AN ADOPTION OF HALAL FOOD RECOGNITION SYSTEM USING MOBILE RFID/NFC TECHNOLOGY

BY

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A thesis submitted in fulfilment of the requirement for the degree of Doctor of Philosophy in Information Technology

Kulliyyah of Information and Communication Technology
International Islamic University Malaysia

NOVEMBER 2018

ABSTRACT

Radio Frequency Identification (RFID) is the type of wireless technology that enables handheld devices to read the low-priced tags at a short distance without requiring a power source. Since Malaysia is a modern Muslim country and heading towards being a global halal-hub; herein consumer retail industry maintaining halal product integrity is a vital factor which requires to introduce a comprehensive and appropriate tracking and tracing technology to maintain halal product integrity and develop a technological framework that can support the entire Halal Product Supply Chain (HPSC). In the meantime, one of the debated issue with in the halal food industry is detecting fake halal products from genuine ones, therefore, in accordance to this problem Malaysian Muslim authority on halal product Jabatan Kemajuan Islam Malaysia (JAKIM) introduced and implemented the halal logo as the halal validation on the request of market trading agencies. Also, JAKIM introduced a platform for sending a text message in order to inquire about the halal status of products with "SMS Halal JAKIM" and such that this can be performed by sending SMS or MMS. While this service exposed to be time-consuming and witnessed other internal problems. Thus, this prevailing condition was an indication for a comprehensive study that could address the issues in order to provide complete details about consumer products. Therefore, this research has used near-field wireless technologies i.e. RFID/NFC in order to validate halal status for the food products by developing a database based on products listed in the JAKIM website. This research introduced a system which is suitable for every user through developing an application for identifying and validating halal products through Android smartphones which are capable to read NFC or external RFID readers. Whereas, existing applications made use of barcodes which can be easily copied instead of using barcodes using RFID/NFC tags minimizes the chances of fraud within the halal industry. In addition, this study compared the usability, efficiency, affordability, security, and customer satisfaction between new application and old systems by collecting data from customers who were asked to use the new application while checking the halal status of the product. Therefore, a paired sample test was performed to assess the differences between the new and existing systems. The results indicated a significant difference between the systems and values for each of the construct were found $p<0.5$, and the mean difference for usability was found 2.022, efficiency 2.446, affordability 1.830, security 1.956, and for satisfaction 2.00. The values for mean differences revealed that the new system is better than the existing ones in terms of usability, efficiency, affordability, security, and customers satisfaction. Also, this system is an addition into existing systems that are based on product identification techniques using RFID/NFC technologies and this system will help consumers to identify halal products with ease while they are shopping in stores.

خلاصة البحث

تقنية التعريف بالتردد اللاسلكي (RFID) هو نوع من التكنولوجيا اللاسلكية التي تمكن الأجهزة المحمولة من قراءة العلامات منخفضة السعر على مسافة قصيرة دون الحاجة إلى مصدر طاقة. بما أن ماليزيا بلد مسلم حديث وتتجه نحو كونها مركز حلال عالمي؛ في هذا الموضوع صناعة التجزئة الاستهلاكية والحفاظ على سلامة المنتجات الحلال هو عامل حيوي يتطلب إدخال تقنية تتبع شاملة وملائمة للحفاظ على سلامة المنتج الحلال وتطوير إطار تكنولوجي يمكن أن يدعم سلسلة توريد المنتجات الحلال (HPSC). في غضون ذلك، فإن إحدى القضايا التي تمَّ بحثها في صناعة الأغذية الحلال هي اكتشاف المنتجات الحلال المزيفة من المنتجات الأصلية. ووفقًا لهذه المشكلة ، قامت السلطة الإسلامية الماليزية للمنتج الحلال Jabata Kemajuan Islam Malaysia (JAKIM) بتقديم وتطبيق شعار الحلال كعلامة التحقق من الحلال بناءاً على طلب وكالات التداول في السوق. وكذلك قدمت JAKIM منصة لإرسال رسالة نصية من أجل الاستفسار عن حالة المنتجات الحلال مع "SMS Halal JAKIM" ، بحيث يمكن القيام بذلك عن طريق إرسال SMS أو MMS. بينما تعرضت هذه الخدمة إلى أن تكون مضيعة للوقت وشهدت مشاكل داخلية أخرى. لذلك كان هذا الوضع السائد بمثابة إشارة إلى الحاجة لدراسة شاملة يمكن أن تعالج هذه القضايا من أجل تقديم تفاصيل كاملة عن المنتجات الاستهلاكية. لذلك، استخدم هذا البحث تقنيات لاسلكية قريبة المجال، أي RFID / NFC من أجل التحقق من حالة الحلال للمنتجات الغذائية من خلال تطوير قاعدة بيانات تعتمد على المنتجات المدرجة في موقع JAKIM. قدم هذا البحث نظامًا مناسبًا لكل مستخدم من خلال تطوير تطبيق لتحديد المنتجات الحلال والتحقق منها عبر الهواتف الذكية التي تعمل بنظام Android والقادرة على قراءة NFC أو قارئات RFID الخارجية. في حين أن التطبيقات الحالية تستخدم الباركود التي يمكن نسخها بسهولة بدلاً من استخدام الباركود، فاستخدام علامات RFID / NFC تقلل من فرص الاحتيال داخل صناعة الحلال. بالإضافة إلى ذلك، قارنت هذه الدراسة سهولة الاستخدام، والفعالية، والقدرة على تحمل التكاليف، والأمن، ورضا العملاء بين التطبيقات الجديدة والأنظمة القديمة من خلال جمع البيانات من العملاء الذين طُلب منهم استخدام التطبيق الجديد أثناء التحقق من الحالة الحلال للمنتج. لذلك، تم إجراء اختبار عينة زوجية لتقييم الاختلافات بين الأنظمة الجديدة والقائمة. أشارت النتائج إلى وجود فرق معنوي بين الأنظمة والقيم لكل من البُنى بمقدار $p<0.5$، ووجد أن الفرق المتوسط لإمكانية الاستخدام مساوي لـ 2.022،

والفعالية 2.446، والقدرة على التحمل 1.830، والأمن 1.956، والارتياح 2.00. أظهرت قيم الاختلافات المتوسطة أن النظام الجديد أفضل من الأنظمة الحالية من حيث سهولة الاستخدام، والفعالية، والقدرة على تحمل التكاليف، والأمن، ورضا العملاء. بالإضافة إلى ذلك، يعد هذا النظام إضافة إلى الأنظمة القائمة التي تعتمد على تقنيات تعريف المنتج باستخدام تقنيات RFID / NFC، وسيساعد هذا النظام المستهلكين على تحديد المنتجات الحلال بسهولة أثناء التسوق في المتاجر.

APPROVAL PAGE

The thesis of Mohsen Khosravi has been approved by the following:

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DECLARATION

I hereby declare that this thesis is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

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ACKNOWLEDGEMENTS

Firstly, it is my utmost pleasure to dedicate this work to my dear parents and my family, who granted me the gift of their unwavering belief in my ability to accomplish this goal: thank you for your support and patience.

I wish to express my appreciation and thanks to those who provided their time, effort and support for this project. To the members of my dissertation committee, thank you for sticking with me.

Finally, a special thanks to Professor Asadullah Shah for his continuous support, encouragement and leadership, and for that, I will be grateful forever.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

Malaysia is a modern Muslim country heading towards being a global Halal hub; it has been well-known as a successful halal-hub in the world since 1997. Halal is often used in reference to food and drinks, i.e. the food which is allowable for Muslims to eat or drink under Islamic Shariah (law). Halal is based on an Arabic term meaning "permissible". In English, it most often referred to like food that is allowed according to Islam law. In the Arabic language, it signifies that anything that is permissible under Islam. The antonym of Halal is 'Haraam', which refers to something which is "prohibited" under Islamic law(Kamali, 2003; HDC, 2015; Ismail & Nasiruddin, 2014). The term halal and haraam will be used strictly to describe food products, meat products, cosmetics, personal care products, food ingredients, beverage and food materials(Tanakinjal et al., 2009). Which foods are halal or which foods are haram, is decided according to the Holy Quran and the Glorious Shari'ah (Kamali, 2010).

In consumer retail industry, keeping up halal item trustworthiness is a fundamental belief, so it is necessary to present a complete and extensive tracking and tracing technology to keep up halal item uprightness and build up an innovative structure that can bolster the whole Halal Product Supply Chain (Bahrudin et al., 2011; Bohari et al.,2013). Information Technology (IT) is supposed to be the best formula to be used to make the world a more helpful and practical place for individuals from a wide range of culture and religions. Nowadays, smart spaces and smartphones are going to lead the world of business.

RFID refersto Radio Frequency Identification and is a term that portrays an arrangement of ID (Bohn, 2006). RFID depends on putting away and remotely recovering data or information as it comprises of RFID tag, RFID persue and back-end Database (Schwerin &Rosen, 2009).

The mobile RFID empowers business to give new administrations to portable clients by securing administrations and exchanges from the end-client to an organization's current online business and IT frameworks (Ahsan, Shah & Kingston, 2010). RFID innovation has been acknowledged as an execution differentiator for an assortment of business applications, yet its capacity is yet to be completely used. In future, the users ought to have the capacity to utilize his own particular versatile reader gadgets to recognize the things, look for the following thing of intrigue, restrict and explore. Figure 1.1 demonstrates how RFID technology works.

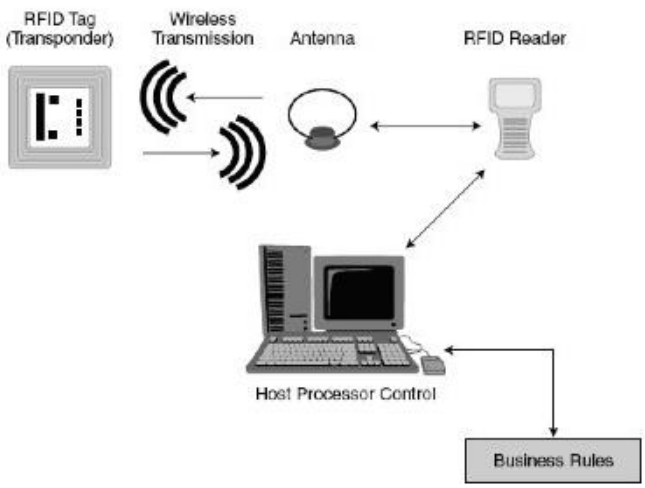

Figure 1.1 RFID technology process.
Source: (Ahsan et al.,2010)

This study focuses on approving halal status for food items by utilizing RFID or Near Field Communication (NFC) innovation to upgrade existing techniques in Malaysia.

1.2 BACKGROUND OF THE STUDY

At the 2007 world halal forum, Malaysia's former Prime Minister, Tun Abdullah Haji Ahmad Badawi stated the government's aim of establishing Malaysia as a global halal hub. Subsequently, a large number of researches was conducted in various fields of study to help pursue the goal of "Malaysia as a global halal hub" (Tan et al. 2012). One of the controversial issues in the halal food industry is detecting fake halal products from genuine ones. Malaysian Muslim specialist on the halal item, Jabatan Kemajuan Islam Malaysia (JAKIM) has created and actualized the halal logo as the halal approval dueto the demand of market broker organizations. To check the originality of halal products, customers could either browse JAKIM's website or call JAKIM's office via phone.

On the one hand, these methodsare time-consuming but on the other hand,cases misrepresentation and abuse of the halal logo have progressively been accounted by purchasers (Mohamed Syazwan Ab & Mohd Remie Mohd, 2012). To address such issues various studies have been conducted in the halal product identification field. Whereas no study has focused on various methods including the use of RFID and smartphones for validating halal products. In the Malaysian Halal industry, RFID innovation is viewed as undeveloped since standardized tags are regularly used as programmed identifiers regardless of the presence of web-based interfaces and cell phone applications (Nasir et al. 2011). However, Muslim consumers still face problems in validating halal products.

MyMobiHalal 2.0 is a mobile-based support application for Muslims to identify the Halal status (Junaini & Abdullah, 2008) so that users can send and receive MMS as answers to their queries instead of entering 13-character barcodes in the

SMS. This study thus discusses the barcode conception and its functions in customer product industry.

Another study has implemented 2-D barcode halal logo detector to identify halal products and UV hologram to spot fake halal logo (Mohd Albakir & Mohd-Mokhtar 2011). The scanned image is decoded and used to match a database. Prototype hardware as halal detector device has also been designed so that the customer can hold the product in front of it, then the status of the product will appear on the device screen.

Another study proposes a system that would help the consumer to validate halal products through Smartphone barcode captured straightaway on time with the applied halal product alert database system (Kassim et al, 2012). The system is called MyHalal designed to focus on a new database structure which details the company's information, Halal certificate expiry alert and newapplications technique usingSmartphone without accessing the network. The only operating system that customers need to have is a smartphone with a minimum Android 2.1.

Other researches have implemented RFID technology to identify and validate halal status (Norman et al, 2009). One study states that barcodes, reader and ingredient information by far are not adequate to validate the information claimed by the manufacturer or food producer; instead, a real-time tool is needed to feed users with genuine and validated information to assist user-buying process that is RFID technology. The perception of Malaysian customers was measured, and the result indicates users agreed that a real-time system is required for the information dissemination (Anir et al, 2008).

It is imperative for specialists and makers to give redress data since buyers depend basically on item bundling, including the Halal logo, fixings and producers so

as to approve Halal status (Nasir et al, 2011).While few studies found that 66% of all shoppers had inquiries regarding halal logos showed on nourishment products, the same number are false while 92% of reviewed customers encouraged the authorities to give an option approving framework that uses ongoing strategies. As indicated by this review, just 26% of the respondents selected RFID, however, SMS and scanner tags were viewed as attractive by 48% and 22% of respondents, individually. As narrated in that review, this reaction may have been because of the development of standardized tags, SMS and MMS, and the absence of infiltration of new innovation, for example, RFID. 68% of the respondents additionally emphatically concurred that approving Halal status utilizing RFID ought to be executed, as this would decrease the number of fakes and help Muslim shoppers to effectively approve certified Halal status, and additionally help Malaysia to end up plainly the world's Halal centre point.

1.3 PROBLEM STATEMENT

The government of Malaysia has set the goal of making “Malaysia as the major halal hub in the world”. In this regard, a large number of researches have been initiated in different fields of studies such as business, management, accounting, electronic, computer science and information technology. Some studies indicate the use of technology is the key factor in approaching this goal such as (Gumbri & Norlida Mohd Noor, 2015; Ismalaili Ismail et al.,2016; Kawata et al.,2018; Pesavento et al.,2016; Guangyao Ran et al., 2016; Razalli, 2018).

In Malaysia, Halal approval is carried out in few ways. One is "Sistem Maklumat Halal" or the Halal Information System overseen by JAKIM that gives data on Halal items. To get to the data, shoppers must have an Internet connection yet no retail location in Malaysia furnishes PCs with Internet connections to the customers.

Another way is the rise of portable applications, such as, "SMS Halal JAKIM" which is an application which approves halal status on sustenance items by sending instant messages to JAKIM. Customers need to sort in the 13-digit scanner tag numbers. In any case, messaging long numbers is tedious, tiring and typographical blunders may happen. One single error can deliver poor outcomes. Utilizing MMS (Multimedia Messaging Service) could be an answer to this issue. Through this framework, customers don't need to sort in the 13-digit standardized identifications; rather, they utilize cell phone cameras to catch the picture of the scanned tag. This caught picture is then sent to JAKIM for approval. A base, one-megapixel camera is required for pictures to be perceived by the JAKIM server. Be that as it may, sending MMS pictures costs clients more than sending SMS.

Another mobile application, “MyHalal” uses image processing and recognition module from a digital camera (Junaini & Abdullah, 2008). This technology gadget provides camera and barcode readers that could be used to quickly identify and verify the information of the products or the halal status is reliable for the consumers while they are shopping.

The existing systems are relayed on reading and scanning barcodes but the problem with barcodes is that they can be easily copied and make the Halal validation unsafe. To beat these issues, Halal RF Validation is being created with the expectation of helping Muslims approve the Halal status of nourishment items in the most helpful way that is available. Through this framework, Halal status might be resolved in almost no time and without cost. In particular, with the utilization of remarkable recognizable proof numbers that are devoted to each and every item, this application could diminish the quantity of Halal logos impersonation. On the other hand, in

today's smart business spaces, RFID and NFC mobile shopping are going to be the trend (Zhu et al.,2005).

1.4 RESEARCH GOAL

The goal of this research is to propose an effective method to recognize and validate the halal status for food products utilizing the RFID technology.

1.5 RESEARCH OBJECTIVES

This study is carried out to fulfil the following objectives:

1- To design a database of halal products that are in JAKIM list.

2- To propose a method for halal food validation using RFID technology.

3- To develop halal recognizable proof/approval applications for android advanced mobile phones which are furnished with NFC or outside RFID reader innovation.

4- To evaluate customer satisfaction using proposed halal food detection system.

1.6 RESEARCH SCOPE

The research objectives are achieved by identifying the problem scope which covers the following aspects:

- Development of halal products database which is identified by JAKIM.
- Analysis of RFID technologies and tags to find the efficient and reliable method for development of product identification using this technology.