

Blockchain and IoT Integrated Banana Plant System

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Summary

Internet of Things (IoT) integrated with the Blockchain is the state of the art for keen cultivation and agriculture. Recently the interest in agribusiness information is enlarging owing to the fact of commercializing the smart farming technology. Agribusiness information are known to be untidy, and experts are worried about the legitimacy of information. The blockchain can be a potential answer for the expert's concern on the uncertainty of the agriculture data. This paper proposes an Agri-Banana plant system using Blockchain integrated with IoT. The system is designed by employing IoT sensors incorporated with Hyperledger fabric network, aims to provide farmers with secure storage for preserving the large amounts of IoT and agriculture data that cannot be tampered with. A banana smart contract is implemented between farmer peer and buyer peer of two different organizations under the Hyperledger fabric network setup aids in secure transaction of transferring banana from farmer to buyer.

Keywords:

Banana, Hyperledger Blockchain, Internet of Things (IoT), Smart Contract

1. Introduction

Blockchain is a change in the information game due to its unique capabilities and benefits. At its core, the blockchain system consists of a distributed digital ledger, shared between system participants, which resides on the Internet: transactions or events are validated and recorded in the ledger and cannot be subsequently modified or deleted. It provides a way for information to be recorded and shared by a user community. Within this community, selected members retain their copy of the Ledger and must jointly validate any new transactions through a consensus process before they are accepted to the Ledger [1].

The Internet of Things (IoT) connects people, places and products, and thus offers opportunities for value creation and capture. Sophisticated chips, sensors and actuators are embedded in physical objects, each transmitting data to the IoT network. The IoT's analytical capabilities use this data to convert insights into action, impact business processes and lead to new ways of working [2].

Both blockchain technology and the Internet of Things (IoT) are currently capturing the imagination of many

stakeholders involved. The IoT and blockchain are both built on decentralized, distributed approaches; in combination, from operational efficiencies to revenue generation, they theoretically give tremendous benefits. The use of data and information is becoming increasingly crucial for the agricultural sector to improve productivity and sustainability [3]. Information and Communication Technology (ICT) significantly improves the efficiency and effectiveness of data collection, storage, analysis and use in agriculture. It allows agricultural practitioners and farming communities to easily obtain up-to-date information and thus make better choices in their day-to-day farming. [4] The IoT produces a large amount of data, and the ownership of the data is not always clear with multiple stakeholders involved.

Blockchain will help mitigate IoT-related security and scalability issues in the following ways:

- In a blockchain system, the distributed ledger is tamper-proof and this eliminates the need for trust among the parties concerned. The overwhelming amount of data produced by IoT devices is not managed by any single organization.
- In order to get access to the network, the use of blockchain to store IoT data would add another layer of authentication that hackers would need to bypass. Blockchain offers a much more robust encryption level that makes it nearly impossible to overwrite current records of data.
- By allowing anyone allowed to access the network to monitor transactions that have occurred in the past, Blockchain offers transparency. This will provide a clear means of determining a particular source of any data leaks and taking swift remedial action.
- Blockchain will allow billions of connected devices to process transactions quickly and communicate with each other. Distributed ledger technology offers a feasible option to facilitate the processing of a vast number of transactions as the number of interconnected devices increases.

- Blockchain will allow IoT companies to reduce their costs by removing the processing overheads related to IoT gateways by providing a way to allow trust among stakeholders (for e.g. traditional protocol, hardware, or communication overhead costs).
- Smart contracts, an agreement between two parties that is stored in the blockchain, which further allow stakeholders to execute contractual agreements based on certain conditions being met. For example, when the requirements for providing a service have been fulfilled, smart contracts could authorize payments automatically, without any need for human intervention.

2. Literature Survey

In the course of recent years, Blockchain innovation has noticed an upheaval of research and development interest, primarily in the financial oriented business. The capacity to give permanent records, alongside their capability to empower confidence and trust among dubiety or untrusted peers, are too alluring property to keep this innovation from its application to different areas.

Many industries are interested in combining IoT and Blockchain. A few organizations have as of now began to investigate their potential. Helium, [5] San Francisco, California is one such organization who is dealing with connecting low power IoT devices to the internet utilizing Blockchain. The usage of IoT devices in the supply chain management have also developed major interest in combining IoT with Blockchain. The adoption of IoT devices in Agri-food inventory system is presented by the author [6]. The research on the utilization of RFID and NFC-based devices to achieve direct on-the-field transparency and continuous data creation, considering diligence through a cloud-based database was conducted.

The significance of integration of blockchain and IoT in thriving smart applications in agriculture is extensively reviewed and has indicated that blockchain can present novel answers for ongoing security and execution challenges in IoT-based agricultural systems. profess that pilot and little scope blockchain ventures are begun in a predetermined number of nations around the globe. 93% of these activities are either in idea phase or have begun a little pilot and 7% of these undertakings don't have accessible data [3].

3. Proposed Work

We have proposed an Agri-Banana plant system using IoT and Hyperledger Blockchain. We have chosen Banana plant as a paradigm for the reason that, banana is a super nutritional fruit consumed worldwide and in India banana is considered as promising plant and is a part of different traditions and customs. Also, banana plant is valuable from multiple points of view such as: practically all the parts of the banana plant are consumable and are rich wellspring of potassium, magnesium, nutrients and fibre. The banana harvest is believed to be recognizably in danger of the scorching and chilly climate conditions. [1] Hence, it is important to keep track of environmental growth conditions of banana plant.

The system make use of IoT sensors to collect different environmental parameters which are necessary in monitoring the growth of banana plant. Monitoring the growth of Banana plants is also helpful in exhibiting the quality of banana fruit. Hence, farmer will be awarded with best price depending on the quality of banana fruit he has grown. The system also aids in integrating farmer and buyer. The farmer can sell his commodity to the buyer by entering into an agreement using the smart contract written in blockchain.

We have chosen few sensors such as: DHT11 and octopus soil moisture sensors to monitor the environmental growth conditions of banana. DHT11 is a sensor that measures temperature and humidity of the surrounding environment. Octopus soil moisture sensor measures the soil moisture. We consider these two sensors as our IoT devices. We connect these sensors to Raspberry Pi to record the temperature, humidity and soil moisture data digitally. The Raspberry Pi is an extremely modest PC that runs Linux, yet it additionally gives a cluster of GPIO pins that permits to control electronic components for processing and exploring IoT. The data stored on Raspberry Pi is then transmitted to Hyperledger node using MQTT protocol. MQTT is a publish/subscribe protocol that allows edge-of-network devices to publish to a broker [fig 1].

Our Hyperledger Blockchain setup consists of two organizations namely org1 and org2. Org1 has farmer peer, org2 has buyer peer. There is one orderer, and one certificate authority each in org1 and org2.

Using our Blockchain setup two types of operations can be carried out such as: inserting data into the ledger, and reading the data from the ledger. For insertion of IoT data into the ledger the timestamp of the payload is used as the key and temperature and humidity data as the values. The most recent time stamp is used to read the last inserted value from the ledger.

At the HyperLedger Node, a node.js application gets the data values and makes a transaction proposition from the received payload. The transaction is acknowledged just on the off chance that it has been endorsed by any one peer from the organization. When the transaction is marked and submitted, it is approved for the signatures. And if the transaction is substantial then the payload data value is added to the ledger record.

An Agri-chaincode is written to define the rules for transactions between org1 and org2. Agri-chaincode consists of banana smart contract. Banana smart contract is written to execute the transfer of banana fruit from farmer to buyer [Fig 2].

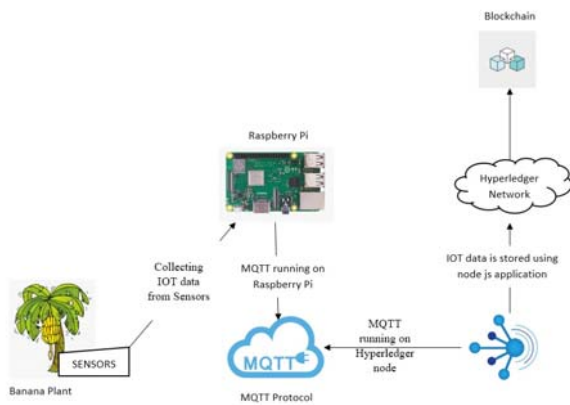


Fig 1: Block diagram of Blockchain and IoT Integrated Banana Plant System

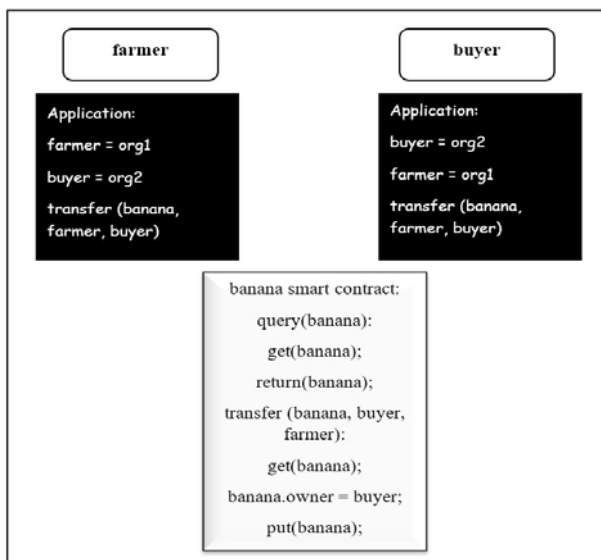


Fig 1: Agri-chaincode Banana Smart Contract

3. Conclusion

The integration of Blockchain and Agriculture research is considered to be in the state of infancy, it is the objective of this work to propose an attainable approach to build an integration of agriculture and blockchain-based applications, to alter agribusiness industry advancements. The paper focuses on the decentralized approach of Blockchain. We are storing IoT data on the digital ledger of blockchain. The data stored on the Blockchain is secured and immutable, and beneficial in several ways such as: banana plant growth can be monitored, the quality of the banana can be derived, analysis on the next cycle of banana plantation can be predicted. The banana smart contract supports secured transaction between farmer and buyer. The future work will refine the model for assessing the ease of use of the proposed design in practice. The blockchain framework will be actualized as an adaptable blockchain to facilitate the setup and the board of the blockchain network without thinking often about the hidden framework.

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