Paradigm Shift from Paper Contracts to Smart Contracts

Kritagya Upadhyay
Department of Computer Science and Engineering
University of North Texas
Denton, TX, 76207, USA
kritagyaupadhyay@my.unt.edu

Ram Dantu
Department of Computer Science and Engineering
University of North Texas
Denton, TX, 76207, USA
ram.dantu@unt.edu

Yanyan He
Department of Computer Science and Engineering
University of North Texas
Denton, TX, 76207, USA
yanyan.he@unt.edu

Abiola Salau
Department of Computer Science and Engineering
University of North Texas
Denton, TX, 76207, USA
abiolasalau@my.unt.edu

Syed Badruddoja
Department of Computer Science and Engineering
University of North Texas
Denton, TX, 76207, USA
syedbadruddoja@my.unt.edu

Abstract—The ambiguity and complexity of the traditional legal contracts have motivated the study and exploration of a better and advanced contract known as blockchain-based smart contracts. A smart contract is a self-executable contract where the terms of the agreement between the involved parties are directly written into the lines of code that resides in the distributed ledger technology known as the blockchain. Obtaining a better understanding of smart contracts to overcome the fundamental issues of traditional legal contracts is vital for the successful and faster dispute settlement process without the intervention of any third-party mediators like courts, banks, lawyers, etc. In this paper, we present a comprehensive overview of the key features of the paradigm shift from traditional paper contracts to smart contracts. In addition, we also discuss why smart contracts are necessary to be legally enforced and the crucial conditions that are required for them to be legally enforceable. Furthermore, we outline recent trends and emerging technologies such as Natural Language Processing, Machine Learning, and the Internet of Things that have been combined together with smart contracts.

Index Terms—Smart contract, blockchain, enforceability, traditional legal contract, electronic contract, ambiguity, ethereum, interpretations, artificial intelligence

I. INTRODUCTION OF A CONTRACT

An agreement that is in written or spoken form is known as a contract. A contract settles an agreement or a dispute between one or more parties, generally, an offeror and an offeree, since it is intended to be enforceable by law [1]. As a contract is legally enforceable, if one party fails to do what they have promised to do, the other party has the right to ask the court to enforce the agreement or award damages for injury sustained because the contract has been breached. All the responsibilities, do's, and don'ts are outlined in a contract. People have been using verbal agreements too, but the risk of disagreements and confusion can be reduced by only using written and tangible legal contracts. For a contract to be legally enforced, it needs to meet four requirements which are as follows:

- Agreement: The involved parties in a contract must reach a mutual agreement. An offeror will make an offer, and an acceptance will be replied to by an offeree.
- Consideration: Each agreement must be made in return for the performance of a legally sufficient act. An agree-

ment lacks sufficient consideration if one party is not required to exchange something of legal value.
- Contractual Capacity: All the involved parties in the legal contract must possess the entire legal capacity to fulfill contractual duties.
- Lawful Object: The purpose of the contract must be legal.

II. AMBIGUITY AS A CHALLENGE IN TRADITIONAL LEGAL CONTRACTS

Ambiguity arises when there are multiple meanings and interpretations from a single source. Ambiguity is inherent to traditional contracts. Despite the contract being intentionally designed and drafted by lawyers in such as way that it includes ambiguous words and phrases for its flexibility and open nature, it also brings a lot of serious problems when the involved parties have different interpretations, confusion, and misunderstandings. Although an ambiguity can have some more classification, we have classified an ambiguity that a legal contract has in following different types and described them very briefly [2]:

A. Lexical ambiguity

Lexical ambiguity in a legal contract occurs when one word has multiple meanings. This ambiguity is also one of the main reasons for several people to have several interpretations while reading a contract. For example, the meaning of the word, *'book'* has two meanings, which can mean *'something to read'* or the *'process of making a reservation'*. In either case, the meaning varies, but the spelling and pronunciation remain the same.

B. Syntactic ambiguity

Syntactic ambiguity occurs when a given sequence of words can be interpreted as two different grammatical structures, each structure associated with a different meaning. For example, the sentence *'the turkey is ready to eat'* has two meanings and interpretations. It either means the turkey is cooked and ready to eat, or it can also mean the turkey is hungry and ready to be fed.

C. Antecedent ambiguity

Antecedent ambiguity occurs when the antecedent or originator of a given element is not obvious. For example, *'Tenant broke the rules of terms and conditions in the contract created by the Landlord, and he paid a fine'*. In this case, the antecedent of *'he'* could be either *'Tenant'* or *'Landlord'*.

D. Temporal (time-based) ambiguity

An ambiguity that occurs in reference to time is called temporal ambiguity. For example, *'The customer's subscription expires on March 1'*. We see this kind of sentence a lot in contracts offered by business service companies. However, we do not know if the subscription expires at the beginning of the day or at the end of the day. This will create as many interpretations for the people as many different clock times they have of *March 1*.

E. Contract-reference ambiguity

The words such as *'hereunder'*, *'herein'*, *'foregoing'*, *'reasonable'*, *'best efforts'*, *'good faith'*, *'may'*, *'might'* are few examples of contract-reference ambiguity. These words do not have any specific meanings. For example, suppose the drafter of the contract uses the word *'hereunder'*. In that case, it either means it applies for everything else that's below until the end of the contract or just for everything else until the end of that particular clause or section. Hence, these words are responsible for generating plenty of ambiguities in legal cases.

III. IMPORTANCE OF A SMART CONTRACT IN LEGAL WORLD

Smart contracts have got significant attention from legal advocates, institutions, and attorneys in recent years. Unlike traditional paper and electronic contracts, a smart contract is the most novel and technologically advanced contract, which is a computer program intended to execute and enforce automatically. The concept of a smart contract was first introduced by Nick Szabo in the early 1990s [3]. The smart contract runs on the Ethereum blockchain. This contract is just a collection of code, i.e., functions and data, i.e., state that resides at a specific address on the Ethereum blockchain [4]. A smart contract itself is a type of Ethereum account. It has a balance, and it can send transactions over the blockchain network when triggered. Hence, it reduces the need for trusted intermediates. As it is self-executed and self-enforced, a smart contract is not controlled by the involved parties. They are instead deployed to the blockchain network and run as they are programmed. Involved parties or user accounts can then interact with the deployed smart contract by sending transactions that execute a specific function defined inside the smart contract.

The main reason why smart contracts are becoming influential in the legal system is due to their modernness and innovative nature. Although a conventional paper contract has always prevailed in the legal world since its origin for its enforceability, it still lacks a plethora of opportunities and advantages a smart contract can provide. Smart contracts are well suited for agreements without the presence of any third party or central authority. In contrast to traditional contracts, smart contracts are enforced by the blockchain system. Hence, there would be no need for expensive court systems. This way, contracts become way cheaper as more peer-to-peer transactions can be governed by smart contracts rather than by trust.
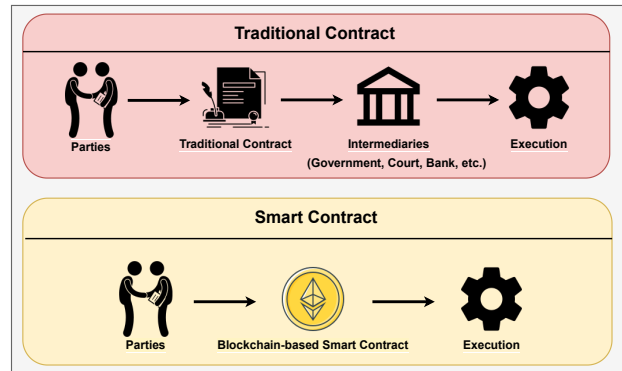

Fig. 1. Traditional contract Vs. Smart contract, where the traditional contract needs an intermediate but the smart contract is self-executable without the need of an intermediate.

It can be challenging when there are contracts between organizations from two different countries with different languages and legislation. Researching and visiting different court systems can be very costly, and the judicial systems of one country will have limited power over companies from other countries. Nonetheless, blockchain-based smart contracts will not face these difficulties as they would not differentiate between any countries or their legislation and judicial practice. Enforcement of the conventional contracts through a centralized authority such as court systems is not only very costly but also brings uncertainty to the result. There will always be that probability where lawyers will intentionally reveal some esoteric ambiguous loophole concealed in the conventional contracts that entirely void the contract. Even when the contract seems unquestionable and indisputable, the involved contracting parties rely on their court system's goodwill to make sure that the contract is enforced.

During the COVID-19 pandemic, there were various cases of eviction of the tenants by the landlords in many states within the U.S and in other countries as well [5]. Before letting someone live in a residence, landlords and tenants have signed the contract where they agree that if the rent is not paid on the due date, the landlord has the right to take action against the tenant in the form of eviction. Nonetheless, there were cases of tenants being evicted by their landlords during the pandemic, even when the tenants were willing to pay the rent. This means that the paper contract with the government seal or signature stamp that can be torn apart at any time is not sensible and preferable when compared with the smart contracts.

In the coming years, conventional paper legal contracts will

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definitely be replaced by smart contracts due to their faster settlement process, higher efficiency, and less vulnerability to legal loopholes [6]. In addition, smart contracts are less expensive, and they can reach across borders just as easily as within borders.

IV. CONVERSION FROM TRADITIONAL LEGAL CONTRACT TO SMART CONTRACT

A. Traditional Paper Contract

Traditional paper contracts are the most common type of legal contract we see in our everyday lives. The agreements between the parties, name of the parties, date, clauses/section, and the signatures of the parties are written in a paper that also includes a lawful governing seal, usually from a rubber stamp. The whole content of the contract is written in natural language by a person, usually by a lawyer, according to what the parties agree for that states their terms and conditions [1]. In traditional paper contracts, the involved parties and the middlemen, usually lawyers and attorneys, need to meet in person to inform them about the terms and conditions of the agreement. When the parties have to make some changes to their existing contract, they meet again with their middlemen and create a new draft of the contract. Once all involved parties agree on the new draft, they sign the contract. In this type of contract, the cost of the attorneys is
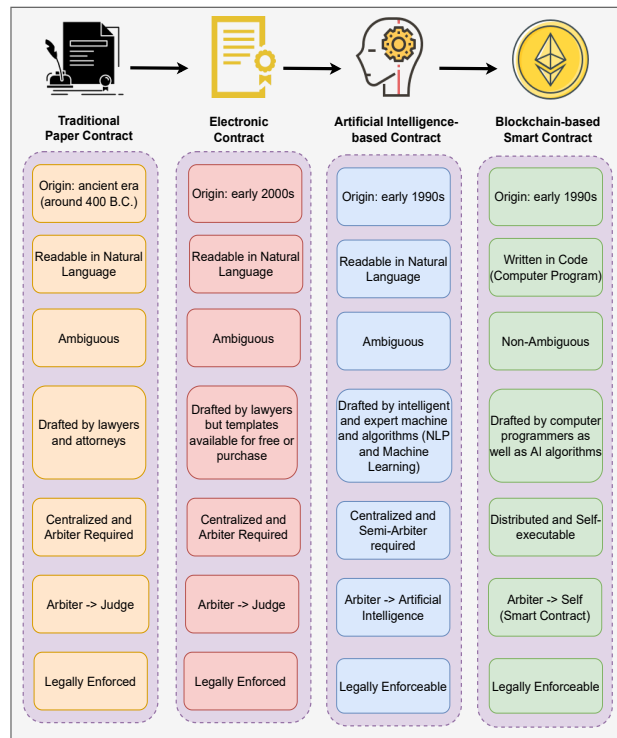

Fig. 2. Paradigm shift of the contract from one stage to the other, where traditional paper contract is the most primitive kind and blockchain-based smart contract is self-executable and, hence, a disruptive technology.

usually very costly. Other expenses such as paper materials, printing, rubber stamps, several copies of the contract for each party, and travel costs to meet the parties are also involved, which ultimately increases the final price in the agreement's implementation.

In case when the agreements set out in the contract are not met, and the contract is violated, the involved parties have to go to the central authority, i.e., the court system. Here, the legal judge in the court system acts as the arbiter who settles the dispute between the parties.

B. Electronic Contract

People started realizing that traditional paper contracts are a lot more expensive and consume more time when drafting. Even for a slight change in the process of drafting the contract, all the involved parties had to meet in person and their hired attorney for the signatures. After the arrival of the internet and personal computers for the regular households was popular, in the early 2000s, electronic contracts were created. Traditional contracts and electronic contracts were basically the same. Still, the major difference between them is that depending on the different needs and uses of the parties, ready-made templates of the various kinds of contracts are already available on the internet. The parties getting into an agreement just need to choose a template from the available templates, fill in their details, and attach their digital signatures [7], [8], [9], [10]. Although the parties just have to download or buy the existing templates, which saves a lot of time compared to traditional paper contracts, the parties can also modify the template according to their needs if they have to. Despite being an electronic contract, this kind of contract is still written in natural language. However, as the whole process has more automation than paper contracts, the probability of human error is lesser. The advantage of an electronic contract is low transaction cost and other miscellaneous costs such as paper and printing.

Despite being an electronic contract, only the drafting and signing of the contract is automated, but settling the dispute still remains as primitive as traditional legal contract where the involved parties must visit the judicial system in case of dispute settlement.

C. Artificial Intelligence-based Contract

Artificial Intelligence (AI) has been gaining popularity unlike any other science and has touched almost every sector since its arrival, including law. It is a type of technology that can mimic and replace human behavior. There has been an increasing demand in AI contract drafting in the field of law these recent years [11], [12], [13]. The contract drafting software based on AI learns from the past and similar contracts. It scans previous documents, identifies essential terms and phrases that include abundant legal jargon, and drafts a suitable legal contract template in just a few seconds. The most significant advantage of AI-driven contract software is that it learns the whole legal contract document by analyzing its subjects, word patterns, writing style, IF/ELSE agreements,

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different sections, and clauses, etc. and creates a similar legal contract accurately without the intervention of any third party such as lawyers and attorneys.

Moreover, using AI with the law does not only remove lawyers as contract drafting middlemen but also removes the judge from court of law itself as the demand for prediction of trial outcomes through data analytics as AI intelligence has been able to predict outcomes with increasing accuracy. Scientists and researchers have been using Natural Language Processing (NLP), Machine Learning, and Deep Learning to enhance expertise and intelligence by creating AI algorithms to replace the third and centralized entity, i.e., the legal judge from the judicial system, for the dispute settlement processes. AI algorithms have been used extensively to find the settlement area between the involved parties, reducing the need for human contact and increasing the dispute settlement process. The usage of these AI algorithms allow the parties to save their time by settling directly and these AI-based settlements are far more consistent and uniform as it does not leave any room for errors and human biases [14], [15], [16]. However, two more features are missing even when AI is used for legal contracts, i.e., distributed nature and self-execution of the contract.

D. Blockchain-based Smart Contract

So far, we have discussed how a simple and conventional paper contract was originated and how it was drafted and functions. Later, the conventional contract was converted to an electronic or digital contract. Despite saving a lot of time and resources, electronic contracts still required a middleman for settling the disputes, if there were any. As the technology became more advanced, with the rise of AI and its branches like NLP, machine learning and deep learning were able to learn from the past and were capable of both drafting new contracts as well as for settling the dispute as arbiter without any human intervention, increasing the efficiency. Still, there was one important part missing all along with these transformations, i.e., automation and self-execution of the contract.

As mentioned earlier, blockchain is a distributed ledger system that is decentralized, immutable, and cryptographically secured. A smart contract is a concept in the blockchain, which is a computer code that resides inside the blockchain that has all the IF/ELSE statements and agreements between the involved parties of the contract. Due to the features and characteristics of this blockchain-based smart contract, the contract is distributed, decentralized, and secured. As a result, this makes the smart contract self-executable which does not require any outsiders or the third parties or any arbiters in case of disputes. A smart contract is designed in such as way that if one of the two parties violates the contract, then with its self-executable feature, the contract gets triggered, and the violating party is penalized automatically. For instance, there are two parties A and B inside the smart contract that is programmed for a rental agreement. Assuming, A being the landlord and B being the tenant, if B is unwilling or fails to pay his/her rent by the due date, A does not have to seek the arbiter or a third-party AI-based expert system in this case. Since the smart contracts are self-executing by nature, once the tenant violates the contract by not paying the rent at the proper time, the money from the tenant's account can be automatically transferred to the landlord's account.

It would be impossible for anyone meddling with the contract to modify anything inside the contract as it is cryptographically secured and immutable. Not only is it immutable, all the nodes or participants will also know about the transactions and logs inside the blockchain as it is distributed throughout the network. However, it does not mean that everyone in the blockchain network would know that the tenant could not pay rent and he/she has to suffer from embarrassment. Since everything inside the blockchain is encrypted, the involved parties (accounts) will remain anonymous. In addition, blockchain-based smart contracts completely eliminate the trust factor because it follows a peer-to-peer network architecture [17], [18]. Hence, the involved parties do not have to be concerned with the central (third-party) figure, such as a human judge in courts, as it usually introduces biases.

Recently, artificial intelligence has been used as research to create smart contracts for blockchain, which we discuss further in detail in the sections below.

V. ADOPTION AND LEGAL ENFORCEMENT OF A SMART CONTRACT

Smart contracts have been popular in a short period of time. At the advent of blockchain and smart contracts, only a handful of people were using smart contracts. However, in these recent years, the smart contract has been increasing its scope around as many areas as possible. Trading activities, mortgages and loan systems, record storage, insurance, supply chain management, and crowdfunding are famous use case examples of smart contracts. Although the smart contract is still not as mature as traditional paper contracts, people have started to realize that smart contracts have been offering solutions to the existing legal and security challenges that have an abundance of loopholes [19].

Just like in a traditional paper legal contract or an electronic/digital, a smart contract also has the same elements and features. These elements are mutual agreement, consideration, competent parties, genuine consent, and finally, legally enforceable. Similarly, in a smart contract, there will be one party that offers and another party that accepts in exchange for a benefit. The involved parties in the smart contract have to reach an agreement. These rules are mostly represented by IF/ELSE conditions or require function. As mentioned earlier, in exchange for a benefit from the other party, each party gives up something of value. Also, its significant for the parties in the smart contract to be competent as the smart contract can only be enforced when the involved parties are qualified. The smart contract also has the feature of genuine assent as all involved parties in the smart contract must engage in the agreement independently [20]. Finally, the smart contract
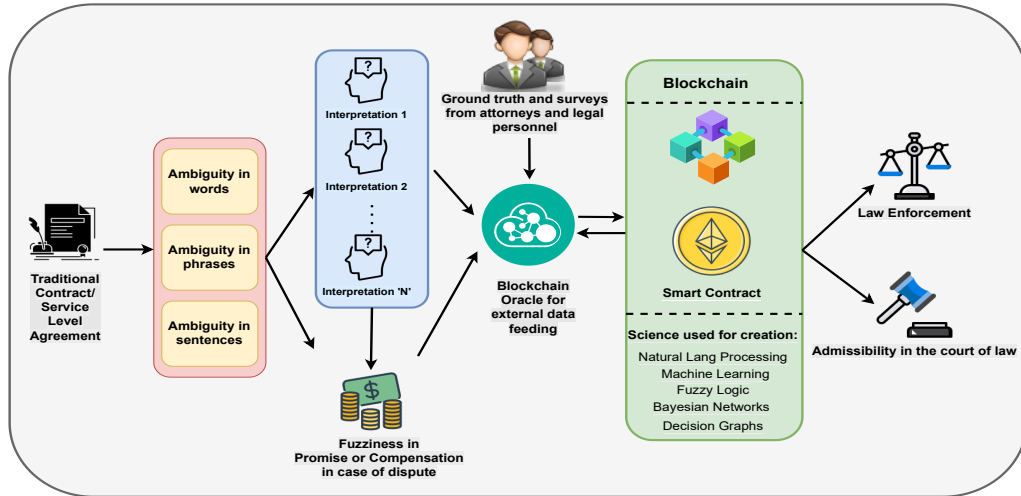
Fig. 3. Conversion of the traditional paper contract to a legally enforceable blockchain-based smart contract. Here, a paper contract has plenty of possibilities of ambiguities. Hence, the ambiguities are explored on the word, phrases and in sentence level and their corresponding interpretations are created and fed onto the blockchain with the help of Blockchain Oracle including the fuzziness of the agreements and ground truth from the lawyers. Once the smart contract is created, it is made enforceable and admissible in the courts of law [22], [29].

has a lawful and legal purpose, although it is written in the code and not in the natural language like the traditional paper contracts. Hence, the smart contract has exactly the same features as the paper contract. In addition, it has more technological features that are even more advantageous to us compared to paper contracts. Some of these advantages are that the smart contracts are decentralized, distributed, immutable, and settlement occurs faster [21].

Whether a smart contract is legally enforceable or not depends on whether the smart contract meets the requirement of a valid legal contract. This will also depend on what law applies and the jurisdiction in which the enforcement is called [22]. Since the smart contract is a relatively new and one of the emerging technologies, it may not have been evaluated and tested by regional or national law. Nevertheless, smart contract's enforceability should not be ruled out simply because they are written entirely in computer code for automation and self-execution. As long as a smart contract behaves like a traditional paper legal contract and complies with the national/provincial/state law, the current legal system should not have any issue in adopting the smart contract.

The following are the significant requirements, also named by the authors as five A's that a smart contract needs to fulfill to be adopted by the current legal system for legal enforceability.

A. Admissibility

The term admissible means that something can be accepted. For a smart contract to be admissible in the court of law, it must prove that it is valid in the proceeding or comply with the law. A smart contract should be admissible in the court of law just like a traditional paper contract, as the smart contract also behaves the same way the paper

contract does. Additionally, the smart contract also has all the major components that make it a legally enforceable contract. Hence, for this reason, a smart contract describes the information and has the characteristics that are pertinent to a resolution of issues in any kind of judicial proceedings so that a judge or jury can consider such information and characteristics to make a decision.

B. Authenticity

Many documents must fulfill the criteria of authenticity in the court of law for them to be legally enforceable. Authenticity defines that the process by which the information and characteristics of a smart contract are proven to be veritable and legitimate. For anything to be legitimate and legally enforceable, it should be genuine and not a forgery. One of
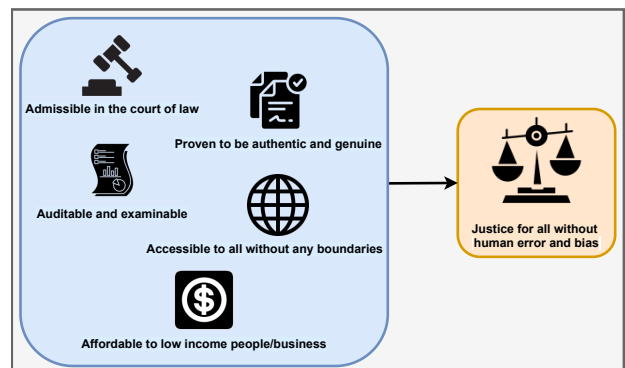

Fig. 4. Major requirements, also known as 5 A's for Smart Contract's enforceability. These 5 A's proves why a smart contract provides justice for all without any human errors and biases and is perfectly legally enforceable.

the major traits of the smart contract is immutability which is the biggest proponent of authenticity because once the smart contract is written and deployed onto the blockchain, it can neither be modified nor changed to maintain its integrity and legitimacy.

C. Auditability

Auditability of the smart contract or any kind of document is a core part of legal compliance from the judicial perspective. This feature of auditability and the audit logs enables the court to examine and verify when the smart contract was created, deployed into the blockchain, signed, and used to make a transaction. In addition, the smart contract and the transactions made via the smart contract give involved parties detailed and tamper-proof timestamped audit logs of every event.

D. Accessibility

The contract law should not, in any case, be out of reach of the parties, and there should be no sense of discrimination. The terms and agreements in the legal contract should be fair and unbiased all the time. For example, when multinational companies are legally bounded by traditional paper or electronic contracts, the companies' corresponding government will have limited power over companies from different governments. However, if these multinational companies had been using smart contracts, there would be no discrimination and differentiation between any country and their legislation and judicial practice. Hence, smart contracts ensure their reach to everyone equally.

E. Affordability

Hiring a contract lawyer to review our written agreements in paper contracts in the contracting process is one of the principal steps, as the words and formats used in the paper contract need to be very specific and must follow a certain pattern to be legally binding. Although hiring and working with a contract attorney will probably ensure that the agreements are admissible in court and are legal, it is still very pricey. Depending on the situation, when a lawyer or an attorney is hired, just for the review of the paper contract, the price can be unreasonably high, ranging from at least $500 to $1000. To make it worse, if people actually hire an attorney to draft and negotiate the contract for them, the price can be even exorbitant.

On the other hand, the development and deployment cost of the smart contract is expensive as well. Moreover, proper auditing and testing of the smart contract are costly as it requires people with special expertise and background. In addition, when deployed to the main net and when making transactions with the smart contract, the incurred gas fee and transaction fee can be excessively high too. Currently, it may seem that the smart contract is not fit for small and mid-sized businesses because of the development and deployment cost of the smart contract. Although the development cost and deployment cost of the smart contract is also expensive

currently, it is inevitably true that in the future, the cost of adopting the smart contract will plummet down as these days, the cost of cryptocurrencies are just exaggeratingly high due to immature market of cryptocurrencies and other factors.

VI. ACTIVE RESEARCH TOPICS IN SMART CONTRACTS AND EMERGING TECHNOLOGIES IN LEGAL ASPECTS

In spite of smart contracts being itself considered as one of the emerging technologies, there are other technologies as well where researchers are actively collaborating with each other to experiment and amalgamate smart contracts with other disciplines [15], [24], [28], [30], [31]. The smart contract has been providing immense benefits, but there are still various challenges on how to derive the smart contract from the legal contract as typically, regular paper contracts are written in natural language and hence creates the high risk of ambiguity, whereas a smart contract is a piece of code or a computer program. Hence, the derivation of a complete smart contract from a vague legal contract is still one of the major challenges.

There are various groundbreaking researches being conducted in the field of Artificial Intelligence (AI) and law using formal models of legal texts and legal reasoning as well [15], [16], [17]. One of the major roles of formal models is to remove ambiguity as regular legal contracts are written in natural language. As a result, there are no parenthesis or brackets; hence, the scope of connectives such as "AND" and "OR" can be vague. There are other words and phrases that are used in legal contracts as well, which are ambiguous. For example, words such as "UNLESS", "REASONABLE", "MAY", "CAN", etc., are capable of several interpretations [22], [23], [29]. Therefore, a lot of novel legal researches include the usage of propositional logic, fuzzy logic, and AI that attempts to understand, interpret and resolve the ambiguity of legal contracts [29].

A. Natural Language Processing

Natural Language Processing (NLP) manipulates the natural language, such as text or speech, by a computer program. NLP is a subsection of Artificial Intelligence (AI) that does not only help computers to understand human language but also to interpret it. NLP has roots in disciplines such as computer science and computational linguistics. Recently, computational law research using NLP has been a hot topic as computational law involves analyzing natural language-based data and documents such as legal contracts in a considerable quantity. Therefore, modern machines and programs can analyze more language-based data and documents than humans consistently without any fatigue and bias.

There has been a massive increase in the demand for software development for the automation of tasks due to the growth of legislation. Presently, an analyst or an attorney is required who is expensive to hire to draft and interpret the law in legal activities. Nevertheless, there is always an issue of ambiguity and vagueness in the legal documents and contracts as they are written in plain natural language, which creates

multiple interpretations for multiple parties involved in the legal action. For instance, the word "book" has numerous meanings. One is the verb that means to reserve, and the other is the noun that means something to read from. Attorneys overlook these issues intentionally or unintentionally when they draft and analyze the contracts as they review and analyze thousands of legal contracts full of ambiguous words and legal jargon. Instead, researchers are using NLP so that they can pinpoint the specific vague terms and provide correct revisions for improvement [31]. Furthermore, NLP experts are trying to create a computational model to generate smart codes from the analysis of legal contracts, using NLP and Blockchain-based smart contracts so that they don't leave room for ambiguities.

B. Machine Learning and Deep Learning

As NLP technologies have been involved more in attempting to review, analyze, interpret, and generate the logic for the smart contract's development, more research is going on at the security side of the smart contracts where machine learning has been used [16], [24], [30], [31]. Just like NLP, machine learning is also considered to be a subset of AI. Machine learning is defined as a branch of AI and computer science that focuses on using the available data and algorithms to imitate the way humans learn by improving their learning accuracy eventually. On the other hand, deep learning is a subset of machine learning and AI that is a neural network with three or more layers where these neural networks simulate the human brain's behavior. Deep learning algorithms are more modern and accurate for learning something than machine learning algorithms but require more data to learn.

In recent years, hackers and malicious attackers have not only been exploiting vulnerabilities in web-based systems but also in blockchain-based smart contracts, which has resulted in huge economic and financial loss. For that reason, to find out and detect these vulnerabilities of the smart contracts, the researchers have used an analysis model that uses machine learning extensively [24]. These studies have successfully shown that their analysis model can predict various types of vulnerabilities, particularly in smart contracts of Ethereum blockchain written in Solidity language such as access control, arithmetic, denial of service, re-entrancy, etc. with accuracy, precision, and recall with more than 90% [15].

Machine learning has not only been used just for prediction and detection of smart contract vulnerabilities but also have been used for legal contracts management [32]. Machine learning helps in identifying and analyzing the clauses and other relevant data in the contracts. Besides, it also has been allowing business companies to review thousands of contracts quickly by classifying the contract according to its relevancy, classifying the clause, pinpoint a significant part of the clause, and learn more about new clauses.

Nevertheless, machine learning and deep learning typically take a lot of computer processing power and memory. On the other hand, blockchain costs a lot for any processing, storing, or computer processing power as well. Since anything inside the blockchain costs money and is usually expensive, the cost factor of using machine learning and deep learning inside the smart contract or the blockchain still remains a significant challenge.

C. Internet of Things (IoT)

Internet of Things, also known as IoT, is a large number of devices connected to the internet to share data with each other. These internet-connected devices use sensors to gather data and communicate with each other so that humans can improve their living and working lifestyles. One popular example of IoT is a smart home that automatically adjusts heating and lighting to a smart factory that monitors industrial machines to look for problems and then automatically adjusts to avoid failures.

IoT establishes an excellent combination with blockchain-based smart contracts, particularly when it comes to business, financial and legal transactions as they are traditionally authorized by a third party, such as a bank or a court, making the transaction process complex and time-consuming. When smart contracts are used with IoT, it will solve a plethora of problems such as the publishing of secure software updates as URLs on the blockchain that includes cryptographic hash that IoT devices can validate and allowing of automatic payments to everyone on the IoT network and ensuring of micropayments made between the IoT devices as well, and sending of accurate information on food temperature for frozen items to the blockchain network by the IoT sensors so that the data can be analyzed among stakeholders to ensure the quality and freshness of the frozen foods. IoT also helps in security vulnerabilities by allowing the data sharing more securely across stakeholders, automating transactions, verifying identification and authentication, and reducing costs by disintermediating mediators when merged with blockchain-based smart contracts [24], [32]. For instance, the status of the IoT network will be improved by allowing devices to register and validate themselves, self-executing contracts, and reducing the threat of cyber attack since there would be no central system to attack [24]. Therefore, when combined with IoT, blockchain-based smart contracts will let us gain immense benefits.

VII. Conclusion

A blockchain-based smart contract is in the germination phase, but it is also one of the hottest topics and emerging technologies. It is spread not just in the scope of computer science but also towards computational law and computational linguistics. We have discussed why a smart contract is advantageous and beneficial to bring into practice now. Due to its unique features such as self-executability and self- enforceability, distributive and decentralized nature, immutability, cryptographically secured, and faster settlement process, it is undoubtedly a better legal contract compared to the traditional versions of contracts. In addition, it is also better than conventional contracts because it entirely eliminates the issues of ambiguity in the contract as it is

written in the code. As a result, the involved parties in the contract would not have to suffer from confusion, multiple interpretations, and misunderstandings. Therefore, the smart contract is the answer for an effective and efficient tool that can accommodate in increasing the clarity and accuracy and reducing the complexity of the dispute settlement process.

This paper provides an extensive overview of the entities and components of a contract and the evolution of a contract. The contract originated as a paper contract and is still widespread worldwide from tiny to large tasks, but the development kept on advancing. Eventually, the paper contract evolved to electronic or digital contract and from digital contract to Artificial Intelligence-based contract and finally to Blockchain-based smart contract. Looking back at the developmental trends in computer science and information technology sector, it is evident that the paradigm shift of the contract from the traditional paper contract is not going to stop at Blockchain-based smart contract. There will be other advanced technologies in the future that will adopt the contract and add more features and make the contract even more versatile and efficient. Regardless of how advanced and smart the contract is, the usability of such smart contracts should always be encouraged, and the legal enforceability of such smart contracts should always be maintained. We hope that this paper will facilitate the researchers currently working on legal contracts and smart contracts to find new paths and open problems to tackle in the coming years.

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