

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 9, Issue 7, July 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

 \odot

Impact Factor: 7.542

9940 572 462

6381 907 438

🛛 🖂 ijircce@gmail.com

🙋 www.ijircce.com

International Journal of Innovative Research in Computer and Communication Engineering

|e-ISSN: 2320-9801, p-ISSN: 2320-9798| <u>www.ijircce.com</u> | |Impact Factor: 7.542



|| Volume 9, Issue 7, July 2021 ||

| DOI: 10.15680/LJIRCCE.2021.0907070 |

Legal Agreements to Smart Contract using Blockchain Technology

Thorlikonda Balasundar, Thota Bharadwaj, Pulivarthi Balakrishna Prasad, Pachhala Nagababu

Assistant Professor, Department of Information Technology, Vasireddy Venkatadri Institute of Technology, Guntur,

Andhra Pradesh, India

UG Students, Department of Information Technology, Vasireddy Venkatadri Institute of Technology, Guntur,

Andhra Pradesh, India

ABSTRACT: Complex legal agreements enable many real-world applications, from data sharing systems to financial transactions. However, legal expenses scale with complexity because of the manual processes to draft, revise, and enforce agreements. To reduce such costs, we propose a new framework for lawyers to develop machine readable legal agreements, which are automatically verified and deployed on the Ethereumblockchain. Specifically, our framework introduces domain specific repositories to store human and machine readable legal language, a web interface and Python API to draft legal agreements, correctness checking via formal verification, and a voting system for blockchain based adjudication. Experimental evaluation found that our proposed framework offers an efficient verification system, incurs linear scaling of Ethereum blockchain gas consumption in terms of agreement size, and correctly models 81% of conditions in real world agreements through the domain specific repositories. These results suggest a practical approach for developing verifiable and blockchain compatible legal agreements

I. INTRODUCTION

"Smart contracts" is a term used to describe computer code that automatically executes all or parts of an agreement and is stored on a blockchain-based platform. As discussed further below, the code can either be the sole manifestation of the agreement between the parties or might complement a traditional text-based contract and execute certain provisions, such as transferring funds from Party A to Party B. The code itself is replicated across multiple nodes of a blockchain and, therefore, benefits from the security, permanence and immutability that a blockchain offers. That replication also means that as each new block is added to the blockchain, the code is, in effect, executed. If the parties have indicated, by initiating a transaction, that certain parameters have been met, the code will execute the step triggered by those parameters. If no such transaction has been initiated, the code will not take any steps. Most smart contracts are written in one of the programming languages directly suited for such computer programs, such as Solidity.

At present, the input parameters and the execution steps for a smart contract need to be specific and objective. In other words, if "x" occurs, then execute step "y." Therefore, the actual tasks that smart contracts are performing are fairly rudimentary, such as automatically moving an amount of cryptocurrency from one party's wallet to another when certain criteria are satisfied. As the adoption of blockchain spreads, and as more assets are tokenized or go "on chain," smart contracts will become increasingly complex and capable of handling sophisticated transactions. Indeed, developers already are stringing together multiple transaction steps to form more complex smart contracts. Nonetheless, we are, at the very least, many years away from code being able to determine more subjective legal criteria, such as whether a party satisfied a commercially reasonable efforts standard or whether an indemnification clause should be triggered and the indemnity paid.

Before a compiled smart contract actually can be executed on certain blockchains, an additional step is required, namely, the payment of a transaction fee for the contract to be added to the chain and executed upon. In the case of the Ethereumblockchain, smart contracts are executed on the Ethereum Virtual Machine (EVM), and this payment, made through the ether cryptocurrency, is known as "gas." The more complex the smart contract (based on the transaction steps to be performed), the more gas that must be paid to execute the smart contract. Thus, gas currently acts as an important gate to prevent overly complex or numerous smart contracts from overwhelming the EVM. Smart contracts are presently best suited to execute automatically two types of "transactions" found in many contracts: (1) ensuring the payment of funds upon certain triggering events and (2) imposing financial penalties if certain objective conditions are not satisfied. In each case, human intervention, including through a trusted escrow holder or even the judicial system, is

International Journal of Innovative Research in Computer and Communication Engineering

|e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.542

Volume 9, Issue 7, July 2021

| DOI: 10.15680/IJIRCCE.2021.0907070 |

not required once the smart contract has been deployed and is operational, thereby reducing the execution and enforcement costs of the contracting process.

As just one example, smart contracts could eliminate the so-called procure-to-pay gaps. When a product arrives and is scanned at a warehouse, a smart contract could immediately trigger requests for the required approvals and, once obtained, immediately transfer funds from the buyer to the seller. Sellers would get paid faster and no longer need to engage in dunning, and buyers would reduce their account payable costs. This could impact working capital requirements and simplify finance operations for both parties. On the enforcement side, a smart contract could be programmed to shut off access to an internet-connected asset if a payment is not received. For example, access to certain content might automatically be denied if payment was not received.

II. EXISTING SYSTEM

Existing projects, such as Ergo, model legal agreements as software programs by embedding machine readable functions inside legal clauses. Ergo provides a repository of clauses that users can import into their agreements, and it supports Coq for formal verification. Unlike Ergo, which focuses on representing the commonly used parts of a legal agreement via a functional programming language, our framework models the entire agreement via combinational logic and thus can formally verify the entire agreement.

III. PROPOSED SYSTEM

When instantiated, the lawyers must provide parameters to populate the text template, a list of parties who can update the state of the action, and a list of independent arbiters who can adjudicate disputes. When deployed as an Ethereumblockchain smart contract, the parties can propose updates to the state of any action. The other parties, and arbiters in the case of a disagreement, vote to decide whether to update the action state. The design of an action was based on concerns raised in that some inputs into programmatic agreements require human judgment. Clauses use deterministic combinational logic to resolve combinations of actions or other clauses (recursively) to a single Boolean output.

ARCHITECTURE:



Fig 1: Architecture diagram of legal agreement

International Journal of Innovative Research in Computer and Communication Engineering

|e-ISSN: 2320-9801, p-ISSN: 2320-9798| <u>www.ijircce.com</u> | |Impact Factor: 7.542



Volume 9, Issue 7, July 2021

| DOI: 10.15680/IJIRCCE.2021.0907070 |

IV. RESULTS

A MARANATI B	• - • ×
C (D 12/0015000	ti 📑 🛤 🗮 💴 1
	💼 🛛 🕈 🖪 🖉 🏝 S P 🖉 S 🔺 S C S P S M S N S A S P S I S N P 🗎 Burleye.
d Agreements	
ents and and and other	Legal Agreements
	Our fragmants persents ten interfaces a Putter All and peak and click web fragment in
	which one can write a legal agreement.
	The Python interface exposes all features of the framework. The web-based interface
	supports drafting an agreement by importing clauses from the repositories, writing custom clauses, and converting agreements to Wyper for deployment on the Ethereum blockhain.
and all the second and the	
	Refer Diversity Barry D
This is a representation of the random of constance database of the off is such more	
Affeatab yap	
· · · · · · · · · · · · · · · · · · ·	
Legal Agreements	
6 100 1600 2100 2000 9.	Legal Agreements
	8 8
	Our framework presents two interfaces, a Python API and point-and-click web frontend, in
	which one can write a legal agreement.
	The Python interface exposes all features of the framework. The web-based interface supports drafting an agreement by importing clauses from the repositories, writing custom
	clouses, and converting agreements to Vyper for deployment on the Ethereum blockchain.
and the second s	
and the second se	Test
	Go to Legal Search
This is a representation of the number of cases in our distribute registered is each state.	
This is a representation of the number of cases in our database registered is each state.	

Fig 2: Interface of Legal Agreement

Physical and a straight of the second					
					S
					0.00
			-		
0926	1239 1475 0941 0487 1568	1212 0341 1315 0702 1508 04	00 1665 1295 1595 00117	1147 0229 1759 1551	
881 9627 1376 1376	0436 1214 0803 0111 1962 a	1721 03730087 0357 0069 1914	1149 1114 0052 0 0416	1481 1189 0332	10301
1205 0346 0781	2 1548 0404 0729 0464	0045 0000 1561 0106 1517	0552 0323 0662	0961 0613 000516040100	1279 0815
415 1115 1564 1746 0405 01	1954 1598	004400312 1691 0649	1769 1136 0388 1	1507 0542 1976 0922 0	19 1353 0987
	1301 04/92/02/35 1409	0701 1165 0500 0	060 1124 0563	. 1997	
tion connects similar document	ents. Hover over a document to r	Appear Dismissed Appeal All Appear Appeal All Appear the keywords it contains! Clivered Appear Appe	towed to on the legend to see the	e 2 categories individually	
Enter Query					
Search by Appellatis	Seconds by	Approval Nex.	Search by Date		
C @ 127.0.0.1/5000/wskquery/que	ry - think				4 P 0 5
	in a m a m a k a O	3 8 9 8 9 9 <u>7</u> 9	P & O + O × O F O	AM ON OA OF OI	G 174 - El Rei
al-Agreement					
Legal St	itements matching your Que	ery (Click to Download)			
ase #1482					
Penal Codes: s. 302, s. 120, s. 34					
n Penal Codes: s. 302, s. 120, s. 34 ed No. Accused No					
n Penal Codes: s. 302, s. 120, s. 34 eed No. Accused No					
n Penal Codes: s. 302, s. 120, s. 34 and No. Accused No ase #1692 n Penal Codes: No IPCs in this file					
n Penal Codes: s. 302, s. 120, s. 34 and No. Accused No asse #1692 n Penal Codes: No IPCs in this file view of the judicial Commissioner, tem	nation of employment of a temporary serv	ant governed by the Central Civil Services	(Temporary Bervice)		
n Penal Codes: s. 302, s. 120, s. 34 eed No. Accurated No asse #1692 n Penal Codes: No IPCs in this file view of the judical Commissioner, then view of the improve years are a syment of a temporary employee is pas	ination of employment of a temporary service instrument of dismissait or removal, but it is add to accenters what ther the order was into	int governed by the Central Civil Services open to the Court even if an order memory index to be of termination simplicitier or of	(Temporary Bervice) of termination of Istemisal entailing penal		
n Penal Codes: s. 302, s. 120, s. 34 and Nr. Accusated Nr anne #1052 n Penal Codes: No IPCs in this file View of the judicial Conveniencer, terr systems of a terroprove single part of the statistic coder clasted Age operations, and that the order clasted Age operations, and that the order clasted Age	station of employment) of a temporary serve ed to assortain whattee the order was inte 11. 1996, of the Oner Commission pase Profession Developer Add and an employment	ant governme by the Central Circl Services relation to be of termination samplicities or of all in appeal clearly indicated that the ords do by the Control vehice the other of services	(Temporary Service) of tempsation of Interessationaling prevai tempsations and the service seal of a public servant		
n Penal Codes: a. 302, a. 120, a. 34 and No. Accusate No and Michael No and Michael No n Penal Codes: No IPCs in this file view of the judical Commissioner, tem 1 (VM), with expression per an be transmitted as a p openness, and that the order dated Apr openness, and that the order dated Apr upant	Institut of employment of a temporary serv estimate of discusses or temporary serv stationart of discusses or temporary 11, 1959, of the Cheld Commissioner pass (Instatistical Disputes Act) and an employ m	ant governed by the Central Chill Services open to the Court even if an order merely ed in appeal clearly indicated that the ord- ada by the Court where the order of disni	(Temporary Bervice) of temporary preval of the Supermersheet of the Supermersheet seal of a public servant		
en Penal Codes: a 302, a 120, a 34 mark 16, Accument No	ination of exployment of a temporary ser- instance of discussion or removal, but is to 1, solet and without the order was into 1, solet and without the order was into producting Disputes Act) and an employ re	tent governed by the Central Civil Bervices open to the Court even if an order manage de in append clearly included that the order also by the Court where the order of dism	(Terreporary Service) of terreport for the service of the service of the service seal of a public service		
an Penal Codes: a. 302, a. 120, a. 34 ment Nr. Accusant No	station of employment of a temporary serve and to ascertain whatther the order was inte 11. 1990; of the Chart Commission pase Industrial Disjustice Act and employe Industrial Disjustice the Court at the relevan	and government by the Centreful Cost Bernstein open to the Court even if an order manage make to be of termination simplicities or of adde by the Court where the onlive of disret of facts relating to the imprograd detection	(Temporary Bervice) Itemsal entaing penal of the Superinterdet at the superinterdet at the patient service		
an Penal Codes: 6, 302, 6, 120, 6, 24 med No. Accusado No Sano & 1502 an Penal Codes: No IPCs in this fills o view of the publicad Conversion results of the organized set of the organized set of the set of the set of the set of the organized set of the set of the set of the set of the organized set of the set of the set of the set of the organized set of the set of the set of the set of the organized set of the set of the set of the organized set of the set of the set of the organized set of the set of the set of the organized set of the set of the set of the organized set of the set of the set of the organized set of the set of the set of the organized set of the set of the set of the set of the organized set of the set of the set of the set of the organized set of the set of the set of the set of the organized set of the set of the set of the set of the organized set of the set of the set of the set of the organized set of the organized set of the	Institut of employment of a temporary service instrument of dismassi or removal, but it is submetted and the characteristic of the service 11, 1998, of the Characteristic one pass (Instruction Disputes Act) and an enclose pass (Instruction Disputes Act) and an enclose the to place before this Court at the relevance (Instruction Disputes Act) and the relevance (Instruction Disput	seri governed by the Central Civil Services open to the Court even if an order marry of the Court even if an order marry of a segred clearly included that the order also by the Court scheme the order of distri- net facts in relating the the importance detector by responsible officers on the assumption facts, it is, therefore, no the assumption	(Temporary Bervice) of tematuation of of tematication of or of the Supportendent seal of the Supportendent seal of the Supportendent seal of the Substantiation of the theory of the Substantiation what the Substantiation of the Substantiation of the seal of the Substantiation of the Substantiation of the Substantiation of the Substantiation of the Substantiation of the Substantiation of the Substantiation of the Sub		Chapters

Fig 3:Interaface of legal Agreement



Fig3: Interface of Legal Agreement

V. CONCLUSION

Our framework enables lawyers to use a web interface to write legal agreements that can be automatically verified via formal verification and deployed on the Ethereumblockchain for lower adjudication costs when disputes arise. Storing legal language in repositories enables reuse of human and machine readable legal language across agreements. By having both a web interface and a Python API, our framework is accessible to both legal professionals and software developers alike. We aim to reduce the manual work involved with drafting, checking, and enforcing complex agreements. The evaluation indicates that the framework, through combinational logic, can accurately model 81% of legal constructs found in real-world agreements. The formal verification runtime and blockchain gas costs for generated agreements scale linearly with agreement complexity. These results suggest a practical approach for developing verifiable and blockchain compatible legal agreements

REFERENCES

- 1. Bourke v. Dun & Bradstreet Corp, 59 F.3d 1032 (7th Cir. 1998). [Online]. Available: https://casetext.com/case/bourke-v-the-dun-bradstreet-corp
- Baybank v. Vermont National Bank, 118 F.3d 30 (1st Cir. 1997). [Online]. Available: <u>https://caselaw.findlaw.com/us-1st-circuit/1057693.html</u>[3] Lease abstraction. Kira Systems. [Online]. Available: <u>https://kirasystems.com/solutions/lease-abstraction/</u>
- Garoufallou, S. Virkus, R. Siatri, and D. Koutsomiha, Eds., Toward a Metadata Framework for Sharing Sensitive and Closed Data: An Analysis of Data Sharing Agreement Attributes. Cham: Springer International Publishing, 2017. [Online]. Available: <u>http://cci.drexel.edu/media/19189/</u>metadata-for-sharing-closed-data-grabus-greenberg-56-mtsr2017.pdf











INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

🚺 9940 572 462 应 6381 907 438 🖂 ijircce@gmail.com



www.ijircce.com