Secured and Transparent Perishable Goods Network Using Blockchain Technology

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Abstract – The environment monitoring is an important factor for maintaining quality of perishable goods. Perishable goods are goods that have limited lifespan if not refrigerated properly. Blockchain is the trending technology that provides a secured and transparent network for maintaining a ledger. The ledger contains all transactions between the importer, grower and shipper. Every transaction is automatically done without any central authority. The environmental monitoring includes temperature and humidity. The reading from temperature and humidity sensor is published in the block chain. A smart contract is generated to calculate the penalty if temperature of container is not maintained in the specified range. After penalty calculation, the grower is fined and the balance amount is paid to the growers account.

Catchphrase: Blockchain, smart contract, temperature and humidity sensor, hyperledger

1. INTRODUCTION

Cloud computing refers to both applications delivered as Information technology is gaining much attention in blockchain technology. Though the main block chain technology is bitcoin blockchain, originally "block" "chain", is a growing list of records, called blocks, which are linked or chained using cryptography technology is the bitcoin currency. Blockchain is the underlying technology for Bitcoin. The Blockchain is a decentralized ledger of all transactions across a peer-to-peer network. Using this technology, participants can perform transactions without the need for a central certifying authority. Potential applications include fund transfers, settling trades, voting and many other uses. A distributed system is a network that consists of autonomous computers that are connected using a distribution middleware. They help in sharing different resources and capabilities to the users with a single and integrated coherent network. A distributed ledger is a database that is consensually shared and synchronized across network spread across multiple sites, institutions or geographies. Figure1 shows the distributed technology ledger called as blockchain, which is the technology that underlies with bitcoin.
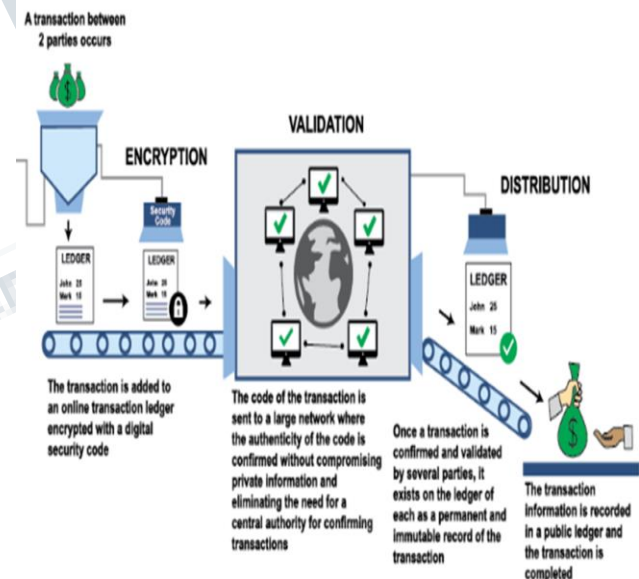
Figure 1. Distributed ledger technology

After bitcoin technology, there came the ethereum which is generic platform but possess some transaction deficiency. Then Linux introduced hyperledger which contains hyperledger tools and hyperledger fabric. Hyperledger fabric is the building block for the blockchain technology. Figure 2 shows the applications of Blockchain.

Figure 2. Blockchain applications

The main objective of the paper is to determine the main benefits of the Blockchain technology in supply chain. The following are the task considered:

1) Study the metrics, basic concepts and technics of Blockchain technology.
2) Consider the examples of industries and organizations that have implemented the blockchain technology.
3) Examine industries possible for implementing blockchain-based applications.
4) Find out the main problems in Supply Chain and logistics industry.
5) Try to employ Blockchain technology to solve these difficulties.

II. LITERATURE SURVEY

Food supply chain based perishable food network have been extensively studied. Food safety accidents occurred recently "horsemeat scandal" in 2013 (Boyacia et al. 2014). It's worth noting that these kinds of scandals are even more frequent and serious in China, such as "Sudan red", "c1enbuterol", "Sanlu toxic milk powder" and "trench oil"(Xiao et al. 2012). In order to satisfy the importers or customer need to guarantee the food safety and quality control through the transparency of the food supply management (Akkerman et al. 2010). Then an advanced technology is used to monitor the perishable goods network using thermometer and RFID. The thermometer is used to monitor the temperature in the container and RFID is the tracking system for identifying location of the goods in the network. Zhang (2011) developed a system to investigate the benefits of using RFID. Wang (2010) proposed a rule based network

design to support the real time system. This system calculates the shelf life of agricultural product in transmission.

A real time system for monitoring the perishable food supply chain using zig-Bee standard wireless sensor network (WSN) was developed by Junyu Wang (2014). This system includes configurable architecture for comprehensive sensor and a network switching scheme are designed to meet the requirements.

An agri-food based supply chain traceability system for china based on RFID and blockchain technology developed by Feng Tian (2016). Feng Tian developed traceability with the trusted information in the agricultural based supply chain that will provide food safety by gathering, transferring and sharing data in production, processing, warehousing and distribution. Krystsina sadouskaya (2017) made a thesis on adoption of blockchain technology to define how the blockchain make changes in the supply chain and logistics industry.

Henrik Stemberg (2018) states how blockchain used in supply chains, blockchain is considered as a platform to collect information about the supply chain from the producer to the consumer.

III. LIMITATIONS OF EXISTING SYSTEM

Initially the container temperature is monitored using thermometer which is only useful for the system that is static. It cannot monitor the container that is dynamically changing its location from one place to another. Then came the wireless sensor network which is centralized system required a third party authentication for every transaction. The public key infrastructure is required for authentication of the every transaction. After that block chain with RFID came to existence, where the cost of RFID is high. So the following system is developed. The blockchain is developed considering the following limitations and made the same as the advantage of the system.

IV. PROPOSED SYSTEM

The IOT based perishable goods network is a supply chain network involving the following steps which is shown in the figure 3.
• Perishable items such as bananas, pears, and coffee
• Business partners such as growers, shippers, and importers
• Shipments of perishable goods
• Agreements between business parties that stipulate conditions of the agreements

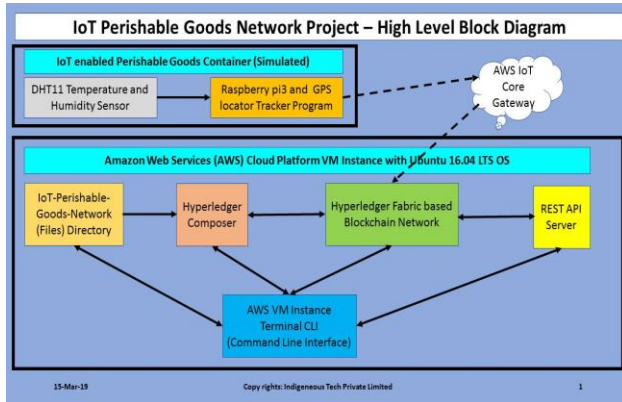• Acknowledgement of receipt of goods and services

Figure 3. Architectural diagram

The following steps are needed to model a perishable goods network:

Creating of AWS (amazon web service) VM instance with Ubuntu 16.04

Download and installation of all pre requisites software in Ubuntu that includes npm, python, go language, hyperledger fabric, hyperledger composer tool, hyperledger playground etc

Writing the codes for main logic which holds code for penalty calculation and main concept stored as logic.js. Then the permission.acl which possesses the access right that tells who are users to login the blockchain network.

The code perishable.cto possesses the information of the goods transported in a container and temperature it should be maintained.

Creation of directory IOT-perishable-network. This directory contains all the programming files combined together into a single .bna (business network file).

Downloading and installing software required for the hyperledger composer, hyperledger framework and composer rest API.

Start the hyperledger fabric blockchain network.

Create the necessary permission card.

Creating peer admin permission card and deploy .bna file

Creation of other permission and interaction with deployed smart contract (logic.js).

V. CONCLUSION

Thus a computer system is designed using hyperledger fabric framework based Blockchain technology with internet of things (IOT). Temperature sensor senses the temperature of the container that is filled with perishable goods and provides a real time solution. The humidity is also calculated along with the temperature. If there is any deviation in the temperature, then the exporter is calculated a certain amount called penalty. By doing so the exporter has to pay the amount as a penalty to the importer.

VI. FUTURE ENHANCEMENT

The user interface can be extended. The temperature that is calculated could be directly sent to the user interface. In future work along with temperature, humidity and GPS vibration of the container, freshness in the air could also be calculated.

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