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Blockchain and Smart Contract Based Decentralized Rental Platform

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Abstract

The advent of blockchain technology has emerged as a revolutionary influence in contemporary society, restructuring engagements and commerce. It is characterized by a decentralized and distributed network of blocks storing information with digital signatures. Initially developed for digital cryptocurrencies like Bitcoin and Ethereum, blockchain has expanded its utility across various domains, leveraging its core features of decentralization, persistency, anonymity, and auditability. Originally designed for cryptocurrencies, blockchain technology has extended its utility to encompass various sectors such as finance, healthcare, and beyond. This study reviews its use in various sectors, focusing on smart contracts, and identifies research challenges and opportunities over the last decade.

Keywords: Blockchain, review, finance, information systems, wireless networks, smart contracts, technology

INTRODUCTION

In an era marked by technological innovation and a growing demand for efficiency and transparency, the concepts of decentralization, blockchain technology, and smart contracts are at the forefront of revolutionizing various industries. One area where these innovations hold immense promise is in the realm of rental platforms, where landlords and tenants seek a more streamlined, secure, and cost-effective way to engage in property transactions.

The traditional housing rental process has long been plagued by intermediaries, complex agreements, and trust issues between parties. However, the emergence of blockchain technology, with its inherent features of transparency, security, and decentralization, presents a unique opportunity to reshape the way rental platforms operate. By integrating blockchain and smart contracts into the housing rental ecosystem, it becomes possible to establish a decentralized rental platform that can address many of the pain points in the current system [1].

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This study delves into the exciting realm of "Building a Decentralized Rental Platform Using Blockchain and Smart Contracts". We will explore the principles, technologies, and innovative solutions that underpin this transformative approach to housing rentals. By harnessing the power of blockchain, we aim to create a platform that facilitates trust, reduces the need for intermediaries, ensures tamper-proof record-keeping, and streamlines the rental process for both landlords and tenants. Throughout this exploration, we will delve into the fundamental concepts of blockchain technology, its decentralization capabilities, and the role of smart contracts in automating and securing rental agreements. We will also examine real-world

case studies and practical implementations, shedding light on the advantages and challenges associated with building a decentralized rental platform. Ultimately, this study serves as a guide to understanding the potential of blockchain and smart contracts in reshaping the future of housing rentals and creating a more efficient, transparent, and user-centric rental experience.

Problem Definition

Traditional rental systems suffer from inefficiencies, lack of transparency, and the need for trust in centralized intermediaries. Renters often encounter challenges related to payment verification, contractual disputes, and data privacy. Service providers contend with issues such as late payments and fraud. To address these issues and empower a secure and transparent rental ecosystem, our project aims to develop a decentralized rental platform using blockchain and smart contracts.

Existing System

The present system is a collection of decentralized apps created on the blockchain. For deploying, administering, and monitoring their decentralized applications, most software developers lack a practical plan. This means that the application's dependability and security cannot be guaranteed. The most significant nuance in this is how difficult blockchain technology is, though there are other subtleties as well. Software developers seldom consider the influence of the blockchain infrastructure after deployment when structuring business code, which leads to inefficient decentralized systems. Additionally, several applications do not use blockchain, so there is no safety for vehicles. Even when they are not being charged what they should be, pricing changes may still be made depending on the mediator's power.

OBJECTIVES AND OUTCOMES

Efficiency and Cost Reduction

- *Reduced intermediaries:* Blockchain eliminates the need for intermediaries like banks, which can reduce transaction costs.
- *Automated processes:* Smart contracts automate rental processes, reducing administrative overhead.

Dispute Resolution

- *Smart contract escrows:* Smart contracts can hold rental deposits in escrow and automatically release them when the rental period ends without disputes.
- *Immutable documentation*: All interactions and agreements are documented on the blockchain, simplifying the resolution of any disputes.

Transparency and Trust

- *Immutable records:* Blockchain provides a tamper-proof ledger, which creates trust between parties by allowing them to verify rental histories and agreements.
- *Transaction history:* All rental transactions and related interactions are recorded, promoting transparency.

Payment and Financial Transactions

- *Cryptocurrency payments:* Blockchain allows for secure cryptocurrency transactions, reducing the need for traditional banking systems and lowering the risk of chargebacks.
- *Smart contract payments:* Smart contracts can be used to automate rent payments, ensuring timely and transparent transactions.

LITERATURE SURVEY

In recent years, the application of blockchain has been widely researched and used. Smart contracts are a collection of tamper-proof, self-executing algorithms. Smart contracts are similar to real contracts. It can be done by typing the text in the instructions. Take Turing's completed Ethereum smart contract as an example. User can write a contract and own a state machine. When an event occurs, the state of

the state machine will change and the contents of the contract will be executed. This method increases the intelligence of the application. Combining blockchain technology with smart contracts allows transactions to be completed as quickly as possible, at lower cost, and with higher security.

There are three elements of blockchain evolving into better models: Phase 1.0 uses digital currency, Phase 2.0 uses smart contracts, and Phase 3.0 creates programmable blockchains. Slowly but steadily, blockchain's features began to spread into many areas. The introduction of smart contracts has changed the game for blockchain applications. Smart contracts were first developed in the 1990s as a digital business protocol for enforcing agreements. Smart Contracts are repositories of code that encapsulate and reproduce the terms and conditions of real contracts in the digital world.

A contract is a legal agreement between two or more parties in which each party undertakes to fulfil its obligations. The important thing is that the contract is legal. But smart contracts make transactions transparent by replacing a trusted third party between contractors. Crimes are mined and verified by network nodes in a distributed blockchain. They also allow transfers from untrusted individuals. This eliminates the risk of unnecessary direct contact between the parties involved, reliance on third parties and commission fees.

TECHNICAL BACKGROUND

Blockchain Structure

As shown in Figure 1, the structural form of a blockchains, a chain structure in which one block is connected with another. Blocks are connected by hash operation. Hash operation is unidirectional and irreversible. After a certain number of blocks are generated, the transactions packed by blocks will be determined. If you want to void the original block record, you need to generate forks to change the generation direction of blocks. The participants of the blockchain network package the transaction records recognized by the participating nodes into the chain through a consensus algorithm. The proof of work algorithm represented by the bitcoin chain as an example, the node that completes the difficult hash calculation first obtains the bookkeeping right, packs all transactions, and thus gets the reward of virtual currency bitcoin.

Smart Contracts

Smart contracts are similar to real contracts. It can be done by writing scripting language code. Take Turing's completed Ethereum smart contract as an example. In principle, one can write a contract and

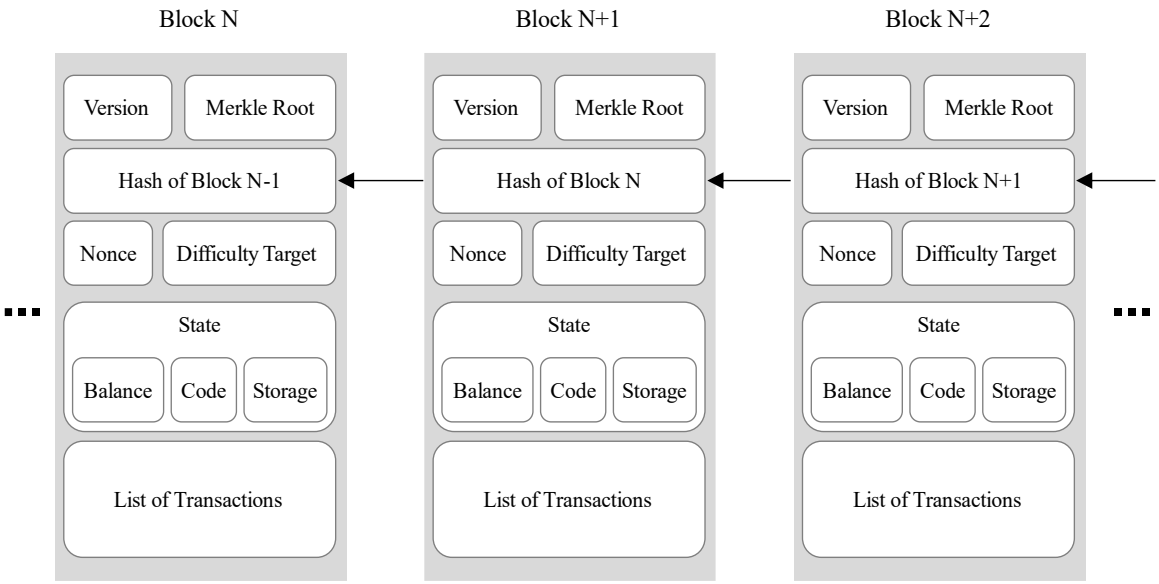

Figure 1. Blockchain architecture.

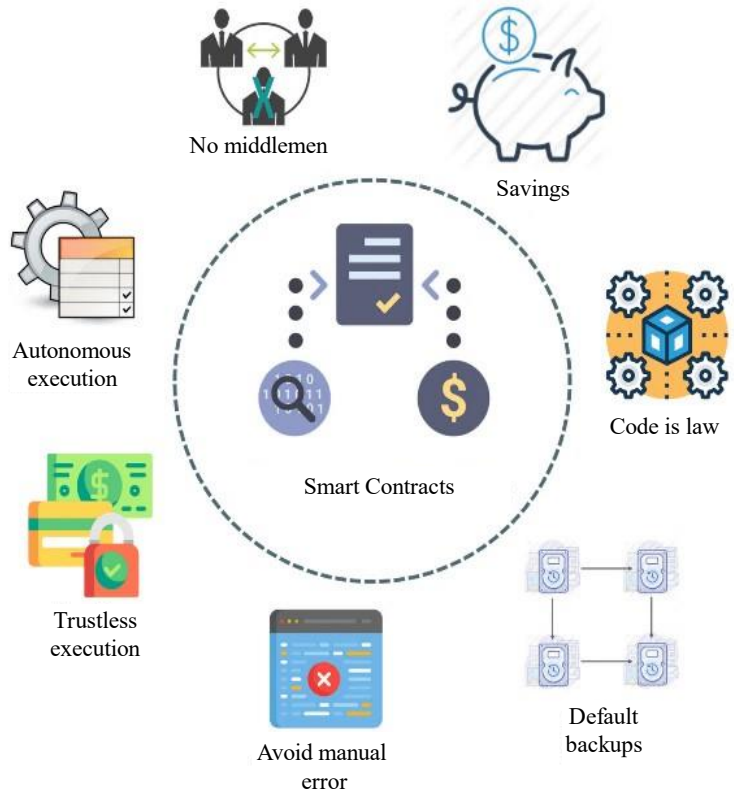

Figure 2. Smart contract.

own a state machine. When certain conditions occur, the status of the machine will change and the contract terms will be applied. This method increases the intelligence of the application. Since events are included in event descriptions, when the events are completed, the smart contract will automatically send the pre-set data and events containing the events tested by the smart contract. The core of all smart contracts is the smart contract module, which executes smart contracts in the form of transactions and events. A smart contract is simply a system of business processes and state machines [2]. It does not create or replace smart contracts. It looks to simplify the complex process of making digital promises that will be fulfilled according to the needs of the participants as shown in Figure 2.

POTENTIAL IMPROVEMENTS IN BLOCKCHAIN AND SMART CONTRACT

Processing Data

- *Problem:* Some popular blockchain systems struggle with handling a lot of information and executing tasks efficiently.
- *Simplified:* Blockchains sometimes have trouble managing lots of data and performing tasks quickly [3].

Getting People to Use It

- *Problem:* Many people have misunderstandings about smart contracts and blockchains, which can make it hard to convince them to use these technologies.
- *Simplified:* People may not fully understand or trust smart contracts and blockchains, making it tricky to get them on board [4].

Making Changes

- *Problem:* Once a smart contract is set up, it is very hard to change it if there is a mistake. This can lead to security issues.
- *Simplified:* Fixing mistakes in a smart contract can be tough, which might cause security problems.

Making Sure It is Secure

- *Problem:* There are many ways a blockchain system can be vulnerable to attacks or errors.
- *Simplified:* Keeping a blockchain system safe from attacks or mistakes is a big challenge.

Ease of Use

- *Problem:* Smart contracts can be a bit rigid and hard for regular people to use easily. They also do not allow for easy changes once set up.
- *Simplified:* Smart contracts are not very flexible, and they are not user-friendly for everyone [5].

Legal Issues

- *Problem:* Figuring out the legal rules for smart contracts can be tricky. Some people debate whether they need specific regulations.
- *Simplified:* Understanding the legal side of smart contracts can be complex. Some argue that they need special rules.

Privacy

- *Problem:* While public smart contracts can hide identities, they might not always protect privacy well enough [6].
- *Simplified:* Some smart contracts might not keep personal information as private as we would like.

Potential Improvements

Using Data Science

- *Idea:* We can make smart contracts better at handling large amounts of data by incorporating data science methods.
- *Simplified:* We can use data science to help smart contracts work with lots of information more effectively.

Adding Artificial Intelligence

- *Idea:* Artificial intelligence, specifically machine learning, can enhance smart contracts in various ways, making them smarter, more secure, and capable of offering personalized recommendations [7].
- *Simplified:* AI enhances smart contracts, making them smarter, more secure, and able to offer tailored recommendations, like suggesting rentals that match a user's preferences.

Applying Game Theory

- *Idea:* Game theory can help us understand how different players interact in a system, which is useful for designing smart contracts in games or other scenarios.
- *Simplified:* We can use math and strategies from games to create better smart contracts, especially for gaming situations.

SYSTEM REQUIREMENTS

This section enumerates the project requirements for the development and research of a smart rental application that employs blockchain technology, smart contracts, ReactJS, Node.js, SQL, MetaMask, JavaScript, Solidity, and Web3.js.

External Interface Requirement

- *User interface:* The user interface will be constructed using ReactJS, ensuring an intuitive and universally accessible experience for users across various domains, including property rentals and other rental services. Functionalities will encompass multi-domain listing, rental agreements, payment processing, and access control. We prioritize achieving responsive and cross-device-compatible user interactions.

- *Hardware interface:* IoT device integration, particularly for property access control, is contemplated. These interfaces are to be meticulously crafted to seamlessly mesh with ReactJS components.
- *Software interface:* The system is designed to interface with SQL for data management and retrieval, with a preference for SQL database management systems. Blockchain interactions, primarily on the Ethereum platform, shall be facilitated through the utilization of MetaMask for wallet management and Web3.js for smart contract interaction. The Node.js framework will be implemented in the role of backend architecture, overseeing application logic, blockchain interfacing, and database management. The interactions between ReactJS, Node.js, and blockchain components will be diligently documented and well-defined [8].

Non-functional Requirements

- *Performance requirements:* The application's performance parameters are set to stringent standards, ensuring swift transaction processing on the blockchain. Responsiveness of user interactions is mandated to meet user expectations across various rental domains. Scalability mechanisms are prescribed to accommodate the expansion of rental services and user numbers. JavaScript codebase optimization is mandated to meet performance objectives.
- *Safety requirements:* The system is designed to interface with SQL for data management and retrieval, with a preference for SQL database management systems. Blockchain interactions, primarily on the Ethereum platform, shall be facilitated through the utilization of MetaMask for wallet management and Web3.js for smart contract interaction [9]. The Node.js framework will be implemented in the role of backend architecture, overseeing application logic, blockchain interfacing, and database management. The interactions between ReactJS, Node.js, and blockchain components will be diligently documented and well-defined.
- *Software quality attributes:* The software quality attributes are foundational, encompassing: A commitment to reliability across the entire application, ensuring consistent performance, including smart contract execution and blockchain interactions [10]. A dedication to the maintainability of frontend, backend, and smart contract components, supporting updates and expansions over time. The usability of the user interface (ReactJS) remains a focal point, emphasizing user-friendliness, particularly concerning interactions with MetaMask and blockchain capabilities [11]. The portability of the application is paramount, with special attention to compatibility with MetaMask and the blockchain network for deployment across various platforms.

CONCLUSION

In summary, this system has a wide application area in many areas such as house rental, agricultural equipment, vehicle rental, etc. Smart contract technology has a lot of promise, but it is still in its infancy and there are many problems to be solved, such as the inability to process and manage data before smart contracts mature on the main blockchain, development of contract language and effective scanning and technology, mismanagement, various vulnerabilities in smart contracts, etc. Future developments in data science, artificial intelligence and game theory that can be integrated into smart contracts in blockchain systems are taken into account and made visible.

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