The Users Perceptions and Opportunities in Malaysia in Introducing RFID System for Halal Food Tracking

NORMAN AZAH ANIR, MD NASIR MOHD HAIRUL NIZAM, AZMI MASLIYANA
Faculty of Computer Science and Information Technology,
University of Malaya
50603 Kuala Lumpur
MALAYSIA
azahnorman@um.edu.my, hairulnizam@um.edu.my, masliyanaazmi@gmail.com

Abstract: The lack of information presented on the food packaging of specific food product usually lead to confusion, thus redundant unsold goods are stacked-up in the shopping market. Barcode, labels and ingredients information by far is not adequate to authenticate the validity of the food information claimed by the manufacturer or food producer. This long-established approach fails to inform the users and no longer fitting in this cyber world. Much work has been carried out to find the best solution to ensure information presented on the food packaging is true yet legitimate. In similar cases by big food store, shows the agility of RFID has assist them to better track their food status. By taking this example, we have carried out some studies to better understand the capability of RFID in tracking Halal status in Malaysia food market. This study is aimed to understand the Malaysian users' perception on implementing a real-time tool in order to feed users with genuine and validated information in the user-buying process. Furthermore, by conducting this study, researcher can better understand and identify the market opportunities to deploy such technology to the Malaysia users. A quantitative approach was chosen to gather data from the users around Klang Valley and Kuala Lumpur, Malaysia. A survey form consisting of 32 questions were distributed to 50 to 60 identified users, where respondents were selected varies from Halal and non-Halal users. Graphs and tables are presented to depict the findings of users' perception on the RFID tag for Halal Tracking in Malaysia. The results show 48% of the users agreed that a real-time system is required for the information dissemination. However, sadly only 34% knows what RFID is and what RFID can do in developing a real-time system for Halal tracking. Approximately 98% of the respondent agrees that a new tracking system is required for information traceability. This result shows clear opportunity to introduce new tools, nevertheless solid awareness activities are required to ensure the success of the new system.

Key-words: - Halal information, Halal tracking, RFID, User tracking system.

1. Introduction

Radio Frequency Identification (RFID) was discovered as early as 1935, which was during the World War II. RFID is one of the oldest tools available in the tracking technology today. Its capacity in tracking involving a complicated system to an ordinary system makes it one of the best tracking tools of its kind. Tracking system using RFID covers from the high-end business sectors to mid-range usage due to RFID's feasibility in the number of applications available today. As [1] believes, the potential application of RFID technology is limited only to one's imagination. [1] also quoted from [2], the most prominent RFID applications are as follows: item tracking and tracing, inventory monitoring and control, asset monitoring and management, anti-theft, electronic payment, access control, and anti-tampering.

In food and packaging industry all around the world, RFID tracking system is picking up momentum as it is being utilized to cater the demand of tracking inventory besides theft cases in the hypermarket. One of the largest food market chains, Wal-Mart had notified its 100 suppliers to install RFID tags (for inventory tracking) by January 2005. The remaining 12,000 supplier will have to follow suit by 2006 [3].

In Malaysia's food industry, food status especially involving Halal status is one of the prime area that has potential to leverage this technology. This is simply because the Malaysian Muslim consumers' are

very much concern about the authenticity of Halal food products claimed by food producers. There are findings that revealed fabricating activities done by food manufacturer to post Halal logo on their food packaging in order to attract Muslim users to buy their product, though in reality, the food manufactured from their premises are not certified by the authorized body. This is major problem in Malaysia market today. Halal brands, trademarks and logo hold no reliability or authenticity leading to possible doubts from the customers. This is indeed agreed by [4], where traceability is essential for many purposes, including assurance that systems conform to their requirements. Due to this fact a simple yet robust tracking is highly required to track food ingredients sold in the market. Traceability proves to be able to answer the Muslims concern in Malaysia on the way of how the particular food is being prepared and how it is being packaged. Besides, RFID technology is well-positioned as a means to achieve greater product velocity and operational visibility across supply chains, increase efficiencies in inventory management, and enable product tracking and monitoring [5].

Realizing the potential market for Halal food industry since the last two decades, countries worldwide began to set up Halal authorities to provide Halal certification services. However, a tracking system is needed to verify the Halal brand, trademark or logo on food packaging. Current Halal tracking approaches are manual, and just recently move towards the development of web-based information system that provides the list of Halal foods and Halal food search. A SMS (Short Messaging Service) system has been developed years ago to track product status where consumers have to SMS product barcodes to the authorized body. Still, approaches provided are insufficient. For example, imported products are not listed in the portal. A comprehensive tracking system need to be employed to help depict related claims of the brand or the trademark on the package in a real time basis and in a trusted environment. With the power to track and trace items easily, RFID could be the best device to solve this problem. [6] and [7] discusses on the RFID and barcodes advantages and disadvantages, where findings in the mid 90's still apply today, showing the significant and capability of RFID in the system tracking.

Table 1: Comparisons between RFID and barcode

Subjects	RFID Tag	Barcode
Reading capability	Does not require transponder to be in line of sight	Barcode readers require a direct line of sight to the printed barcode
Information identification	Multiple tag identification (Read numbers of information simultaneously)	Single tag identification
Rate of reading	Tags read faster	More time consuming due to the fact that that line of sight is required
Reading range	RFID tags can be read at much greater instances up to 300 feet	The range to read a barcode is much less, typically no more than fifteen feet
Usability	Reusable	Not reusable
Information configuration	RFID tags, however, can be read/write devices; the RFID reader can communicate with the tag, and alter as much of the information as the tag design will allow	Barcodes have no read/write capability; that is, you cannot add to the information written on a printed barcode
Cost	RFID tags are typically more expensive	Barcode tags are cheaper

Table 1 above shows the comparisons between RFID and Barcode. Barcodes are synonym to Malaysians since it can be easily found in hypermarkets to tag the price. Due to the fact that barcodes require direct line of sight and can only perform single tag identification, it usually caused congestion at cashier lanes. On the contrary, RFID is able operate at much greater distance and tags multiple items which is useful for supply chain management. Once all goods are attached with RFID tags, they can be tracked automatically by the radio readers, which give complete inventory visibility and efficiency.

[6] state that Wal-Mart is expected to handle about four billion cartons in 2004 and five billion cartons in 2005. Any increase in the efficiency of tracking goods in its global supply chain could generate tremendous benefits. This proves that RFID save more details for each product than barcodes.

Currently, most of the retailers in the world including Malaysia are using bar code system as a product identification mechanism in order to keep track of their inventories. However [8] believes that barcode labels are being found to be inadequate, as it is an increasing number of fraud cases due to their low security level. Instead [9] stated that in the context of counterfeiting, RFID is a promising technology. From an application standpoint, there are four major advantages of RFID over bar coding [10], they are:

a) Contactless and remote interrogation
b) No line of sight required
c) Multiple parallel read possible
d) Individual item instead of an item class can be identified

A real time tracking leveraging on the RFID technology, enable consumer and even food distributor to segregate the Halal food and non-Halal food conveniently. In this scenario, food management can be much easier as it increases the capability to track and trace the food manufacturer's information. Electronic Product Code (EPC) Network architecture with the EPC code technology helps businesses today to embark in the RFID-technology effectively and globally rather than in limited environment. EPC code contains of numeric data that is capable to hold data ranging from 64 bits to 256 bits of data. This numeric data hold the EPC version number, name of enterprise or manufacturer, class of product and unique identification of an individual item of the product. With this, it will enable the Halal

information being programmed in the RFID tag, unlike the Universal Product Code (UPC) or bar code. The capability of RFID to cater a large-scale checking and tracking enables faster and more resilient product recognition for consumer. Moreover, RFID with the EPC code technology provide a large storage capacity comparing to the limited storage capacity of a bar code.

2. What is RFID? Tagging and Tracking

RFID system consists of two main components [8]:

a) A transponder which is located on specific product or object to be identified
b) A reader which read or write or read as a data capturing device

RFID systems manage information with tags which embedded non-contact radio chips [11]. RFID in general means technology that uses radio frequency to identify product or object. The transponder consists of a microchip storing the serial number that is attached to an antenna for object tracking purposes. This transponder is called RFID tag. An active tag that has high computational task requires a battery to power up the connection, for the purpose of data transmissions to the reader. Passive tags require no battery and no on-tag transmitter. Passive tags draw power from the reader that send out electromagnetic waves using a specific radio frequency emitting power to the antenna of the tags thus enabling the data to be transmitted between RFID tags and the reader. Typical RFID systems are connected to an enterprise database system to provide information or operational functions [12]. The tags can be embedded into the packaging of a product and can be read by devices on shelves, at check out registers or at warehouse gates without human intervention [13]. RFID tags can be protected from unauthorized duplication or counterfeiting by applying cryptography, authentication algorithm or other security algorithm on the tag itself [14].

Currently, EPC Network consist of three main components including the Object Name service (ONS), EPC Discovery Service (EPC-DS) and EPC Information Service (EPC-IS). The components provide service as below:

a) ONS gives similar service like the Internet Domain Name System today. ONS maps the tag information (EPC code) to the correct directory

to correctly route information for tracking process.

b) EPC-IS store information of distributors of the manufactured products. Usually distributors will deploy this service rather than the EPC-DS.

c) EPC-DS contains information of the manufacturer's product. The EPC-DS and EPC-IS connected with each other to provide track and trace capability.

3. Religious Observances and the Impact towards the Economy

The growth of Muslim population, the speed of trade globalization, the advancement in science and technology and the ongoing initiatives to simplify manufacturing processes makes it essential that the Halal concept be fully understood by marketers [15]. There are estimated to be around 1.8 billion of Muslims around the world today. The Muslims has strong fellowship surrounding food whereby they practice according to a strict food preparation and procedure as governed by the holy Quran. Halal is an Arabic word that means lawful. Food or drink product approved for Muslim consumption, must conform to the Islamic dietary laws as specified in the Holy Qur'an, the Hadith or sayings of the Prophet Muhammad (Peace and blessings of Allah be upon Him), his Sunnah or tradition, and in the Fiqh or understanding of the Islamic Jurists: Imam Hanafi, Imam Shafi', Imam Maliki and Imam Hambali.

Due to advancements in food technology and distribution, Muslims today are more exposed to various ingredients and manufactured foods. While many things are clearly Halal or clearly Haram, there are some things which are not clear. These items are considered questionable or suspicious and more information is needed to categorize them as Halal or Haram. The most common of these are food additives, gelatin, emulsifiers and rennet in cheese manufacture. These products can become Halal if the raw materials are Halal and the process is agreeable according to the Islamic way. It must be understood that finished food products made from Halal animals are no longer Halal if they have been contaminated by haram products. Therefore, the Muslim community would have to know whether the addition, ingredients or finished foods contain any haram substance. Lawful foods are practiced by different types of religion whereby the practices are different with respect for each of the religion. In Islam for example, food practices are vital as it has a strong connection with the well-being of the believers. Table 2 below from [16] shows the percentage of Muslim population by continents in the year of 2006.

Table 2: World Muslim Population in 2006 (IslamicPopulation.com, 2007)

Continent	Total Population (million)	Muslim Population (million)	Muslim %
Africa	923.2	442.88	47.97
Asia	3970.5	1060.65	26.71
Europe	731.7	50.7	6.93
North America	331.7	7.13	2.15
South America	566.05	3.08	0.54
Oceania	33.54	0.60	1.79
Total	6313.78	1565.28	24.79

In Southeast Asia alone there are over 250 million Muslim Halal consumers. Malaysia, Indonesia, Singapore and many other countries in the region have government mandates to import Halal-certified products only. In these countries, Halal is considered as a symbol of quality and wholesomeness not only by Muslims but also by non-Muslims [17]. [18] claimed based on the estimated expenditure per capita for food of US$0.85 (RM3.23) a day, it is estimated that the market for Halal products is US$560 billion (RM2.12 trillion) a year. In Malaysia, 60% of the populations are Muslims and if one were to estimate the per capita expenditure for food as RM1 a day, then the demand for Halal products is more than RM5 billion a year. From 1995 to June 2003, the Malaysian Industrial Development Authority (MIDA) has issued licenses to 424 food-manufacturing companies with a total investment of RM5.9 billion. The growing request of Halal food has turned the Halal food market to be one of the major agri-food components in today's market trade. The impact towards economy at this instant is no longer in the Muslim countries but countries around the world where there are Muslim presences.

4. Existing approach towards *Halal* Tracking in Malaysia

Currently, the practise of Halal tracking is in a manual manner by the assigned Islamic authorities. There is no specific real-time tracking system or technology that is implemented to track Halal food. In Malaysia, current tracking is by the Halal trademark posted on the food packaging. This Halal trademark logo issued by authorities to the authorized company who has undergone through strict procedure to get Halal-certification [19].

Fig. 1: Malaysia New Halal Logo

By posting the Halal trademark logo, the company is then trusted to manufacture food according to the strict regulation specified by Malaysia's authorities. Currently, Malaysia uses Halal logo above that comes in different colours including black, blue, green, red, orange and grey.

Fig. 2: JAKIM's E-Halal Portal

E-Halal is a web-based information system developed by JAKIM that consist of a database of companies that posses the Malaysian Halal certification and Halal information on other consumer products, food premises, and abattoirs. The directory provides Halal food search using product barcode, food description and company description. Consumers can enquire the Halal status of the food product through Short Messaging Service (SMS) system. E-Halal uses the product barcode as the product identifier.

Fig. 3: JAKIM's Short Messaging Service (SMS) system.

4. Research Methodology

A survey was conducted to gather users' requirements in order to implement the Halal tracking system thus understanding the Malaysian users' requirement on new suggested system. This survey is also important to collect and analyse the users' understanding on Halal concept. The survey where divided into 2 different respondents group. The end-user, as reported in this paper and the manufacturer, which will be covered in later paper. The questionnaire for the end users consists of 32 questions, distributed to 50 selected consumers in the area of Lembah Klang and Kuala Lumpur. Respondents involved in this survey are from the Halal and non-Halal consumers. The questionnaire was created with the objective to see the readiness of Malaysia end-users to move to new technology on Halal tracking which are the RFID technology and its benefit for users.

5. Research Findings

From the data collected, analysis showed 78% users questioned about the authenticity of the Halal certificate received by manufacturer and 66% users questioned about the authentication of the logo. This result showed that users are not convinced on the certificate issued and logo used by manufacturers to claim product are Halal.

This shows that both identifications fail to provide a validity check for user to ensure the food status.

Question arise	Percentage (%)
Authentication of Halal certificate	78%
Authentication of Halal logo	66%

Table 3: Uncertainties in Halal logo and certificate.

Based on the survey done, we found that 92% of the respondents agree that improvised detecting machines will assist them to certify, authenticate and validate Halal certificate and logo. About 96% of the respondents wish to have a system that can provide information to track and trace Halal certification. Therefore, a detecting system is required to fulfill these requirements.

Type of detector	Percentage (%)
Real time	48
Offline	4
Barcode	22
RFID	26

Table 4: Types of detector

Table 4 shows the percentage for types of detector that are being suggested to fulfill the requirements. Only 26% of the respondents choose RFID as detecting tools while 48% of the respondents choose real time applications example online SMS as a detector. We have concluded that due to lack of exposure, it has resulted that users are keen to use SMS as the detector as they fail to see and understand the benefit of RFID as a better tracking tool. Fig. 4 shows the RFID awareness amongst our respondents).
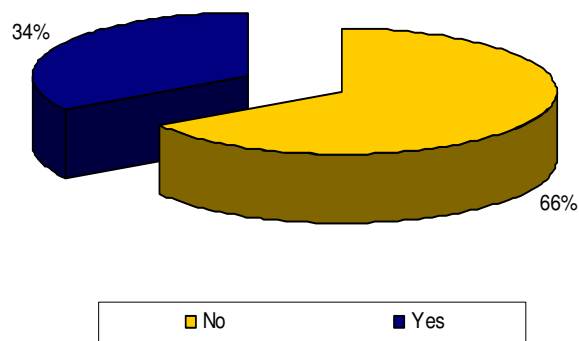

Fig. 4: Awareness of RFID among consumers in Malaysia

Although only 34% of the consumers aware of the usage of RFID in Malaysia, 66% users believe, that RFID can be a useful tool to authenticate and validate Halal certificate and logo. Another 68% users also agreed that RFID should be widely used in Malaysia (Please refer Fig. 5).
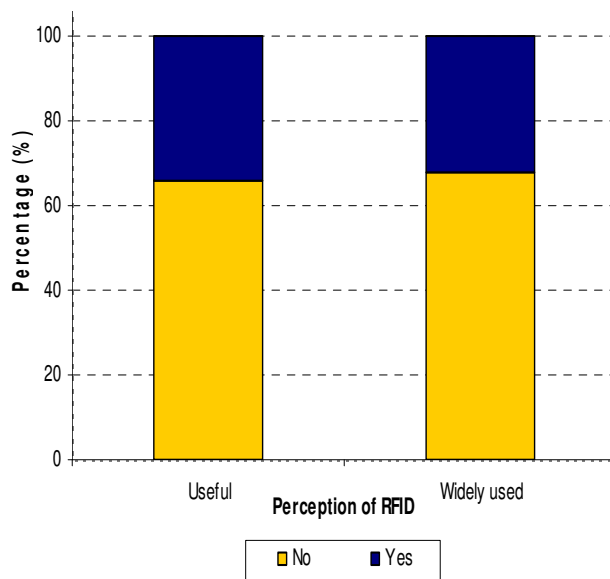

Fig. 5: Perception on RFID among consumers in Malaysia

Mean score in Table 5 shows the awareness of consuming Halal for respondents especially Muslims due to their obligation to the religion (Please refer Table 5).

Awareness	Mean	Std. Deviation
Understanding on Halal	1.28	0.607
Importance on consuming Halal products	1.24	0.822
Buying habits	1.98	0.958
Reactions on unsure status	1.08	0.274

Scale:
1.00 = Very important, 2.00 = Important,
3.00 = Less important, 4.00 = Not important

Table 5: Awareness on consuming Halal products

In order to consume Halal products, certification on Halal logo is crucial. Near 74%, respondents will look for Halal logo on the food packaging, 22% respondents will read the ingredients while 4% respondents determine the manufacturers. Thus, we can conclude that, 100% respondents are positive that it is important for the manufacturers to give right information to users. Manufacturer also must help accommodate the market on Halal status where 98% respondents suggested using a system for this matter. To ensure the success of this system, 98% of the consumers confirmed the importance of getting Halal updates the Halal authorities on each Halal status of a manufacturer. Therefore, the implementation of a new system that uses RFID in tracking Halal food will be important to achieve the objective of being the Halal Hub of the world (Please refer Fig. 6). Halal Hub is the objective of the government of Malaysia in becoming the Halal focal point, thus connecting the global Halal-supply chain.
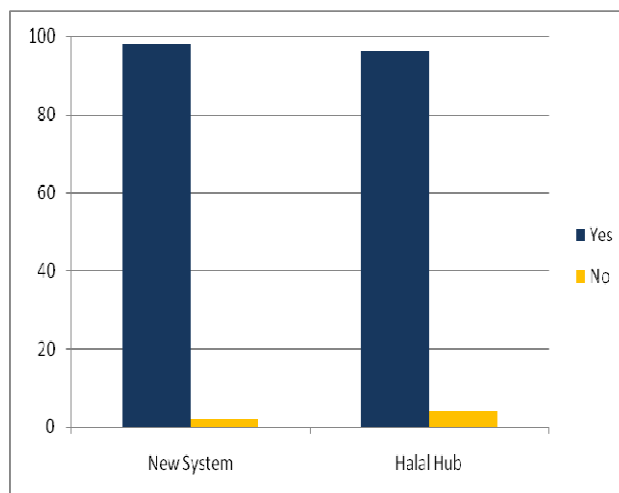

Fig. 6: Factors and support of using RFID as Halal detector in Malaysia

6. Proposed System: Halal Tracking System

The two main components of the EPC network are EPC embedded in a RFID tags and RFID readers. The aim of the EPC network is to let consumers to sense products e.g. food in real-time basis whether the foods is Halal-certified or not. Following Fig. 7 describes the proposed system to enable Halal Tracking in Malaysia. There will be three main players in this system including the end-users, food manufacturer/distributor and the Malaysia authoritative body controlling the Halal standard.
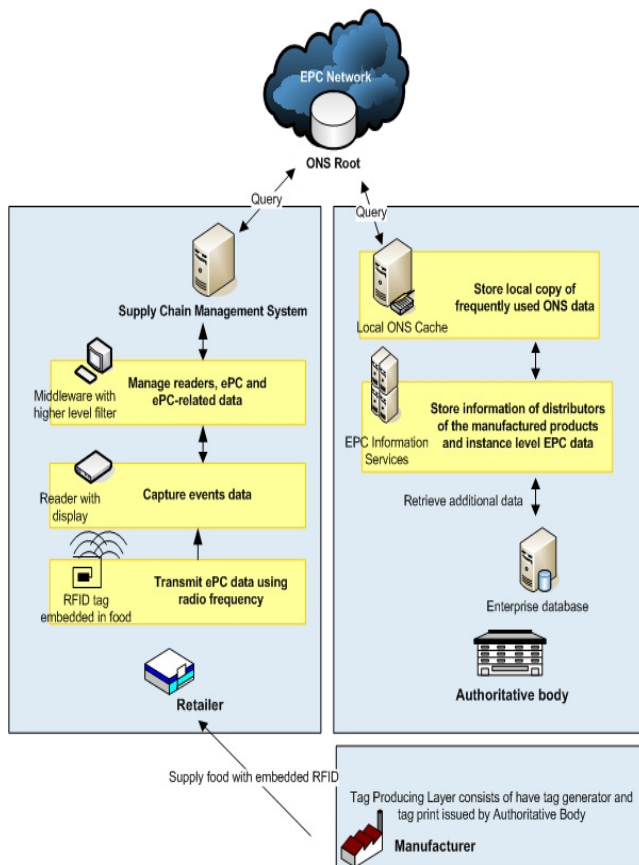
Fig. 7- Halal Tracking System: Component and Layers

1. An EPC, a unique identification number that identifies a specific food product in the supply chain will be embedded in microscopic RFID-tag and will be attached to the food product.

2. RFID readers situated in the food store either at each food rack lanes or at the cashier points will automatically scan each RFID-tag when tags enter their read range and then broadcast small bits of data contains EPC to the reader.

3. The use of middleware to act as a connecting layer to manage and process the flows of data coming from one or more tag reader devices, send to the application layer. In addition, it also performs filtering, aggregation, and counting of data, to reduce the volume of data prior to sending to retailer's enterprise applications e.g. Supply Chain Management System.

4. Retailer's enterprise applications query the Root ONS for the location the related information of the Authority Body's Local ONS. Architecturally, the ONS has two layers; the first is called Root ONS, which built using the same functionality and technology as the Domain Name Service (DNS) [20] and [21]. of the internet that

provides a global lookup service to map an EPC into one or more Internet Uniform Reference Locators (URLs) that describes the item represented by the EPC. While, the second layer of the ONS is called the local ONS, which is the directory of manufacturer and related information for that particular of food product.

5. The Authority Body's Local ONS is queried for the location of the product data, which is stored in an EPC information System.

6. EPC-IS that stores all information of the item including shipping, manufacturing and other data related to the product (Halal information) in Physical Markup Language (PML) will enable consumer to get the information on a real time basis before they compete their purchasing at any of food rack lanes or the cashiers point. The purpose of PML core [22] is to standardize the format and content of messages exchanged by the sensors within the EPC network.

7. Conclusion

This paper discussed on the findings of users requirements of newly suggested Halal tracking system. The analyses of data collected shown clear opportunity of new real time system for Halal tracking in Malaysia food market. The requirement from users will be the platform to test proposed system architecture design in the earlier stage of the proposed project. Leveraging on the suggestion of the design by the EPC Network to include the Product Authentication Service (EPC-PAS) [9], the Halal tag tracking will be able to decrease fraud and counterfeit of tags and information in tags.

There are still some research needs to be carried out in order to incorporate information in the EPC code. Subsequently a standard of data or information that must be included in the code must be agreed on, thus making the tracking tool more beneficial. Each of the markets or supermarkets involve in this proposed system must enable a tracking device at each of the checkout counters for the purpose of scanning product Readers must also be place on the rows where the groceries are displayed to assist the while shopping. Besides, EPC-IS server must have connection with 'Halal servers' build by the relevant authorities to give update on the Halal food product at real time basis. Further research may include discussion on items such as:

a) Establishment of a standard that will be used nationally in implementing the RFID technology

b) Developing a database with real-time synchronization within the participating countries to enable ubiquitous tracking system.

8. Acknowledgement

9. Reference:

[1] Byungkwan Ju, Kyoungkeun Kim, Youngwoog Yoon, Yeongseog Lim, Combined RFID with sensor of motion detect for Security system, Proceedings of the 2007 WSEAS Int. Conference on Circuits, Systems, Signal and Telecommunications, Gold Coast, Australia, January 17-19, 2007

[2] Sandip Lahiri, RFID Sourcebook, IBM press, pp-64, 2005

[3] Meloan Steve, Towards a Global "Internet of Things" (2003) http://java.sun.com/developer/technicalArticles/Ecommerce/rfid URL Retrieved April 14, 2008

[4] Madalin Stefan Vlad, Valentin Sgarci, A RFID System Designed for Intelligent Manufacturing Process WSEAS Transactions on Information Science & Applications ISSN 1709-0832, Issue 1, Volume 4, January 2007

[5] R. A. Wolf, A. Sparavigna, And B. Montrucchi, RFID Label Converting: Quality Enhancement with Atmospheric Plasma Treatments, WSEAS Transactions on Systems, ISSN 1109-2777, Issue 8, Volume 5, August 2006

[6] N.C. Wu, M.A. Nystrom, T.R. Lin, H.C. Yu Challenges to global RFID adoption, Technovation 26 (2006) 1317–1323

[7] Brewer, A., Sloan, N., and Landers, T. L., Intelligent tracking in manufacturing, Journal of Intelligent Manufacturing (1999) 10, 245±250

[8] Finkenzeller, Klaus, RFID handbook: Fundamentals and Applications in Contactless Smart Cards and Identification,Second Edition (2003), John Wiley & Sons.

[9] Staake Thorsten, Theisse Frederic and Fleisch Elgar, "Extending the EPC Network-The Potential of RFID in Anti-Counterfeiting" (2005) ACM Symposium on Applied Computing

[10] Gaukler, G. M. (2005). RFID in supply chain management. (Doctoral dissertation, Stanford University, 2005). Retrieved August 26, 2006, from ProQuest® database.

[11] Kei Eguchi, Takahiro Inoue, Ichirou Oota, Hongbing Zhu, Fumio Ueno (2007) A Cross-Coupled Type AC-DC Converter for Remote Power Feeding to a RFID Tag, WSEAS Transactions on Circuits and Systems, ISSN: 1109-2734 Issue 11, Volume 6, November 2007

[12] Roberts, C. M. (2006). Radio frequency identification (RFID). Computers and Security, Volume 25 (Issue 1). Retrieved August 19, 2006, from ScienceDirect® database

[13] Sahin, E., Dallery, Y. Gershwin, S. (2002). Performance evaluation of a traceability system. An application to the radio frequency dentification technology. 2002 IEEE International Conference on Systems, Man and Cybernetics, Volume 3. Retrieved August 20, 2006, from IEEE Xplore™ database

[14] Wong, K.H.M., Hui, P.C.L., Chan., A.C.K. (2006). Cryptography and authentication on RFID passive tags for apparel products, Computers in Industry, Volume 57 (Issue 4). (2006). URL Retrieved August 19, 2006 from ScienceDirect® database.

[15] Shahidan Shafie and Md Nor Othman. 2006. Halal Certification: An International Marketing Issues and Challenges. www.ctw-congress.de/ifsam/download/track_13/pap00226.pdf URL Retrieved April 14, 2008

[16] IslamicPopulation.com website http://www.islamicpopulation.com/world_islam.html URL Retrieved November 9, 2007

[17] Riaz, M. N., and Chaudray, M. M. Halal Food Production, CRC Press, Florida 2004.

[18] Melati Mohd Ariff, Malaysia, A Hub In The Making For Halal Food? Ministry of International Trade and Industry (MITI) (2004). http://www.miti.gov.my/Halalhub-new16feb04.html URL retrieved on 8-March-2007

[19] Jabatan Agama Islam Selangor Malaysia, Procedure of certification, (2005). URL retrieved on 8-March-2007 http://www.jais.net.my/pengesahan_Halal2.php

 [20] M. Mealling. The Naming Authority Pointer (NAPTR) DNS Resource Record (2000) IETF Network Working Group Request for Comments 2915

[21] M. Mealling. Dynamic Delegation Discovery System (DDDS) Part One: The Comprehensive DDDS (2002) IETF Network Working Group Request for Comments

[22] C. Floerkemeier, D. Anarkat, T. Osinski, and M. Harrison. PML Core speci¯cation 1.0 (2003) Auto-ID Center Recommendation. URL retrieved on 8-March-2007 http://develop.autoidcenter.org/