PREVENTION OF ADULTERATION IN PACKED FOODS USING BLOCK CHAIN

P.Vijayalakshmi[1] K.Pradeepalakshmi[2] S.Priyanka[3] B.Sowmiya[4]

Associate Professor[1] U.G.Scholar[2,3,4]

Department of Computer Science and Engineering, Panimalar Engineering College,Chennai.

Abstract- *A food supply chain or food system refers to the processes that describe how food from a farm ends up on our tables. The processes include production, processing, distribution, consumption and disposal. The food we eat reaches us via food supply chains through which food moves systematically in domino-like motion from producers to consumers while the money consumers pay for food goes to people who work at various stages along the food supply chain in the reverse direction. Every step of the supply chain requires human and/or natural resources. Because a food supply chain is domino-like, when one part of the food supply chain is affected, the whole food supply chain is affected, which is often manifested through changes in price.*

Keywords— RFID sensor , Bar code scan

1. INTRODUCTION

In this paper, we propose a blockchain inspired internet-of-things architecture for creating a transparent food supply chain. The architecture uses a proof-of-object based authentication protocol, which is analogous to the crypto-currency's proof-of-work protocol. The complete architecture was realized by integrating a RFID based sensor at the physical layer and blockchain at the cyber layer. The RFID provides a unique identity of the product and the sensor data, which helps in real time quality monitoring. For this purpose, a small feature size 900 MHz RFID coupled sensor was fabricated and demonstrated for real time sensor data acquisition. The blockchain architecture aids in creating a tamper-proof digital database of the food packages at each instance. A detailed security analysis was performed to investigate the vulnerability of the proposed architecture under different types of cyber-attacks.

1.1Existing System

In existing system, the food packages does not contains the proper details like food ingredients, packers details, package date and expiry date etc.. So, the end user or customer does not have any awareness of that product details. That product have product id and shop information only. Real-time monitoring of the food quality and visibility of that quality index would prevent outbreak of food-borne illnesses, economically motivated adulteration, contamination, food wastage due to misconception of the labeled expiry dates, and losses due to spoilage, which have broad impacts on the food security.

2. RELATED WORK

2.1 Ouroboros: A Probably Secure Proof-of-Stake Blockchain Protocol

In this article , they present "Ouroboros," the first blockchain protocol based on proof of stake with rigorous security guarantees. They establish security properties for the protocol comparable to those achieved by the bitcoin blockchain protocol. As the protocol provides a "proof of stake" blockchain discipline, it offers qualitative efficiency advantages over blockchains based on proof of physical resources (e.g., proof of work). It also present a novel reward mechanism for incentivizing proof of stake protocols and they also prove that, given this mechanism, honest behavior is an approximate Nash equilibrium, thus neutralizing attacks such as selfish mining. It also present initial evidence of the practicality of our protocol in real world settings by providing experimental results on transaction confirmation and processing.

2.2. A Supply Chain Traceability System for Food Safety Based on HACCP, Blockchain & Internet of Things

In this paper they build a food supply chain traceability system for real-time food tracing based on HACCP (Hazard Analysis and Critical Control Points), blockchain and Internet of things, which could provide an information platform for all the supply chain members with openness, transparency, neutrality, reliability and security. Furthermore, we introduce a new concept Big chain DB to fill the gap in the decentralized systems at scale. The paper concludes with a description of a use case and the challenges to adopt blockchain technology in the future food supply chain traceability systems were discussed.

2.3 Design and Development of Sensing RFID Tags on Flexible Foil Compatible With EPC Gen 2

In this article ,the design, development, and testing of printed smart sensing tags compatible with the RFID standard electronic product code Gen 2 is presented. Two different strategies are employed to interface the sensors: 1) passive single chip and 2) semi passive architectures. Both strategies provide sensor data by directly answering to the RFID reader inquiries or using a data logging mechanism to store the sensor data in the RFID chip memory. Temperature readout is measured using the embedded sensor in the RFID chip. Additionally, a light sensor and pressure sensor interfaced to a microcontroller are implemented in the passive and semi passive tags versions, respectively. For the employed RFID chip, two different UHF antennas are designed and printed using inkjet and screen printing to compare their radio frequency performances. Finally, the fabricated smart tags are fully validated through measurements in an anechoic chamber and their behaviors are compared with numerical simulation. The screen printed semi passive RFID tag with loop antenna shows a better reading range than the inkjet printed one, whereas the passive tag can be considered as the most cost-effective system.

2.4 The Meat Freshness Monitoring System Using the Smart RFID Tag

In this paper , they proposed a monitoring system for meat freshness and use-by date, based on the smart RFID (radio frequency identification) tag. Freshness can be checked by various factors ,such as the presence of microorganisms ,bacteria , and gases. This paper focuses on detecting the temperature ,humidity ,and the gases released by meat. They analyzed the factors affecting the freshness of meat and decided to use agas sensor as the main detection method. They use temperature sensor and humidity sensor as auxiliary sensors to get the food poisoning index. The proposed system consists of an RFID tag, temperature sensor, humidity sensor, gas sensor, reader, and server. By comparing the temperature, humidity, and gas concentration of the meat storage environment, we can get the relationship between meat freshness and the sensor signal. This monitoring system can show the meat freshness at four distinct grades: High , Medium ,Low ,and Spoilage. In order to confirm the usefulness of the proposed system, they performed experiments on pork. With the smart RFID tag, they successfully estimated the freshness of the meat.

2.5 Applications of Blockchain Technology beyond Cryptocurrency

Blockchain (BC), the technology behind the Bitcoin crypto-currency system, is considered to be both alluring and critical for ensuring enhanced security and (in some implementations, non-traceable) privacy for diverse applications in many other domains - including in the Internet of Things (IoT) eco-system. Intensive research had been conducted in both academia and industry applying the Blockchain technology in multifarious applications. Proof-of-Work (PoW), a cryptographic puzzle, plays a vital rôle in ensuring BC security by maintaining a digital ledger of transactions, which is considered to be incorruptible. Furthermore, BC uses a changeable Public Key (PK) to record the users' identity, which provides an extra layer of privacy. Not only in cryptocurrency has the successful adoption of BC been implemented but also in multifaceted non-monetary systems such as in: distributed storage systems, proof-of-location, healthcare, decentralized voting and so forth. Recent research articles and projects/applications were surveyed to assess the implementation of BC for enhanced security, to identify associated challenges and to propose solutions for BC enabled enhanced security systems.

3. PROPOSED SYSTEM

In our paper, We use the decentralized system blockchain servers to track the manufacturing of packed food items. Here we develop three blockchain servers to monitor the activities between the suppliers , manufacturers and distributors. We propose an architecture to monitor the transparency of the food product. Whenever a product is going to be manufactured the manufacture will be purchasing the ingredients from individual suppliers. Thus the entire flow in a product manufacturing will be updated in each phase in the blockchain servers. So when a customer purchase any product they need to scan the qr code of that product and based on the product id the tracking details like batch id, product id ,expiry date and date of packaging of all individual ingredients will be listed to the customer. Thus the transparency of the product is shown to the end customer.

3.1 Architecture overview

For each product it contains the barcode number and its number will be passing through food API then ingredients will be taken out by using barcode number. First registration. The registration form contains supplier details. Then login. Supplier sells the products to all manufactures what the produce. The manufacturer initially creates the account. They will analyze the raw materials and the manufacturer will request the quantity of raw materials to the supplier. Then suppliers will accept the request from manufacturer and raw material will be added to the manufacturer inventory. The manufacture will send the product ID, expiry date, number of packets, etc to the block chain and then the created product will be added to manufacturer shipment. From the block chain the manufacturer will retrieve the product. First registration. The registration part contains distributer details. And login. The distributer will be seeing the product in the manufacturer cart and then buying product by the distributer will be added to the block chain. First Registration. The registration form contains user details. Then consumer login. Consumer buys the product from distributer. The consumer scan the QR scan by using the mobile app and then view the product in the mobile such as manufacturing date, packing date etc. The consumer will check the product and they will buy the product by using online transaction. Finally user transaction ID, product name and cost will be added to the block chain.

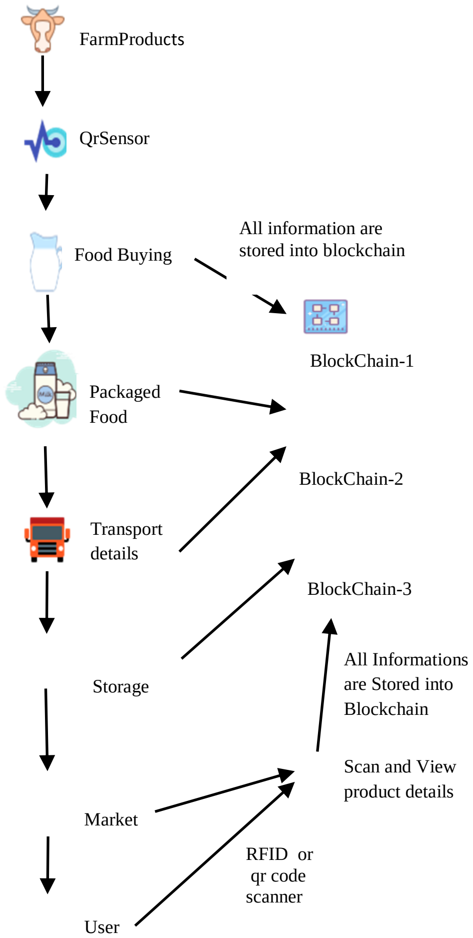

Figure 1. System Architechture

4. SYSTEM IMPLEMENTATION

System implementation is the process of defining how the system should be built ensuring that the system is operational and used. The proposed system comprises of modules such as

1. Analyze the barcode number based on API
2. Manufacture sends product details to Block chain
3. Distributer purchasing the product
4. QR scan code verification & bank interfacing

4.1 Analyze the barcode number based on API:

For each product it contains the barcode number and its number will be passing through food API then ingredients will be taken out by using barcode number. First registration. The registration form contains supplier details. Then login. Supplier sells the products to all manufactures what the produce.

4.2 Manufacture sends product details to Block chain :

The manufacturer initially creates the account. They will analyze the raw materials and the manufacturer will request the quantity of raw materials to the supplier. Then suppliers will accept the request from manufacturer and raw material will be added to the manufacturer inventory. The manufacture will send the product ID, expiry date, number of packets, etc to the block chain and then the created product will be added to manufacturer shipment. From the block chain the manufacturer will retrieve the product.

4.3 Distributer purchasing the product:

First registration. The registration part contains distributer details. And login. The distributer will be seeing the product in the manufacturer cart and then buying product by the distributer will be added to the block chain.

4.4 QR scan code verification & bank interfacing:

First Registration. The registration form contains user details. Then consumer login. Consumer buys the product from distributer.The consumer scan the QR scan by using the mobile app and then view the product in the mobile such as manufacturing date, packing date etc.The consumer will check the product and they will buy the product by using online transaction. Finally user transaction ID, product name and cost will be added to the block chain.

5. RESULTS AND DISCUSSIONS

The proposed system is implemented using J2EE (JSP, Servlets), JavaScript, HTML, CSS, AJAX, Hibernate Framework, MVC Pattern.

6. CONCLUSION AND FUTURE ENHANCEMENT

In order to improve safety and prevent wastage, we have used modern IoT based technologies to monitor the food quality and increase the visibility level of the monitored data. Sensing techniques compatible with existing tracking and tracing infrastructure are proposed for monitoring food products. These sensors can be invasive or non-invasive in monitoring the physical or chemical properties of food such as pH, conductivity, and permittivity or the packaging environment such as temperature, humidity, moisture or aroma. In general, these sensors are aimed to prevent defective products from reaching the consumers. We should add the all details in blockchain. Like product buying place and date, product ingredients buying date, product packaging date ,etc. Blockchain technology was proposed to improve the traceability of a food product. And most important we have used QR code Scanner wireless sensor for scan the product and create sensorID. Each packaged food product with an embedded sensorID travels through multiple stages of transactions at different terminals starting from packaging through transportation, storage and finally to a consumer for purchase. A data block is created containing the information about the package at each valid transaction. Once the transaction is verified, the transaction of the sensorID is converted into a block of information and appended to its pre-existing data blocks thus forming a chain of information blocks and thus a blockchain. Thus , the adulteration can be prevented in the packaged foods and good quality food products will be reached to every customers.

REFERENCES

[1] D. I. Ellis *et al.*, “Fingerprinting food: Current technologies for the detection of food adulteration and contamination,” *Chem. Soc. Rev.*, vol. 41, no. 17, pp. 5706–5727, 2012.

[2] S. Herschdoerfer, *Quality Control in the Food Industry*, vol. 2. Cambridge, MA, USA: Elsevier, 2012.

[3] J. Landt, “The history of RFID,” *IEEE Potentials*, vol. 24, no. 4, pp. 8–11, Oct./Nov. 2005.

[4] R. Saltini and R. Akkerman, “Testing improvements in the chocolate traceability system: Impact on product recalls and production efficiency,” *Food Control*, vol. 23, no. 1, pp. 221–226, 2012.

[5] W.-D. Huang *et al.*, “A passive radio-frequency pH-sensing tag for wireless food-quality monitoring,” *IEEE Sensors J.*, vol. 12, no. 3, pp. 487–495, Mar. 2012.

[6] E. Smits *et al.*, “Development of printed RFID sensor tags for smart food packaging,” in *Proc. 14th Int. Meeting Chem. Sensors*, Nuremberg, Germany, 2012, pp. 20–23.

[7] R. A. Potyrailo *et al.*, “Battery-free radio frequency identification (RFID) sensors for food quality and safety,” *J. Agricult. Food Chem.*, vol. 60, no. 35, pp. 8535–8543, 2012.

[8] C. Amador, J.-P. Emond, and M. C. D. N. Nunes, “Application of RFID technologies in the temperature mapping of the pineapple supply chain,” *Sens. Instrum. Food Qual. Safety*, vol. 3, no. 1, pp. 26–33, 2009.

[9] J. Virtanen, L. Ukkonen, T. Björninen, and L. Sydänheimo, “Printed humidity sensor for UHF RFID systems,” in *Proc. IEEE Sens. Appl. Symp. (SAS)*, 2010, pp. 269–272.

[10] K.-H. Eom, K.-H. Hyun, S. Lin, and J.-W. Kim, "The meat freshness monitoring system using th e smart RFID tag," *Int. J. Distrib. Sensor Netw.*, vol. 10, no. 7, 2014, Art. no. 591812.

[11] K. H. Eom, M. C. Kim, S. Lee, and C. W. Lee, "The vegetable freshness monitoring system using RFID with oxygen and carbon dioxide sensor," *Int. J. Distrib. Sensor Netw.*, vol. 8, no. 6, 2012, Art. no. 472986.

[12] S. Apte and N. Petrovsky, "Will blockchain technology revolutionize excipient supply chain management?" *J. Excipients Food Chem.*, vol. 7, no. 3, pp. 76–78, 2016.

[13] S. Underwood, "Blockchain beyond bitcoin," *Commun. ACM*, vol. 59, no. 11, pp. 15–17, 2016.

[14] Z. Pang, Q. Chen, W. Han, and L. Zheng, "Value-centric design of the Internet-of-Things solution for food supply chain: Value creation, sensor portfolio and information fusion," *Inf. Syst. Front.*, vol. 17, no. 2, pp. 289–319, 2015.

[15] S. Piramuthu and W. Zhou, *RFID and Sensor Network Automation in the Food Industry: Ensuring Quality and Safety Through Supply Chain Visibility*. Chichester, U.K.: Wiley, 2016.

[16] C. Costa *et al.*, "A review on agri-food supply chain traceability by means of RFID technology," *Food Bioprocess Technol.*, vol. 6, no. 2, pp. 353–366, 2013.

[17] O. Novo, "Blockchain meets IoT: An architecture for scalable access management in IoT," *IEEE Internet Things J.*, vol. 5, no. 2, pp. 1184–1195, Apr. 2018.

[18] M. Conoscenti, A. Vetro, and J. C. De Martin, "Blockchain for the Internet of Things: A systematic literature review," in *Proc. IEEE/ACS 13th Int. Conf. Comput. Syst Appl. (AICCSA)*, 2016, pp. 1–6.

[19] F. Tian, "An agri-food supply chain traceability system for China based on RFID & blockchain technology," in *Proc. IEEE 13th Int. Conf. Service Syst. Service Manag. (ICSSSM)*, 2016, pp. 1–6.

[20] F. Tian, "A supply chain traceability system for food safety based on HACCP, blockchain & Internet of Things," in *Proc. Int. Conf. Service Syst. Service Manag. (ICSSSM)*, 2017, pp. 1–6.

[21] K. J. O'Dwyer and D. Malone, "Bitcoin mining and its energy footprint," in *Proc. ISSC/CIICT*, 2014, pp. 280–285.

[22] C. Dwork and M. Naor, "Pricing via processing or combatting junk mail," in *Proc. Annu. Int. Cryptol. Conf.*, 1992, pp. 139–147.

[23] V. Vishnumurthy, S. Chandrakumar, and E. G. Sirer, "KARMA: A secure economic framework for peer-to-peer resource sharing," in *Proc. Workshop Econ. Peer-to-Peer Syst.*, vol. 35, no. 6, 2003, pp. 1–6.

[24] S. Nakamoto, "Bitcoin: A peer-to-peer electronic cash system," Working Paper, 2008.

[25] V. Buterin *et al.*, "A next-generation smart contract and decentralized application platform," White Paper, 2014.

[26] A. Kiayias, A. Russell, B. David, and R. Oliynykov, "Ouroboros: A provably secure proof-of-stake blockchain protocol," in *Proc. Annu. Int. Cryptol. Conf.*, 2017, pp. 357–388.

[27] W. Li, S. Andrein a, J.-M. Bohli, and G. Karame, "Securing proof-of-stake blockchain protocols," in *Data Privacy Management, Cryptocurrencies and Blockchain Technology*. Cham, Switzerland: Springer, 2017, pp. 297–315.

[28] J. F. Salmerón *et al.*, "Design and development of sensing RFID Tags on flexible foil compatible with EPC Gen 2," *IEEE Sensors J.*, vol. 14, no. 12, pp. 4361–4371, Dec. 2014.

[29] K. Mizuno and M. Shimizu, "Transportation quality monitor using sensor active RFID," in *Proc. IEEE Int. Symp. Appl. Internet Workshops*, 2007, p. 19.

[30] M. S. Khan, M. S. Islam, and H. Deng, "Design of a reconfigurable RFID sensing tag as a generic sensing platform toward the future Internet of Things," *IEEE Internet Things J.*, vol. 1, no. 4, pp. 300–310, Aug. 2014.

[31] S. Gueron, S. Johnson, and J. Walker, "Sha-512/256," in *Proc. IEEE 8th Int. Conf. Inf. Technol. New Gener. (ITNG)*, 2011, pp. 354–358.

[32] M. Ammar, G. Russello, and B. Crispo, "Internet of Things: A survey on the security of IoT frameworks," *J. Inf. Security Appl.*, vol. 38, pp. 8–27, Feb. 2018.

[33] X. Lu, Q. Li, Z. Qu, and P. Hui, "Privacy information security classification study in Internet of Things," in *Proc. IEEE Int. Conf. Identification Inf. Knowl. Internet Things (IIKI)*, 2014, pp. 162–165.