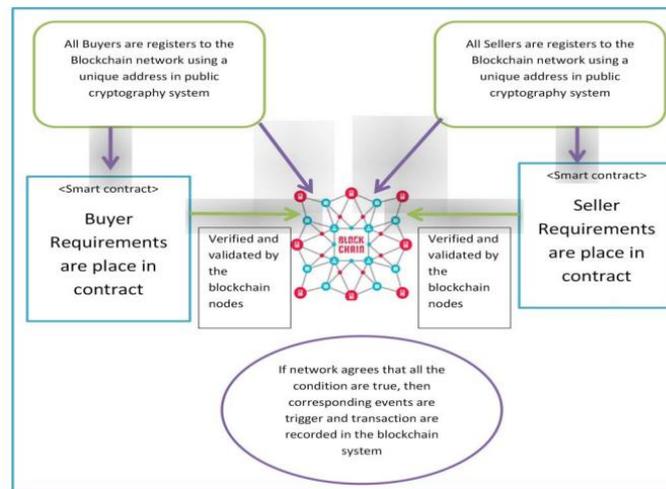
Source: Bhabendu Kumar Mohanta, An Overview of Smart Contract and Use Cases in Blockchain Technology, Conference: 2018 9th International Conference on Computing, Communication and Networking Technologies (ICCCNT), 2018.

Health care system: With the increasing level of human fasting in technology is growing rapidly. Using newly developed devices and supporting technology that human beings can monitor health status while sitting at home. There are a lot of devices already developed to read different features in the human body. This data can be collected using a low-end device and processed locally for quick information. Blockchain technology helps maintain patient privacy and data saved in a digital ledger format. A smart contract can be used in this system to make the system more reliable and automated. Using a smart contract, a human can write down some term and condition which can be applied once the data has been collected. Then these smart contracts will be executed and triggered by the corresponding events. (Jaiswal, 2017)
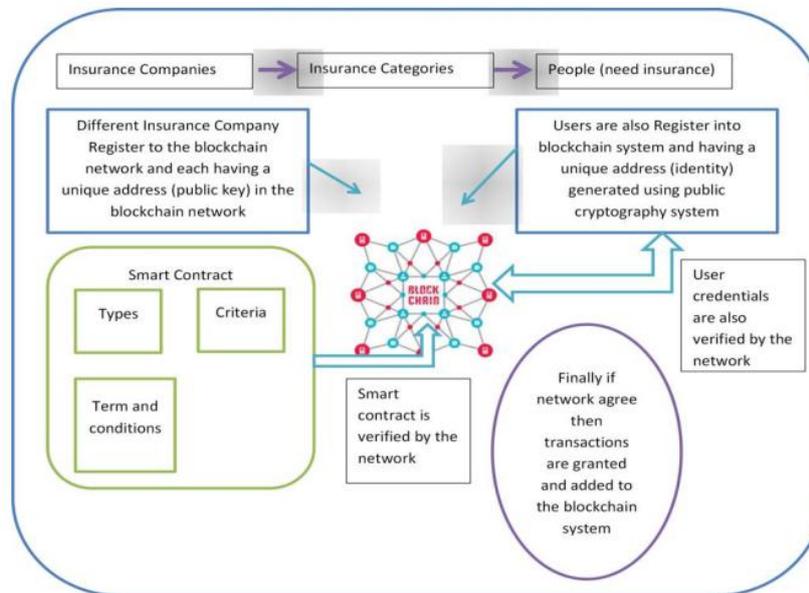
Figure [5] A healthcare system based on a smart contract

Source: Bhabendu Kumar Mohanta, An Overview of Smart Contract and Use Cases in Blockchain Technology, Conference: 2018 9th International Conference on Computing, Communication and Networking Technologies (ICCCNT), 2018.

Insurance: The traditional insurance system takes a very long time to compensate. There is a lot of ambiguity that arises between differing stakeholders during processing. A smart system based on contracts can simplify the process and using blockchain technology everything can be made transparent as well as secure the system without third party intervention. Whenever the smart contract is executed successfully, it triggers the corresponding events the details shown in Figure [6] (Jaiswal, 2017).

Figure [6]: A smart contract-based insurance system

Source: Bhabendu Kumar Mohanta, An Overview of Smart Contract and Use Cases in Blockchain Technology, Conference: 2018 9th International Conference on Computing, Communication and Networking Technologies (ICCCNT), 2018.

Financial System: Blockchain technology invented by the cryptocurrency Bitcoin The system initially used for the financial system only. Conventional banking system involves a third party to transfer funds from one account to another. But in a blockchain system, it is a peer-to-peer transaction and no central storage is used. The financial sector can use blockchain technology and smart contract but there is still a lot of research to be done for this sector to implement the smart contract (Tama, 2017).

Real Estate: The real estate system in the traditional way involves a lot of risks as well as taking time. As it goes through various stages of legal procedures you also need a lot of paper signatures as well as manual verification of documents. Blockchain technology and smart contract can overcome the problem associated with the real estate sector. The centralized system can allow real estate to be bought and sold without a third party. The document is also digitally verified and validated. All documents are also stored in the distributed database of the digital

ledger where everyone can see them (Gao, 2017).

2.2. Legislative recognition of smart contracts in comparative laws: After we have touched on the basic concepts of smart contracts, and this is through exposure to the most important jurisprudential and legislative definitions presented, as well as the characteristics and types of smart contracts, we must clarify the position of some legislations on this new technology.

1.2.2. Western legislation in view of the scientific and technological development witnessed by the various developed countries, it was necessary for their legislators to try to control and frame the legal aspect of these emerging technologies, and below we will briefly review some of the countries that have worked on developing legislative and regulatory texts related to the purification of the blockchain and smart contracts.

1.1.2.2. Italy. The Italian legislator explicitly recognized the smart contracts and records kept in the Blockchain network pursuant to Law No. 12 of 2019, and even more so established them with the same legal value as regular records and contracts, so that their value and legal authority are not denied just because they originated using distributed networks DLT.

2.1.2.2. Belarus. The State of Belarus has tried to keep pace with technological development by framing blockchain technology and smart contracts through Decree No. 08 of 2017 related to the development of the digital economy, which stipulates all legal and technical provisions for smart contracts as a means of conducting transactions in the blockchain technology network.

3.1.2.2. Malta. On July 4, 2018, the Maltese parliament established three laws regulating, in their entirety, blockchain technology and smart contracts, as well as issues related to them. virtual financial assets act.

2.2.2. Arab legislation. We will briefly address some of the positions of Arab countries regarding the recognition and use of blockchain technology and smart contracts within their legal system.

1.2.2.2. The United Arab Emirates. The former UAE in the Arab countries is preparing to establish various legal bases for blockchain technology and smart contracts by amending the legislative and regulatory texts related to regulating these emerging technologies, and more than that, the UAE government has adopted blockchain technology in its various official transactions, as it launched the Emirates Strategy for Transactions Digital 2021 and the Dubai Digital Transactions Strategy, which aims to adapt advanced technologies and employ them to transform 50% From government transactions at the federal level to the Blockchain platform, the Roads and Transport Authority in Dubai is working on implementing the "Vehicle Lifecycle Management Project" that allows vehicle ownership, sales and accident records to be tracked in an integrated manner based on Blockchain technology. The system will allow the preservation of all information related to the data of each vehicle during all stages of its life, starting from the manufacturing process and uses, up to the scrapping stage, in addition to the judicial documentation processes in the authentication, authentication and verification of contracts: what the UAE government is working to transform Dubai into a city that is fully managed by Blockchain platform.

2.2.2.2. Tunisia: Tunisia is considered one of the first countries in the world to adopt a state-run electronic payment system, based on blockchain technology, as Tunisia decided in 2015 to strengthen its eDinar digital currency using blockchain technology, building on the previous achievements achieved by the Tunisian Post, which is a pioneer in the field of financial inclusion. , by enhancing the provision of digital services. Finally, we conclude that Blockchain technology has become one of the most controversial topics today in the field of innovative applications in

the context of the Fourth Industrial Revolution, especially with the emergence of modern technologies and awareness of the need to organize data on the Internet. On the other hand, smart contracts are among the most important emerging applications of Blockchain technology, which Many raise legal questions.

Recommendations.

- The need to expedite the development of a legal framework for smart contracts that balances the economic and programmatic thinking of smart contracts with the ethical dimension of contract law.

- Holding scientific conferences and seminars for specialists for the benefit of students, researchers and specialized university professors to clarify the technical and legal aspects of blockchain technology and smart contracts.

- The Algerian legislator should encourage work in the blockchain network, especially for financial and economic institutions and entities.

- The government should support projects based on blockchain technology and smart contracts, to benefit from them during the digital transformation process.

- Encouraging the use of digital money through the issuance of legislative and regulatory texts that keep pace with the technological development taking place in these fields.

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