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Blockchain Security: Work On Securing Blockchain networks and smart contracts

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ABSTRACT

Blockchain has been one of the most trending areas among the field of technology in recent years. In particularly the financial industry has taken the advantage of such distributed ledger technology in creation of cryptocurrency and broadening of a new sector of the digital market. However, blockchain with its unique characteristic of immutability and transparency can provide much more potential usage in other industries. This project makes use of blockchain's security and traceability to create a platform that can better protect copyright and fair use of media by providing secure storage and usage tracking. This report iterates the project background and objective, and provides an assessment of the progress to date. There are also results from completed milestones, such as justified engineering decision on the development of web application; conceptual class model that supports the design of blockchain and use cases; user interface design that depicts the anticipated product; and an overview of the implementation of a preliminary demo.Discussion of the difficulties encountered in the current stage is the smart contract construction in blockchain after the use case and system architecture design. The remaining work will be on the implementation and testing of the demo, thus indicating an ideal progress for demo implementation in the coming month.

Keywords: cryptography, Decentralization, consensus,and Decentralized Applications.

1. INTRODUCTION

Recent year'sblockchain has emerged as a revolutionary technology and has received interest across a wide span of sectors. Blockchain was originally developed to record transactions across a peer-to-peer network of computers (nodes). In a blockchain, the transactions are recorded on a distributed ledger, which are secured using a cryptographic proof. New transactions are added to the blockchain according to a decentralized consensus protocol. The decentralized consensus protocol, which enables execution of transactions without the need of a central authority, is one of the major innovations of the blockchain technology. In a blockchain, data is held on all of the nodes at the same time, which eliminates a single point of failure. Distributed storage of the ledger through cryptographic proof and decentralized consensus protocol ensures the security of the blockchain.

Developments in the blockchain technology have led to the discovery of smart contracts, which are computerized protocols whose execution is guaranteed through a code that runs on the decentralized blockchain. A smart contract enables automated execution of contract clauses without requiring any trusted intermediaries. The unique features of blockchain enable major advantages for development of decentralized applications.

Blockchain presents serious disruptions to the traditional business processes, which is mainly based on centralized architectures requiring trusted third parties. In particular, smart contract technology promise a major potential to reshape conventional industry and business processes as they can decrease administration and service costs, improve efficiency, and enhance trust among stakeholders by providing a decentralized trustless automated system. The applications of blockchain for financial services, construction, operations in supply chain, energy, government and public sectors.

Sought to identify how blockchain can address purchase management, contract management, asset and inventory management, finance management and subcontractor management in the construction industry. Mentioned the potential of blockchain to improve project management practices. However, very limited research has focused on the state-of-the-art of blockchain applications in project management. Hence, within this context, the first objective of this paper is to fill this gap, to provide a systematic review and analysis of the state-of-art blockchain research in project management, mainly focusing on the use cases. The design of the blockchain system is among the key technical factors impacting adoption of blockchain technologies. The second objective of the paper is to present a decision framework based on the review findings, to guide implementers and researchers on technical design decisions for maximizing the benefits of blockchain applications in project management. Along with the review and the framework, future research directions are suggested to enhance adoption of blockchain in the project management domain.

2. LITERATURE REVIEW

The Basics of Bitcoins and Blockchains: An Introduction to Cryptocurrencies and the Technology that Powers Them by Antony Lewis Year-2019 "Bitcoin, Ethereum, and other cryptocurrencies. Gain an understanding of a broad spectrum of Bitcoin topics. The Basics of Bitcoins and Blockchains covers topics including the history of Bitcoin, the Bitcoinblockchain, and Bitcoin buying, selling, and mining. It also answers how payments are made and how transactions are kept secure. Other cryptocurrencies and cryptocurrency pricing are examined, answering how one puts a value on cryptocurrencies and digital tokens [1].Blockchain technology.Blockchain technology underlies all cryptocurrencies and cryptocurrency transactions. But what exactly is a blockchain, how does it work, and why is it important? The Basics of Bitcoins and Blockchains answer these questions and more. Learn about notable blockchain platforms, smart contracts, and other important facets of blockchains and their function in the changing cyber-economy [1].

The Truth Machine: The Blockchain and the Future of Everything by Paul Vigna& Michael J. Casey"Big banks have grown bigger and more entrenched. Privacy exists only until the next hack. Credit card fraud is a fact of life. Many of the “legacy systems” once designed to make our lives easier and our economy more efficient are no longer up to the task. Yet there is a way past all this—a new kind of operating system with the potential to revolutionize vast swaths of our economy: the blockchain [2].

In The Truth Machine, Michael J. Casey and Paul Vigna demystify the blockchain and explain why it can restore personal control over our data, assets, and identities; grant billions of excluded people access to the global economy; and shift the balance of power to revive society’s faith in itself. They reveal the disruption it promises for industries including finance, tech, legal, and shipping [2].

Blockchain Revolution: How the Technology behindBitcoin Is Changing Money, Business, and the World by Don Tapscott& Alex Tapscott"Blockchain technology is powering our future. As the technology behind cryptocurrencies like bitcoin, open software platforms like Ethereum, and disruptive companies like Ripple, it’s too important to ignore.In this revelatory

book, Don Tapscott, the bestselling author of Wikinomics, and his son, blockchain expert Alex Tapscott, bring us a brilliantly researched, highly readable, and essential book about the technology driving the future of the economy [3].Blockchain is the ingeniously simple, revolution-ary protocol that allows transactions to be simultaneously anonymous and secure by maintaining a tamperproof public ledger of value. Though it's best known as the technology that drives bitcoin and other digital cur-rencies, it also has the potential to go far beyond currency, to record virtually everything of value to humankind, from birth and death certifi-cates to insurance claims, land titles, and even votes. "

Blockchain Basics: A Non-Technical Introduction by Daniel Drescher"A blockchain is a distributed ledger that is replicated across multiple nodes and enables immutable, transparent and cryptographically secure record-keeping of transactions. The blockchain technology is the backbone of cryptocurrencies, and it has applications in finance, government, media and almost all other industries. Mastering Blockchain, Second Edition has been thoroughly updated and revised to provide a detailed description of this leading technology and its implementation in the real world [4]. This book begins with the technical foundations of blockchain technology, teaching you the fundamentals of distributed systems, cryptography and how it keeps data secure. You will learn about the mechanisms behind cryptocurrencies and how to develop applications using Ethereum, a decentralized virtual machine. You will also explore different other blockchain solutions and get an introduction to business blockchain frameworks under Hyperledger, a collaborative effort for the advancement of blockchain technologies hosted by the Linux Foundation. You will also be shown how to implement blockchain solutions beyond currencies, Internet of Things with blockchain, blockchain scalability [4].

3. EXISTING SYSTEM

Client-server architecture is a foundational concept in the realm of distributed computing, delineating the relationship between service requesters (clients) and service providers (servers) [4]. This model operates on a principle of division of labor, where clients, typically devices or applications, initiate requests for services or resources, while servers, robust computing entities, fulfill this requests.Communication between clients and servers is facilitated through standardized protocols over a network, with each client-server interaction adhering to a request-response paradigm. Clients send requests specifying the desired service or resource, and servers process these requests, returning responses containing the requested data or confirming the action taken.

One of the defining characteristics of this architecture is statelessness, where servers do not retain information about previous client interactions, treating each request independently. This fosters simplicity and scalability, allowing systems to efficiently handle varying workloads.Moreover, client-server architecture enables scalability both vertically, by augmenting the resources of individual servers, and horizontally, through the addition of more servers to distribute the workload. Security remains paramount in this architecture, with measures such as authentication, encryption, and access control implemented to safeguard data integrity and confidentiality [6]. Overall client-server architecture provides a robust framework for building distributed systems, facilitating collaboration, resource sharing, and seamless access to services across networks.

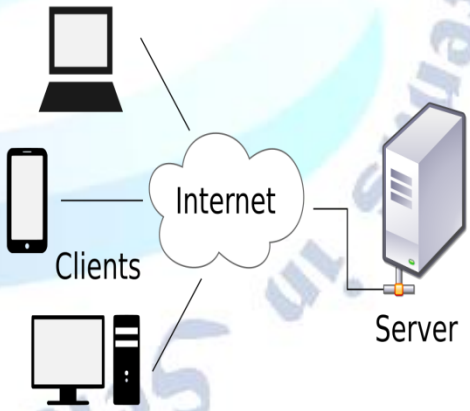
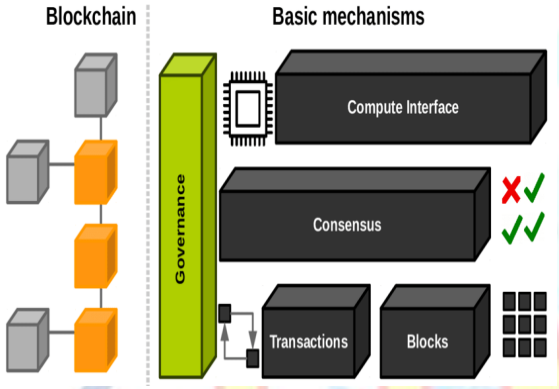


Fig 1:Client-server architecture

4. SYSTEM MODELLING

Peer-to-peer (P2P) network architecture diverges from the client-server model, fostering a decentralized approach where peers, or individual nodes, act both as clients and servers. In this setup, each node has equal

standing, contributing resources and services while consuming those provided by others. Communication within a P2P network occurs directly between peers, without relying on centralized servers. Peers collaborate to share files, distribute computing tasks, or provide other services, creating a distributed ecosystem of interconnected nodes. Unlike client-server architectures, P2P networks often exhibit greater resilience to node failures or network disruptions since there's no single point of



failure. However, managing security, authentication, and data integrity can be more challenging in P2P environments due to the absence of centralized control.P2P networks can be categorized into structured and unstructured architectures [4].

Structured P2P networks organize peers into a specific topology, often utilizing distributed hash tables (DHTs) for efficient resource location. Unstructured P2P networks, on the other hand, lack a predefined structure, relying on techniques like flooding or random walks for resource discovery. Peer-to-peer architecture has found applications in various domains, from file sharing platforms like BitTorrent to decentralized cryptocurrencies like Bitcoin. Its decentralized nature promotes collaboration, resource sharing, and resilience, making it suitable for scenarios where centralized control is impractical or undesirable. However, effective management of security and scalability remains essential considerations in P2P network design and deployment [4].

5. System Architecture

Blockchain networks can be categorized into different topologies, including public, private, and consortium (or permissioned) networks. In a public blockchain, anyone can join the network, participate in consensus, and read/write data. Examples include Bitcoin and Ethereum. Private Blockchains restrict participation to authorized entities, making them suitable for enterprise use cases where privacy and control are paramount.

Fig 2: **System Architecture**

Consortium blockchains are semi-decentralized networks controlled by a predefined group of participants, often used in industries where collaboration is necessary, such as supply chain [5].

Consensus Mechanism

Consensus mechanisms are protocols that ensure all participants agree on the state of the blockchain. Popular consensus mechanisms include Proof of Work (PoW), where miners compete to solve cryptographic puzzles to add new blocks Proof of Stake (PoS), where validators are chosen to create new blocks based on the amount of cryptocurrency they hold and Practical Byzantine Fault Tolerance (PBFT), where a predetermined set of nodes collectively agree on block validity. Each consensus mechanism has trade-offs in terms of security, scalability, and energy efficiency [4].

Proof of Work (POW) Algorithm

Proof of work (POW) describes a consensus mechanism that requires a significant amount of computing effort from a network of devices. The concept was adapted digital tokens by Hal Finney in 2004 through the idea of "reusable proof of work" using the 160-bit secure hash algorithm 1 (SHA-1) [5].Following its introduction in 2009, Bitcoin became the first widely adopted application of Finney's PoW idea (Finney was also the recipient of the first bitcoin transaction) [4].This explanation will focus on proof of work as it functions in the network. Commonly called a cryptocurrency, Bitcoin is technically a token—a representation of ownership of value on the Bitcoinblockchain. The ownership of the token can be exchanged for something of equal value, much like how you hand someone a dollar for a candy bar—they now have the dollar and you have the candy bar.

Blockchains are that record all bitcoin transactions, similarly to how you would enter transactions in a spreadsheet. Each block is similar to a cell [6].

Information such as transaction amounts, wallet addresses, time, and date are recorded and encrypted into a block header—a hexadecimal number created through the blockchain's hashing function. The hash from each block is used in the block that follows it when its hash is created. This creates a ledger of chained blocks that cannot be altered because the information from every block is included in the newest block's hash.

6. CONCLUSION

In conclusion, blockchain technology represents a paradigm shift in the way we conceptualize and implement systems of trust, transparency, and decentralization. At its core, blockchain offers a distributed ledger that records transactions across a network of computers in a secure, immutable, and transparent manner. This fundamental innovation has profound implications across various industries and sectors, ranging from finance and supply chain management to healthcare and beyond. The key strengths of blockchain technology lie in its ability to eliminate the need for intermediaries, reduce transaction costs, enhance security, and enable unprecedented levels of transparency and accountability. By decentralizing data storage and validation, blockchain mitigates the risk of single points of failure and malicious manipulation, fostering a more resilient and trustworthy ecosystem.Moreover, blockchain facilitates the creation of smart contracts, self-executing agreements with predefined conditions written directly into code. Smart contracts automate and enforce the terms of agreements, reducing the need for manual intervention and intermediaries, while enhancing efficiency, accuracy, and compliance. However, blockchain technology is not without its challenges and limitations. Scalability, interoperability, regulatory compliance, and energy consumption are among the key areas that require further research and innovation. Additionally, concerns around privacy, data governance, and environmental sustainability need to be addressed to realize the full potential of blockchain in a responsible and inclusive manner.

7. FUTURE SCOPE

The future scope for blockchain security and smart contracts is promising, with ongoing advancements aimed at enhancing the resilience and efficiency of these technologies. In the realm of blockchain security, developments in consensus mechanisms, encryption techniques, and decentralized identity solutions are anticipated to fortify the integrity and privacy of transactions. Moreover, the integration of artificial intelligence and machine learning algorithms for anomaly detection and threat mitigation holds great potential in bolstering security measures within blockchain networks.

Similarly, smart contracts are poised to revolutionize various industries by automating and streamlining processes, reducing reliance on intermediaries, and ensuring trustless execution of agreements. Future advancements may include the integration of oracles to enable smart contracts to interact with real-world data, as well as improvements in scalability and interoperability to facilitate broader adoption across diverse platforms and ecosystems.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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