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AUTOMATED ETHEREUM SMART CONTRACT GENERATION FOR AGRI-FOOD TRACEABILITY

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ABSTRACT: Food and agriculture supply chain transparency is growing in importance for both consumers and states. The fast expansion of blockchain technology's use is being propelled by its inherent trustworthiness and immutability. This technology can offer safe traceability for the management of the agri-food chain, prevent food fraud, and provide information like a food product's provenance. It is far more difficult than in other businesses to create smart contracts that are suitable for certain use cases. Although many agri-food chain management systems based on smart contracts and blockchain have been developed, they are all quite ad hoc and not easily adaptable to different products or production processes. A new method for quickly adapting and developing universal smart contracts for the agri-food business based on Ethereum is presented in this research. We can automate the process and reuse modules and code using this strategy, which shortens development times without sacrificing dependability and safety. In order to set up a semi-automatic system, we want to start with the production process and build the smart contracts that control the system and the user interfaces that automatically connect with them. To further illustrate how our method works, we provide a case research on honey production. The primary goal of future studies will be to find ways to apply the method to different types of supply chains. Even though Ethereum is now in use, our technology can be simply adapted to other blockchain systems.

Keywords: Block chain technology, Network node, RFID technology and SC programming

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languages.

1. INTRODUCTION

The distributed, decentralized, and immutable ledger database known as blockchain technology guarantees the permanence and integrity of data. A trustworthy third party is rendered unnecessary. This helps explain why some think this innovation can fix problems in fields like the agri-food industry, where dishonest people work together. In 2008, a white paper outlining the original concepts of the decentralized digital currency Bitcoin was written by an anonymous programmer or group of programmers under the pseudonym Satoshi Nakamoto. Its decentralized nature and underlying blockchain technology make it ideal for instantaneous, frictionless transactions between users.

The secure and immutable historical data stored in a distributed database, such a blockchain, can be accessed by anybody with network access. Thanks to the underlying technology that allows users to share data anonymously, the P2P network is able to accommodate anonymous participation. Every time a user wants their transaction added to the immutable blockchain that records all of the transactions recorded in the ledger, a group of users must come to a consensus on it.

The fast expansion of ideas and applications is a direct outcome of the widespread use of blockchain technology by both established businesses and new creative endeavors.

2. LITERATURE SURVEY

BLOCKCHAIN IN AGRICULTURE TRACEABILITY SYSTEMS: A REVIEW

Food is vital for people and communities throughout. People all throughout the world agree that the agricultural and food processing industries are major job creators. There are numerous links in the agricultural supply chain, from growers to distributors to retailers to consumers. Managing this becomes more complicated because of this. The complex nature of the agricultural supply chain makes it difficult to create universal solutions that improve visibility and accountability. This paper delves further into the possible applications of blockchain technology in modern agriculture and food production.

The paper starts out with a concise introduction to traceability, including its concept, several levels of application, resources, and benefits. Here is a quick rundown of the pros and cons of blockchain technology. The penultimate step is to research the literature on blockchain technology and its possible use in traceability systems.

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The next section will focus on important modern commercial applications and the difficulties those projects have faced. It delves at the ways blockchain technology could soon be used to improve the supply chain for food and agriculture.

A REVIEW ON AGRI-FOOD SUPPLY CHAIN TRACEABILITY BY MEANS OF RFIDTECHNOLOGY

The radio frequency identification (RFID) technology has great promise for the agri-food supply chain in terms of better information management and increased safety. The implementation of food item tracking systems has made food safety a top priority for many governments. Consequently, technological tools that improve food and agricultural traceability are necessary.

The primary objective of this research is to examine how the food and agricultural industries have used RFID technology recently. We will achieve this by examining the existing literature via an operational lens. This will make it easier to quickly analyze the text and find new and interesting ways to research. Even while most people agree that RFID could have some positive uses, there are still a lot of obstacles that prevent it from being widely used. People may have a better grasp of the pros and cons of extensive RFID use from the survey results. Presenting a current overview of RFID technology improvements for several agri-food item categories is the main goal of this investigation.

The research's overarching goal is to learn how RFID technology could improve logistical and technical capacities across the production and distribution process. With the introduction of new technologies, the agri-food sector is seeing a dramatic increase in the use of radio frequency identification (RFID) technology. Nevertheless, there are a number of technical and economical obstacles that are now preventing RFID technology from being used in a practical setting.

A FOOD TRACEABILITY SYSTEM BASED ON BLOCKCHAIN AND RADIO FREQUENCYIDENTIFICATION TECHNOLOGIES

Food safety concerns on a global scale have made people more cognizant of and sensitive to these issues. Consumer trust and food safety measures could both benefit greatly from a system that tracks food. Environmental influences can have an effect on food quality at any point in the supply chain, yet modern food traceability systems often fail to account for this. Verifying the precision of the traceability information is a major challenge.

The project's overarching goal was to define best practices for integrating blockchain and RFID for supply chain food tracking. In order to keep environmental data transparent across

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the whole food production process, the system combined a blockchain with a central database to store data. Instead of depending on lot identification data collected at different points in the supply chain, environmental data was captured using blockchain technology. This verified that the traceability data was accurate and complete. In order to make it easier to trace trial temperature data, the model's blockchain was tested in an Ethereum test environment.

A REVIEW ON BLOCKCHAIN APPLICATIONS IN THE AGRI-FOOD SECTOR

Accessibility, low transaction costs, and instant technological application are just a few of the many benefits of food security. A blockchain is an immutable, distributed, and encrypted record of all the bits of information that make up a digital transaction or event. Any time in the future, this record can be reviewed. Because of its decentralization and resilience, blockchain technology is good for international monetary systems. It can be easily expanded to include contracts and procedures like supply chain oversight, though. Improving cutting-edge agricultural systems and e-agriculture projects in precision agriculture through a blockchain infrastructure could lead to a rise in the usage of information and communication technologies.

INTELLIGENT SMART CONTRACTS FOR INNOVATIVE SUPPLY CHAIN MANAGEMENT

The utilization of block chains and smart contracts as instruments for a unique approach to supply chain management is something that we suggest. This approach would facilitate collaboration among supply chain enterprises, increase profitability, and be beneficial to the economy as a whole.

Most modern blockchain supply chain projects aim to track goods from their point of origin to their final destination by use of decentralized blockchain networks. Nevertheless, these limitations are not applicable to our idea. We provide a novel smart contract implementation that tackles the trust and coordination issues that greatly impede supply chain efficiency. Quickly and economically establishing contractual agreements that are in line with their mutual business requirements is essential for partners who are unfamiliar with each other and worried about exploitation in order to resolve the trust issue. An economical management system can help the supply chain reach its overall goals, which will benefit the entire organization and alleviate the coordination issue.

The present scenario stands in stark contrast to this, since individuals' narrow self-interests have taken precedence over society's collective welfare. Innovative supply chain management has been using smart contracts instead of human coordinators to tackle these issues. Relying

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on the coordinator for assistance is no longer a major roadblock to solving these problems. In addition, the supply chain helps managers save money by automating the coordination process.

Artificial intelligence systems can automate contract execution, expense monitoring, and compensation of supply chain professionals, thereby replacing human coordinators. Here, the term "intelligent smart contracts" is used. An advanced paradigm in supply chain management based on decentralized, self-executing smart contracts is presented in this research. To evaluate our approach's broader socioeconomic consequences, we will dissect the complex computing algorithms that power these contracts' decision-making procedures.

3. EXISTING SYSTEM

Developers may face four difficulties that Alharby and Van Moorsel (2015) list while building smart contracts. Making contracts that cannot be broken is the main problem. Second, it is not possible to change or cancel a contract once it has been made. Finally, thirdly, there is a dearth of efficient methods and tools for finding contracts. In the end, it can be difficult to become proficient in the languages required to create smart contracts. In an empirical research, Zou et al. [16] sought to identify possible difficulties that developers may encounter when creating smart contracts, with a focus on the Ethereum blockchain. According to the results, there are a number of major problems. Noticeably lacking in sophistication are the current SC development tools. Since the blockchain and its embedded code are inherently immutable, developing a smart contract in a traditional programming language is not possible. To improve the incorporation of unique blockchain ideas or interfaces into existing software modeling notations, Rocha and Ducasse presented a thorough methodology. The authors state that modeling is an essential part of developing software and offer the idea of specialized modeling notations for decentralized apps (dApps). Presenting three modeling notations, the authors include Entity-Relationship Model (ERM), Unified Modeling Language (UML), and Business Process Model and Notation (BPMN). In the end, the researchers use these ideas to investigate blockchain-oriented software (BOS) in depth. This application makes use of SCs to carry out predefined business logic on the blockchain.

4. PROPOSED SYSTEM

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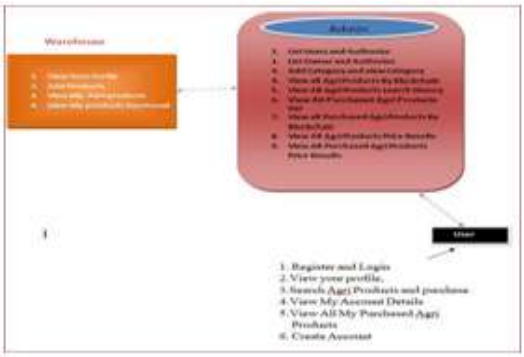
An innovative approach is suggested to simplify the development and modification of smart contracts (SCs) that are specific to the agrifood industry on the Ethereum blockchain. By automating the process while maintaining dependability and security standards, this strategy shortens development time.

People are trying to set up a semi-automated, flexible system that can work across all supply chains in the agri-food industry for the first time. Although this method was originally created for the agricultural industry, it may be used whenever there are interrelated components that go through different changes. A more solid and all-encompassing basis for food production is being laid for blockchain-based field traceability solutions.

Building a flexible, modular system to track agricultural and food supply networks in real time is one step in this direction. Applications with user interfaces and global supply chains make up this system. Extra tests were run on the supply chains to see how safe and fuel efficient they were. In the first stage of the methodical approach, we used pre-made tables to show how food is made. This method makes it easier for developers to configure these modules and put the final product together, even if they don't know much about blockchain technology. In addition, a modern case research was carried out with honey production as the main focus to prove that this method is effective.

5. SYSTEM ARCHITECTURE DIAGRAM



USER

The act of buying anything from a seller is known as buying. Usually, the person doesn't get an address. People participate in account-related activities when they buy agricultural products and services online from specialist vendors. In search of food and agricultural supplies. Making an account is the first step in registering. Please confirm your account details so we can provide you with a full list of all the agricultural products we have purchased.

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WAREHOUSE

Online buyers have been the focus of most of Warehouse's marketing campaigns. Customers may easily get the contact information of a trustworthy business online, which helps with research before buying. Everyone involved benefits from this. Keeping tabs on consumer product data, including usage and purchase rates, is absolutely crucial. "View Purchased Products," "Add Products “and” View All Agricultural Products" are some examples of suggestions made by friends and acquaintances who have used your business. All of these things point to a trustworthy company. Warehouses are places where goods can be received, stored, and then sent out. Tokens representing the object can be bought by users, or they can just report that the tokens are in cold storage without actually owning them.

ADMIN

The software system efficiently controls and keeps tabs on user permissions and access levels. Almost all business process management systems have this capability. Users and warehouse sellers can only be approved and monitored by the administrator. There is access to data on all kinds of agricultural products, including details about specific products, data on products classified by blockchain technology, data on products bought using blockchain technology, results of pricing analyses, and data on price trends.

6. CONCLUSION

The modern customer demands proof that the food they buy has no harmful ingredients, is nutritionally sound, and can be traced back to its farms. As a result, intangible assets like secure traceability and country-of-origin labels are becoming more attractive investments for customers. They would like to see strict rules regarding food safety enforced across the board in the food distribution chain. The importance of food tracking systems in protecting consumers and reducing instances of food fraud cannot be overstated.

The current traceability mechanisms are vulnerable to abuse by dishonest manufacturers. Building a traceability system is made easier by the combination of blockchain technology, smart contracts, and the Internet of Things. Producers are able to pool their resources to provide product information under this agreement.

The information on the products' origin and quality can also be verified by independent third parties. When this tactic is used, customers are more likely to believe the data they get. We offer a way for developers to build agri-food traceability systems without having to master the complex technical parts of supply chain operations. Compared to the norm in the software

sector, this approach stands out. To do this, we built software that can generate the tracing system's user interface (UI) and system components (SCs) on its own. The suggested approach demonstrated its ability to handle the problem space, which the system was designed to accurately reflect.

The process begins with a comprehensive supply chain diagram that includes all participants, resources, commodities, events, data, and producers. Whether you're an expert in the field or just starting out, you'll find the following explanation presented in a series of spreadsheet sheets. Once the HTML5 pages are converted into CSV files, the dApp's user interface and interaction capabilities become accessible. Thanks to this technology, everyone involved in the supply chain can record and confirm important events in an unchangeable log. In addition, the people who recorded the events mentioned earlier can be identified. Previous methods depended entirely on producer assertions for certification; this occurrence instills higher confidence in the quality of product information. This is because it is possible to carry out comprehensive verifications at every stage of production.

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