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DATA TAMPERING AVOIDANCE FOR FOOD SUPPLY CHAIN TRACEABILITY SYSTEM USING BLOCKCHAIN TECHNOLOGY

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MASTER OF INFORMATION SECURITY

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By

FAHRULRAZI BIN ROSLI

Thesis submitted to the School of Graduate Studies,

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DEDICATIONS

To my parents, project supervisor, lecturers, friends and internet. Thank you for making this possible.

ABSTRACT

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Information Security

DATA TAMPERING AVOIDANCE FOR FOOD SUPPLY CHAIN TRACEABILITY SYSTEM BASED ON BLOCKCHAIN TECHNOLOGY

By

FAHRULRAZI BIN ROSLI

July 2019

Supervisor: Professor Dr. Zuriati Ahmad Zukarnain

Faculty: Faculty of Computer Science and Information Technology

Abstract:

Nowadays, the globalization of modern retail markets is increasing, and the supply chain from producers to end users is increasing and becoming more and more important. It is not uncommon to produce products in China, which is packaged in the Indonesia and sold in Thailand. This produces many arguments, for instance is when the product failed to follow such guiding and any quality requirement. In these cases, it is vital to find entities or people that affected by the catastrophe and not only focusing to find the cause of the product failure. Therefore, companies must improve their ability to track products from producers to end consumers by focusing data integrity issues in both parties.

Advanced data secure tracking systems is one of the advantage available because they provide effective response to product failures and reliable information for all stakeholders in term of the data integrity. Therefore, this study proposed a blockchain technology to be incorporated in the traditional traceability system to enhance the security of data transaction by adapting the security technique in the blockchain to increase the safety assurance of the data by having data tampering avoidance as one of the integrity aspects. The blockchain algorithm will be used to link each data that been inserted into the system to protect it from any attempt of data tampering such as unauthorized data modification. The results showed that the algorithm was able to preserve data integrity up to 100% accuracy.

ABSTRAK

Abstrak tesis yang dikemukan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Sarjana Keselamatan Maklumat

PENCEGAHAN PENGUBAHSUAIAN DATA TELARANG DARI BAGI SISTEM PENGESANAN BEKALAN RANTAIAN MAKANAN BERASASKAN TEKNOLOGI BLOCKCHAIN

Oleh

FAHRULRAZI BIN ROSLI

Julai 2019

Penyelia: Professor Dr. Zuriati Ahmad Zukarnain

Fakulti: Fakulti Sains Komputer dan Teknologi Maklumat

Abstrak:

Pada masa kini, globalisasi pasaran moden semakin meningkat, dan rantaian bekalan dari pengeluar ke pengguna akhir semakin meningkat dan menjadi semakin penting. Adalah tidak janggal bagi sesuati pengeluar menghasilkan produk di China, yang dibungkus di Indonesia dan dijual di Thailand. Terdapat beberapa isu keselamatan dalam pengurusan rantai bekalan makanan ini contohnya apabila produk gagal mengikuti garis panduan dan keperluan kualiti tertentu yang telah ditetapkan. Dalam kes-kes ini, adalah penting untuk mencari entiti atau orang yang terjejas hasil dari kejadian kemalangan itu

dan bukan sahaja menumpukan perhatian untuk mencari punca kegagalan produk. Oleh itu, syarikat perlu meningkatkan kemampuan mereka untuk mengesan perjalanan sesuatu produkbermula dari pengeluar hingga ke pengguna dengan memfokuskan isu integriti data. Sistem penjejakan yang selamat dari segi pengurusan data yang canggih adalah salah satu kelebihan yang ada kerana ia memberi respons yang berkesan terhadap kegagalan produk dan maklumat yang boleh dipercayai untuk semua pihak berkepentingan dari segi integriti data. Oleh itu, kajian ini mencadangkan teknologi blockchain untuk diaplikasikan ke dalam sistem pengesanan rantaian makanan tradisional untuk meningkatkan keselamatan pengurusan data dengan menggunakan teknik keselamatan di blokchain untuk meningkatkan jaminan keselamatan. Algoritma blockchain akan digunakan untuk menghubungkan setiap data yang dimasukkan ke dalam sistem untuk melindunginya dari sebarang percubaan data seperti pengubahsuaian data yang tidak dibenarkan. Keputusan menunjukkan bahawa teknik ini mampu mengekalkan integriti data sehingga ketepatan 100%.

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First and foremost, I would like to thank my parents for their countless supports in my journey to complete my years as a Master student.

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APPROVAL

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the degree of Master of Information Security. The members of the Supervisory Committee were as follows:

PROFESSOR DR. ZURIATI AHMAD ZUKARNAIN

Faculty of Computer Science and Information Technology

Universiti Putra Malaysia

(Supervisor)

Date:

DECLARATION

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
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- this thesis has not been submitted previously or concurrently for any other degree at any other institutions;
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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

In this study, the target is developing a traceability system of food supply chain based on blockchain technology to improve its security in term of data tampering avoidance. The content is about the background of supply chain traceability in general and the blockchain, the problem statement, scope of the study and the objective is defined below.

1.1 BACKGROUND

Blockchain technology is known to the public as interest when the Bitcoin currency is re-introduced in 2008 (Iansiti and Lakhani, 2017; Lemieux, 2016). At first, there are many ideas that things can be wrong in applying such currency. Since introduction of the Bitcoin currency in 2009, blockchain technology has become very popular. In the early years many people were questioned about this different currency, and Bitcoin struggled to win any significant traction. However, in 2013 the bitcoin offers rose from $ 13.96 / BTC (from January 7, 2013) to $ 979.45 / BTC (November 25, 2013) (Jansson, Petersen, 2017). On that prove of practicality in Bitcoin applications, industry and companies are ready to use blockchain technology to find other application areas. A particular industry that interested in this, sees the potential for using this technology to increase the security performance on the traceability of this chain of suppliers. In the next section, blockchain technology and supply chain traceability are described.

1.1.1 SUPPLY CHAIN TRACEABILITY

The globalization of modern retail markets is increasing, and the supply chain from producers to end users is increasing and becoming more and more important. It is not uncommon to produce products in China, which is packaged in the Indonesia and sold in Thailand. This produces many arguments, for instance is when the product fails to follow such guiding and any quality requirement. In these cases, it is vital to find entities or people that affected by the catastrophe and not only focusing to find the cause of the product failure. Therefore, companies must improve their ability to track products, from producers to end consumers. Advanced tracking systems are an advantage because they provide effective response to product failures and reliable information for all stakeholders.

1.1.2 BLOCKCHAIN TECHNOLOGY

Blockchain is a reliable database technical schema that is maintained together by a decentralized method and without trust on any parties to maintain its integrity. This method will d create data blocks over any nodes in the system by the use of cryptography function. Is links the data by chaining the block together and became a chain of data. The data that reside in the block contain all the detail requires to be stored and also have the method to ensure the connection between the next and precious block of data. Those blocks are unlimited in term of the length. There could be hundreds of blocks chained to each other to form a set of

chain. Based on connection of the previous block chain, there are some characteristic that should have in the system that is trustless, reliable databases, decentralized and transparency. The system that apply the blockchain is categorized as robust where there is no issue if one node is crash and the system will collapse because it uses the decentralize concept to ensure its continuity

1.2 PROBLEM STATEMENT

The agriculture-food supply chain traceability system is crucial nowadays. The function of traceability aspects has become recognized as essential tools for assuring food safety and their value of quality (Aung and Chang, 2014). They are used in order to get the benefit to trace the product detail such as tracking the product origin in order to handle the product safety itself. The centralized framework of this system is common to be applied nowadays because it uses the concept of single authority of data (centralize database), traditional ways of storing data in the database and easy to maintain. A study of preserving food safety and monitoring of kimchi supply chain in Korea through a traceability system showing the importance of implementing the system the correct way (Alfian et al, 2017). Another study on product identification stated supply chain parties such as farmer and factory will share their information through the center supervision of data and this fulfill the needs of the supply chain system basically (Li et al,2006). This method is effectively giving the chance to provide data tracking and traceability management through the parties or entities that participates in the food supply chain. But there's issues of integrity from this kind of centralize framework by having a single

authority into it because it is a monopolistic in term of data possession and opaque information system control which could affect in the integrity problematic, such as, corruption fraud, falsifying and tampering information.

Based on this reason, this study propose a blockchain technology to be incorporated in the traditional traceability system to enhance the security of data storing and transaction by adapting the security technique in the blockchain to increase the safety assurance of the data and at the same time provide transparency of the supply chain.

1.3 RESEARCH OBJECTIVE

The objective of this project is to impose blockchain technology into the previous traceability system that had been implement by the previous author to improve the security by avoiding data tampering to the data transaction in the system.

1.4 RESEARCH SCOPE AND LIMITATION

This study scope is on security improvement (data tampering avoidance) of agriculture food (rice) supply chain traceability system to increase the data integrity of the system. Referring on the overall concept of blockchain structure, this study will only focus on creating the engine of consensus (protocol to store data behind the blockchain system). Therefore, the smart contract will not be included in this study *Figure 1*.

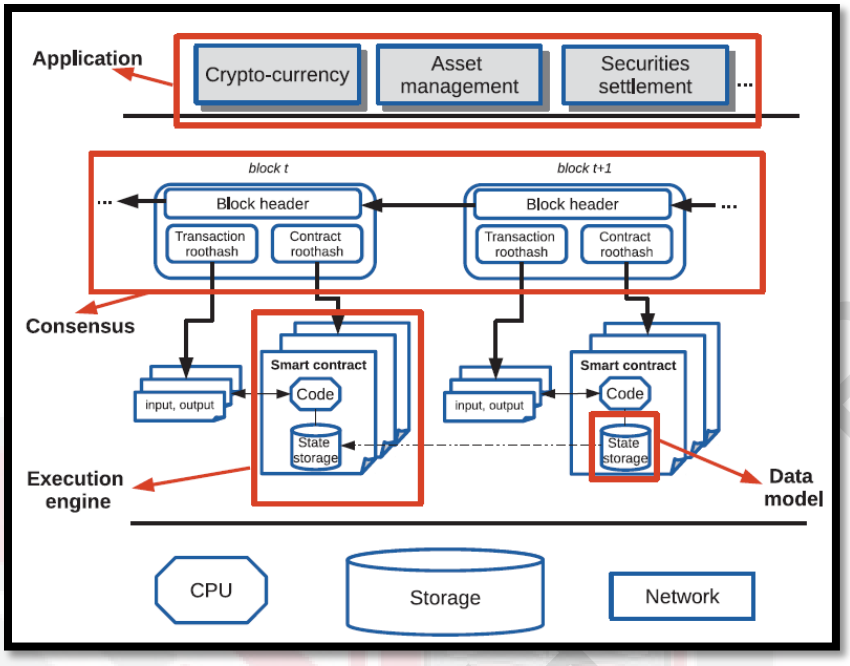

Figure 1.1 Blockchain structure model (Dinh et al, 2018)

1.5 THESIS STRUCTURE

The summary of thesis structure was shown below:

Chapter 1 – Briefly describes about introduction, problem statement, objectives, research scope, research significance, research methodology and research limitation in conducting a research work on the Data Tampering Avoidance for Food Supply Chain Traceability System Based on Blockchain Technology

Chapter 2 – This chapter focused on extensive literature review from relevant publications to understand more about the perspective of supply chain traceability, traceability system, and the blockchain technology that will be used in this research. Together with this is the comparison between the research been done before this and limitation that occurs or arise from that.

Chapter 3 – This section covers a full phase of methodology that will be using throughout this research such as survey, construction of algorithm, prototype development, prototype testing for data collection and analysis of result.

Chapter 4 – Further details on the proposed features of planned algorithms that will be construct and deploy into the traceability system. It also covers the technical requirements and specifications that will be needed to develop the application such as tools and platform that will be used. It will also cover on the analysis of the result of data tampering avoidance based on several cases of tampering toward the system. The process including the result were elaborated in this chapter.

Chapter 5 - As the final chapter for the thesis, the summary of research works will be elaborated here.

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