



**UNIVERSITI PUTRA MALAYSIA**

***REAL TIME TRACEABILITY MODULE FOR HALAL LOGISTIC  
TRANSPORTATION USING GPS AND GEOFENCE TECHNIQUE***

**MAIZATUL AKMA BINTI MOHAMAD**

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**REAL TIME TRACEABILITY MODULE FOR HALAL LOGISTIC  
TRANSPORTATION USING GPS AND GEOFENCE TECHNIQUE**

By

**MAIZATUL AKMA BINTI MOHAMAD**

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in  
Fulfillment of the Requirements for the Degree of Master of Science**

**July 2016**

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

## **REAL TIME TRACEABILITY MODULE FOR HALAL LOGISTIC TRANSPORTATION USING GPS AND GEOFENCE TECHNIQUE**

By

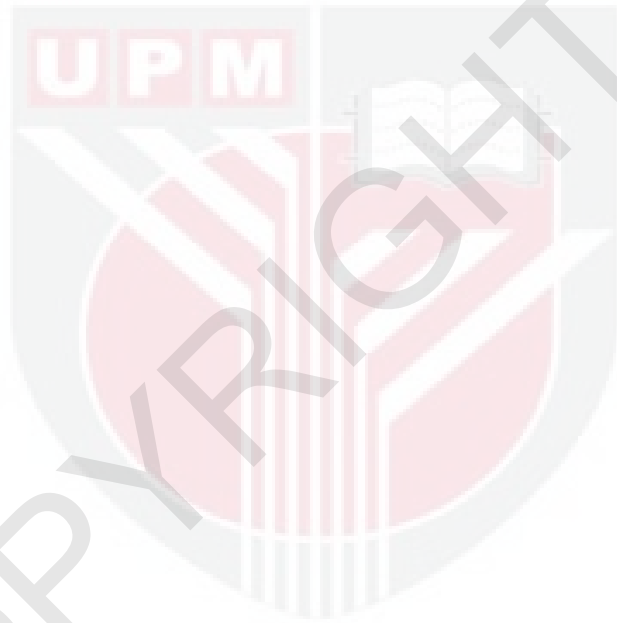
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The general practice of Halal concept in the logistic process has highlighted a number of doubts on the reliability of the Halal goods in every stage of the process, which one of them is the transportation operations. While undergoing the transportation process, Halal goods have the tendency of being contaminated, loss of track and chain breakage due to lack of real time traceability system to execute the monitoring process. Typically, there are a number of tracking systems that enable one to monitor the movements of a certain product, but all of them are too general and contradicting the rules set out by the shariah law in managing the Halal product. This study presents a merged traceability module of GPS tracking system technology with geofence algorithm, entitled the Halaltracer. The significance of Halaltracer traceability module is that it mainly benefits in providing automatic detection on the spatial activity undergone during the shipment process of the Halal goods. The system is able to identify the possibility of cross contamination by examining the vehicle stoppage via geofence technique. The existing geofence technique was upgraded by integrating spatial, temporal and speed rule in the ray casting algorithm used for this technique. As soon as the vehicle is on the move, the tracker will be stimulated, and the stopping location of the vehicle is being inspected, whether it is within the geofence area or otherwise. User will be notified by receiving an email, while the report current and past track can be viewed via web based visualization interface with Google Map as base map. The verification and simulation report illustrate that the module and improved algorithm has successfully been executed to deliver a report of tracking that is in accordance with the requirements of administering Halal goods. A comparison of performance and result of the geofence technique and Family Locator application, developed by Sygic, was made. A user acceptance test has been implemented and most of the respondents agreed that this module will benefit the Halal logistic provider in providing data on real time traceability. Due to its significant function, whereby a conversion of manual procedure into a web based module is

necessary, this module will be effective and brings benefits to the authorities, Halal logistic service providers and also users.



Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**MODUL PENGESANAN MASA SEBENAR UNTUK LOGISTIK  
PENGANGKUTAN HALAL MENGGUNAKAN GPS DAN TEKNIK  
GEOPAGAR**

Oleh

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Praktis umum konsep Halal dalam proses logistik telah menimbulkan beberapa keraguan tentang kebolehpercayaan barangan halal di setiap peringkat proses, yang mana salah satunya adalah operasi pengangkutan. Semasa proses pengangkutan dijalankan, barangan Halal mempunyai kecenderungan untuk tercemar, kehilangan pengesanan dan terputus rantaian kerana kurangnya sistem pengesanan masa nyata untuk melaksanakan proses pemantauan tersebut. Sebelum ini, telah terdapat beberapa sistem pengesanan yang membolehkan seseorang untuk mengawasi pergerakan sesetengah produk, tetapi kesemuanya adalah terlalu umum dan bertentangan dengan peraturan yang ditetapkan oleh undang-undang shariah dalam pengurusan produk halal. Kajian ini membentangkan modul teknologi sistem pengesanan GPS yang digabungkan dengan algoritma geopagar, yang dinamakan sebagai Halaltracer. Modul Halaltracer merupakan modul pengesanan yang dapat memberi manfaat dalam menyediakan pengesanan automatik kepada aktiviti spatial semasa proses penghantaran barang Halal. Sistem ini dapat mengenal pasti kemungkinan pencemaran silang dengan memeriksa lokasi kenderaan berhenti menggunakan teknik geopagar. Teknik geopagar yang sedia ada telah dinaik taraf dengan mengintegrasikan, peraturan kelajuan, masa dan spatial ke dalam algoritma ray casting yang digunakan untuk teknik ini. Sebaik sahaja kenderaan itu bergerak, alat pengesanan akan dirangsang dan lokasi kenderaan itu berhenti akan diperiksa, sama ada dalam kawasan geopagar atau sebaliknya. Pengguna akan dimaklumkan dengan e-mel, manakala laporan semasa dan laluan boleh dilihat melalui antara muka visualisasi berasaskan web dengan Google Map sebagai peta asas. Pengesanan dan laporan simulasi menunjukkan bahawa modul algoritma telah berjaya dilaksanakan untuk menyampaikan laporan pengesanan yang selaras dengan keperluan dalam mentadbir barangan Halal. Perbandingan prestasi dan hasil daripada teknik geofence dengan aplikasi Family Locator, yang dibangunkan oleh Sygic, telah dibuat. Ujian penerimaan pengguna telah dilaksanakan dan kebanyakan responden bersetuju bahawa modul ini akan memberi

manfaat kepada pembekal logistik halal dalam menyediakan data pada masa pengesanan sebenar. Oleh kerana fungsinya yang ketara ini, di mana penukaran prosedur manual ke dalam modul berasaskan web adalah perlu, modul ini akan berkesan dan membawa manfaat kepada pihak berkuasa, pembekal perkhidmatan logistik Halal dan juga pengguna.



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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 Science. The members of the Supervisory Committee were as follows:

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## TABLE OF CONTENTS

		<b>Page</b>
	<b>ABSTRACT</b>	i
	<b>ABSTRAK</b>	iii
	<b>ACKNOWLEDGEMENTS</b>	v
	<b>APPROVAL</b>	vi
	<b>DECLARATION</b>	viii
	<b>LIST OF TABLES</b>	xii
	<b>LIST OF FIGURES</b>	xiii
	<b>LIST OF ABBREVIATIONS</b>	xiv
	<b>CHAPTER</b>	
<b>1</b>	<b>INTRODUCTION</b>	1
	1.1 Background of study	1
	1.2 Problem statement	3
	1.3 Objectives	5
	1.4 Significance of Study	6
	1.5 Scope and Limitation of Research	7
	1.6 Outline of Thesis	8
<b>2</b>	<b>LITERATURE REVIEW</b>	9
	2.1 Introduction	9
	2.2 Supply chain versus Halal Supply chain	9
	2.3 Government requirement for Halal transportation	11
	2.3.1 MS2400-1:2010 Halalan Toyiyban Assurance Pipeline- Part 1: Management System Requirement for Transportation of Goods and/or Cargo Chain Services	12
	2.4 Halal Transportation Traceability	12
	2.5 Technology used in product traceability	13
	2.5.1 RFID	13
	2.5.2 GPS	14
	2.5.3 Difference between GPS and RFID	14
	2.6 GPS tracking system for logistic	15
	2.7 Spatial analysis using geofence	15
	2.7.1 The GPS tracking system integrated with geofence	16
	2.7.2 Geofence technique	17
	2.7.3 Methods and algorithm for geofence	19
	2.8 Summary of the Literature Review	21
<b>3</b>	<b>METHODOLOGY</b>	23
	3.1 Introduction	23
	3.2 Phase 1: Early Design Phase	25

3.2.1	The proposed logistic transportation tracking framework	25
3.3	Phase 2: Development phase	27
3.4	Hardware Survey	28
3.4.1	GPS and GPRS/GSM	29
3.4.2	Virtual private server (Linux)	31
3.5	Software Survey	31
3.5.1	MySQL Database	32
3.5.2	Scripting Language	33
3.5.3	Yii Framework	34
3.5.4	IP address	35
3.5.5	Domain	36
3.5.6	Google Map API	36
3.6	Database design and construction	37
3.7	Setting Up and Connecting GPS Tracker to a Server	37
3.8	Web based module development	39
3.9	The ray casting algorithm	41
3.10	Phase 3. Implementation	46
<b>4</b>	<b>RESULT AND DISCUSSION</b>	<b>47</b>
4.1	Introduction	47
4.2	User Requirement Analysis	47
4.3	Prototype of the Halaltracer Module	48
4.4	GPS Tracking Section	50
4.4.1	Login	50
4.4.2	Menu page selection for GPS tracking part	51
4.4.3	Drawing Polygon For Geofence	52
4.4.4	User Section: Company information	55
4.4.5	User Section: Vehicle	56
4.4.6	User Section: Task	57
4.5	Location Update Report	57
4.6	Geofence stoppage report	58
4.7	Simulation Test of Halaltracer Module	60
4.8	Accuracy of GPS tracking system	67
4.9	Module Comparison	68
4.10	User acceptance test result	73
4.11	Summary of the Result	75
<b>5</b>	<b>CONCLUSION AND RECOMMENDATION</b>	<b>77</b>
5.1	Introduction	77
5.2	Conclusion	77
5.3	Future Work	79
	<b>REFERENCES</b>	<b>80</b>
	<b>APPENDICES</b>	<b>86</b>
	<b>BIODATA OF STUDENT</b>	<b>103</b>
	<b>LIST OF PUBLICATIONS</b>	<b>104</b>

## LIST OF TABLES

<b>Table</b>		<b>Page</b>
2.1	The Difference between Conventional Supply Chain and Halal Supply Chain	10
3.1	Command List for Setting the GPS Tracker with Server	30
3.2	Technical specification for VPS	31
3.3	Command list used in Putty	39
4.1	The Improvement Made by Halaltracer Module	76
4.2	Solution Suggestion for Reports Finding	76

## LIST OF FIGURES

Figure		Page
2.1	Process and Requirement to get Halal Certificate	11
2.2	Geofence Technique	18
2.3	The Grid Test Method	20
2.4	Angle Summation Test	20
2.5	Research Gap	22
3.1	Research Workflow	24
3.2	Proposed Logistic Transportation Tracking Framework	26
3.3	GPS Tracking System Architecture	28
3.4	GPS Tracker Device Used in the Study	29
3.5	MySQL Script for the Coordinate of Polygon	33
3.6	MySQL Spatial Data Type	33
3.7	Typical workflow of a Yii application	35
3.8	GPS data format	38
3.9	Steps in Set Up Server	40
3.10	Ray Casting Algorithm	42
3.11	Geofence concept	43
3.12	Geofence Rule	45
3.13	Proposed Geofence Coding	45
3.14	Ray Casting Coding	46
4.1	Main page of Halaltracer modules	49
4.2	About Menu with Some Description about the Entire Module	50

4.3	Login Page For GPS Tracking Module Part	51
4.4	Menu for GPS Tracking Module Part	52
4.5	Draw Polygon Menu	53
4.6	List of Polygon For Geofence	54
4.7	Company Details	55
4.8	Vehicle Detail	56
4.9	Task List	57
4.10	Path Taken During the Movement of the Vehicle	58
4.11	Email Alert Notification	60
4.12	Simulation Flowchart Diagram	61
4.13	Tracing Information	63
4.14	Geofence Stoppage Location	64
4.15	Generation of Geofence in Urban and Sub-Urban Area	65
4.16	Time of Alert	66
4.17	Comparison of route view between Halaltracer and Family Locator Apps	70
4.18	Comparison of geofence type between Halaltracer and Family Locator Apps	71
4.19	Comparison of email alert notification between Halaltracer and Family Locator Apps	72
4.20	User Acceptance on Data Entry Procedure and Interface Representation	74
4.21	The User Acceptance on the Usefulness of the Module	75



## LIST OF ABBREVIATIONS

LSP	Logistic Service Provider
HTCCP	HalalanToyyiban Critical Control Point
URL	Uniform Resource Locator
IP	Internet Protocol
TCP	Transmission Communication Protocol
TCP/IP	Transmission Communication Protocol/Internet Protocol
GPS	Global Positioning System
GSM	Global System for mobile communication
GPRS	General Packet radio service
DNS	Domain Name System
RFID	Radio Frequency Identification System
CCTV	Closed Circuit Television
VPS	Virtual Private Server
WUI	Web User Interface
WDF	Web Development Framework
API	Application Programme Interface
MVC	Model-View-Controller
NMEA	National Marine Electronics Association
APN	Access Point Name
POI	Point of interest

# CHAPTER 1

## INTRODUCTION

### 1.1 Background of study

Along with the speedy growth of the country, Halal now is regarded as not just a way of life but it is a global industry. The increasing of global need for Halal products and services has driven for the evolution of many Halal systems since early 2000 (Ibrahim, Kamaruddin, & Shabudin, 2012). According to Gornaz et al., (2010), the demand of Halal products has now extend globally including non-Muslim consumer due to awareness of humane animal treatment and perception that Halal products are healthy and safe. Halal, opposite to Haram, is a Quranic term that means permitted, allowed, lawful or legal (Bahrudin et al., 2011; Tieman, 2013).

Malaysia, with a Muslims population density of 61.3% from 28.3 million residents as of 2010, is a country that extensively practices the Halal industry (Department of Statistic Malaysia, 2015). As Halal is extending throughout the supply chain, many doubts about reliability have arisen of various views including the food and logistic industry itself, directing to the opening move to verify the logistics operations in accordance with Halal standard (Othman et al., 2009; Tieman, 2013). The Malaysian government has offered a number of initiatives to support the development of Halal logistics in the country. According to Tan et al., (2012), in 2010, Standards on Halal Logistics, MS 2400: 2010 has been enacted which covers on the Halal transportation and ICT requirement for controlling Halal. These standards state that the organization has to establish and apply a traceability system that allows the identification of inbound goods and freight for the processing stages in the transportation chain service, details of suppliers and record of the distribution route for delivering Halal goods.

The integrity of Halal products depends on the performance of logistic service management (Tan et al., 2012). Logistic plays an important part in building a reliable Halal industry. Tieman, (2006) in his study mentioned that the protection of Halal status can be ensured by proper transportation, storage, and handling with supply chain until the products had arrived the final destination. Logistic service management acts as a medium to collect, consolidate, storage handling, value added, track and trace and control shipment.

Logistic plays important roles in ensuring the Halal status of the goods are always protected (Tan et al., 2012). Previously, consumers only concerned about the aspects of Halal goods in terms of its preparation and ingredients (Jaafar et al., 2011). Recently, consumers had realized that the quality of Halal goods has to be covered from farms to

fork, which includes the sources of raw materials, manufacturing, transporting, storing and handling (Tieman, 2011; Omar et al., 2013).

Managing Halal transportation is not the same with conventional transportation usage. Halal transportation has to follow the “*shariah*” rule to avoid any “*syubhah*” activity that will risk the goods it carries in becoming non-halal. Many issues and challenges arise in maintaining and managing the Halal transportation. Some of them are the issue of proper segregation, the risk of contamination, lack of information sharing and no real time tracking system available in monitoring Halal goods movements. The halal products cannot be mixed with other non-halal product during the transportation process (Tan et al., 2012). This is due to the various situations and circumstances which might lead to risk that will affect the Halal status of the goods.

Tracking and tracing of shipments are essential in manufacturing firms in terms of customer service and for managing logistic network efficiently (Shamsuzzoha and Helo, 2011). In the logistic supply network, global industries are facing a huge problem in dealing with tracking and tracing their shipments. The problem is loss of track among production, delivery and distribution in the logistic supply chain. During the logistic process, Ming, (2006) found that the shipment was facing information integrity risk. Information integrity describes about the reality it present, covering the aspect of accuracy, consistency and reliability (Ming, 2006). This leads to customer dissatisfaction to their service.

This study presents a real time traceability module called Halaltracer, which allows the logistics service providers and authorities to monitor the activity that occurs during the delivery of Halal products. This module provides route information and with little improvement on the existing geofence technique, the vehicle stopping area can be checked and alert will be issued in an event where the vehicle had stopped at an unknown area. The server has been programmed to connect with the global positioning system (GPS) tracker device which periodically obtain and send its positional data to the server. This allows the Halal operator to get real time information logs on the movement of the vehicle. The application focuses on reporting the current location of the vehicle with the integration of stoppage report to check whether or not the vehicle is in Halal’s geofence area. An alert will be sent via email and report of current and past track can be view via web based visualization interface with the Google Map as base map. This module is expected to solve the traceability problem proposed by the government by simply converting the manual method into an automatic method to ensure the integrity of the halal product.

## 1.2 Problem statement

Muslims want assurance on the products they consume, whether it is in compliance with the Islamic principles or not (Tieman, 2011; Batu and Regeinstein, 2014). Maintaining Halal performance during transportation is the biggest challenge in the Halal industry (Jaafar et al., 2013). Conventionally, the control of Halal logistic industry was done manually without a real time track and trace system (Tan et al., 2012). Development of ICT has been seen as a good platform in handling problems regarding the Halal logistic. However, the implementation of ICT usually requires a high investment. Therefore, only a small number of organizations are participating in applying ICT in Halal logistic industry. A study done by Tan et al., (2012) shows that some logistic service provider used radio frequency identification system (RFID) technology which is expensive and closed-circuit television CCTV has limited coverage area. Some of them had already implemented GPS in their system, but the data retrieve is not in real time mode. According to Tieman (2013), the implementation of the Halal logistic system should not significantly increase the cost of Halal products as it is a necessary requirement in the halal logistic system. Moreover, some of the logistics service providers worry that the introduction of ICT in the halal logistic system is complex and that their employee might not be familiar with it. Thus, a real time, user friendly combined with a low-cost module must be developed to overcome this problem.

The existing conventional tracking system is different than the Halal tracking system because it is too general and conflicting the prescribed “*shariah*” aspects. Tan et al., (2012) added that even though the traceability system has been used by some logistic service provider (LSP), however, it only covers when the goods are in receiving stage process. The verification made only covers on Halal status and cargo labelling. Based on audit checklist referred to Jabatan Kemajuan Islam Malaysia (JAKIM), Majlis Ulama Indonesia (MUI) and Western Australia Halal Authority (WAHA), it was found that the checklist on Halal transportation aspect is too general and only little focus was given for this aspect.

During the handling process, the goods are exposed to the problem of being in direct contact with non-Halal goods (Omar et al., 2013). To overcome this problem, specific procedure is required for handling the supply chain of the goods. However, according to Syazwan et al., (2013), Malaysia is still in the early stage of applying the halal supply chain. A study done by Anir et al., (2008) stated that the halal LSP has yet to implement a real-time tracking system for halal logistic transportation. This can be proven by interviews conducted with JAKIM in 2014. According to JAKIM, up until now, Malaysia still does not have a specific halal tracking system for halal logistic. Based on the case study conducted on three LSP in Malaysia, Jaafar et al., (2013) conclude that it is very hard to preserve the halal performance due to lack of information sharing between Halal operators.

Zailani et al., (2010) states that there is no specific method to identify the origin of those goods which cast a big doubt on whether the goods actually came from the same place as stated on the packaging labels. This is because when goods are transferred from one place to another, the chance of supply chain breakage is even higher especially if the other party did not practice Halal supply chain. Halal supply chain is only guaranteed when goods are in their custody. This situation will become more uncontrollable when the goods have reached small retailers where there is no control and monitoring being carried out. Therefore, to overcome this problem, a module for controlling and maintaining halal performance should be established to ensure that the supply chain is always connected, and halal goods status is still maintained.

This matter is supported by Tan et al., (2012) based on several case studies conducted whereby some of LSP were still using manual systems for halal logistic and some of them intended to apply the existing ICT for tracking and tracing. Each LSP used their own initiative to create the tracking system based on the standard enacted by the government, which is the tracking method is not similar to each other. Therefore, it is a must for the government to have a standardized halal tracking system for monitoring the transportation aspect of the Halal goods to ensure the halal status of the goods is maintained and at the same time facilitate the LSP and operator in handling and sharing the information about the halal goods.

The main element considered in protecting the Halal status is by segregating the Halal from Non-Halal goods to avoid cross contamination from occurring. During transportation process, there will always be uncertainties on several subjects such as the content of the container. Basically, only the manufacturers know the content of the container. Upon transferring and transiting the goods from one destination to another, the information would no longer exist. The retailers would also face the same issue where questions of the origin of the products and who are/history of the immediate suppliers remain unknown. Since the logistic companies do not merely work within the Halal logistic, therefore, there will be doubt on whether the product was segregated or handled fully according to Islamic principles.

Tan et al., (2012), in his study stated that among the cause of cross contamination to occur are caused by sharing a container. According to Jaafar et al., (2011), in an interview session conducted on LSP in Malaysia, they found that the containers used came from around the world and they could not identify the previous contents of the containers. Therefore, before loading the goods for the next delivery, they perform a '*Samak*' process.

During the transportations many possible events which lead to cross contamination that will make Halal goods become non-Halal. The problem will take place when the vehicle transit or stop to the place that operates non-halal goods or mix together the halal goods with non-halal goods in a container. This problem is integrity problem where cannot be controlled by the government since it depends on the LSP's integrity itself.

Contamination risk can also occur due to several factors like if the goods are mixed with hazardous goods or exposed to the hazardous environment. For example, in the poultry supply chain, most of the problems and losses during transportation process come from the pre-slaughter process. Therefore, Omar et al., (2013) in her study has gained some Halalan Toyyiban Critical Control Point (HTCCP) related to transportation of poultry supply chain. HTCCP is intended to identify any potential contamination and risk of Halal goods to be non-halal throughout the supply chain process.

According to a study conducted by Omar et al., (2013), it was found that among the HTCCP identified is a problem regarding proper storage of chickens inside vehicles. The chickens should be ensured to not mixed or contaminated with dangerous non-halal goods. Dedicated transportation, which is “*shariah*” compliant, is proposed to be used for reducing the risk of potential contamination. Apart from that, when the chickens have reached their destination either at loading bay or retailer site, proper storage should be provided. Thus, areas that are not halal should be placed away from areas of halal goods. Based on the emerging issues, the integration of tracking system with geofence technique is an ideal solution to solve this issue. This module is ideal because of its capability to monitor vehicle movements and identifies the routes taken and visited areas in order to spare it from going to the non-halal goods areas which can possibly cause contamination and make halal goods become non-halal.

The geofence method was found to be a suitable way to opt for the stoppage matter/problem during the transportation process due to its convenience in providing accurate information on each movements of the vehicle. The existing technique was only to provide an alert and information when the vehicle enters or exits the geofence. In the case of Halal traceability, it is essential to monitor the movement of products specifically. This can be done by monitoring the stoppage location either it is a Halal location or an unknown location as well as the duration for each stoppage. However, the existing technique is not in detail but merely covering the general aspects. Therefore, a specific rule needs to be integrated with this geofence method in order to obtain precise and detail tracking.

### **1.3 Objectives**

The general objective of this research is to develop web based real time traceability module with improvement in the Halal component aspect. The specific objectives are:

- a) To determine requirements and parameters needed for adapting the Halal transportation procedure into real time web-based traceability module.
- b) To develop web-based GPS tracking system using GPS tracker based on the propose framework.
- c) To implement geofence techniques with rules in the GPS tracking system which can cater potential problem arise during the Halal transportation process.

## 1.4 Significance of Study

Based on a study conducted by Tan et al., (2012), apparently, the LSP also interested to apply the traceability system which includes several technological components that are appropriate and compatible for Halal transportation. Among them are the locations tracking system which can identify the Halal goods delivery process. In addition, LSP also interested in using a system, which can provide information about the goods they had sent and received. In this case, the information they want are in terms of Halal goods' latest location, origin and destination of the goods, the contents of the container and any events that occur during the transportation process.

This halal traceability module can assist in providing information not only in Malaysia but also at the global level. During transportation process, the consignee can track the location of the container and the vehicle carrying the goods. As for the consignors, they can also identify current location of the goods and the said module is able to provide with them direct information on suspicious event that may occur during the delivering process. Real time traceability module will be able to ensure the traceability of Halal goods during the delivery process. This module will help the producers, manufacturers, LSP, retailers and consumers in guaranteeing that the goods are always halal. By providing real time view for the entire module, it will provide direct information on suspicious event occurring during the delivery process. This module also believed to facilitate the handling and control of halal goods movement and thus can replace the manual system used previously.

Using a fast and reliable communication technology like global system for mobile communication and general packet radio service (GSM/GPRS), information sharing can be done between each operator along the supply chain. This can reduce the possibility of chain breakage. On behalf of the government, it will facilitate the process of auditing and verification. When the authorities perform the auditing or checking, they can easily ask for evidence based on the database system. In addition, this also allows the halal operator to provide a proper documentation for halal transportation part of their products.

In order to fulfil the requirements of Halal logistic, this study develops a real time module using merged methods of GPS and advancement in the geofence technique. Geofence is a feature that is programmed into the GPS or other devices such as RFID to define geographical boundaries (Kjaergaard et al., 2012). Geofence function by activating the trigger when the set device enters or exits from the areas gazetted as geofence area by the administrator. Alert in the form of SMS or email will be sent to the user depending on the rule set by the administrator (Jung et al., 2013). Based on the issue arose in the field of halal logistic, the existing geofence technique algorithm was added with a rule which is able to check spatial, temporal, and speed attribute of the geofence. This rule works by checking the spatial information of the stoppage location and only check it when the said vehicle is in static mode (speed= 0) and at the specified range of time. This technique was intended to filter out the location of stoppage vehicle either it was in a

halal location or not and at the same time could reduce false alert in each time the vehicle stops.

The use of open source software and database helps in reducing the cost of the module. Moreover, the GPS was found to be a good system with low cost compared with RFID technology. By using GPS, the Halal goods location and its point of origin will be known. The database will provide the tracing information of immediate suppliers and the details of the products from the beginning. Overall, this module will increase consumers trust the validity of halal of a certain product due to an increasing amount of information about the logistic process.

### **1.5 Scope and Limitation of Research**

In this study, the Halal data and information was acquired through the JAKIM halal directory website. The data retrieve was the location of the Halal premise in terms of address. Locational data in terms of coordinate cannot be acquired since it is not available yet in JAKIM database. Therefore, for this study, the process of adding the Halal location was done manually by searching for the address.

Due to time constraint and limited access, the module was tested and simulated by using a car. The car was attached with a GPS tracker device and different situations were tested such as when the car stopped at a Halal place and when the car stopped at an unknown place. The tests were done multiple times to ensure the competency of the module and able to give the desired result.

There are many types of software available for in order to develop the module which are either commercial or open source software. Since costing has been an issue when the LSP yearn to implement a new system, therefore, this study tries to minimize the cost of developing the module by using open source software. The module uses MySQL database which are freely available for storing the data, PHP as server site scripting language and HTML and JavaScript for client-side scripting language.

The logistic process covers on a wide aspect including transportation, warehousing, packaging and retailing. This study only focuses on the aspect of transportation where spatial analysis can be done in this field.



## 1.6 Outline of Thesis

This thesis is organized into five chapters. The first chapter is the introduction chapter, chapter two is for literature review, chapter three for methodology, chapter four for results and discussion and lastly, chapter five is the conclusion and recommendations.

In chapter one, the background study and the problem arise in the field of study is clearly described. In this chapter, the objective, significance of the study and scope of research are also explained.

Chapter two consists of a literature review that presents the issue and challenge on Halal transportation. It also reviews the government requirements, the differences of conventional tracking system compared to the halal tracking system, technology used in product traceability, and spatial analysis using geofence technique.

Chapter three presents the methodology of the research and the development of the Halaltracer tracking module. It consists of requirement analysis, hardware and software specification, database design and construction, setting up and connecting the GPS to server, web-based system development, geofence algorithm and geofence rule applied in the algorithm.

Chapter four demonstrates the prototype of the Halaltracer module. It is divided into two sections which are a section for general interface and details on GPS tracking section. Analysis and report of simulation are also described in detail here with some discussion on it.

Chapter five is a conclusion chapter where the study is being concluded and recommendations for future work are made.

## REFERENCES

- Abad, E., Palacio, F., Nuin, M., Gonzalez de Zarate, A., Juarros, A., Gomez, J. M., et al. (2009). RFID smart tag for traceability and cold chain monitoring of foods: Demonstration. *Journal of Food Engineering*, 394-399.
- Almomani, I., Alkhalil, N., Ahmad, E., & Jodeh, R. (2011). Ubiquitous GPS vehicle tracking and management system. *2011 IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT)*, (pp. 1-6).
- Anir, N. A., Mohd Hairul Nizam, M. N., & Masliyana, A. (2008). RFID Tag for Halal Food Tracking in Malaysia: Users Perceptions and Opportunities. *7th WSEAS Int. Conf. on TELECOMMUNICATIONS and INFORMATICS (TELE-INFO '08)*, (pp. 87-92). Istanbul, Turkey.
- Bahrudin, S. M., Ilyas, M. I., & Desa, M. I. (2011). Tracking and Tracing Technology for Halal Product Integrity over the Supply Chain. *International Conference on Electrical Engineering and Informatics (ICEEI)* (pp. 1-7). Bandung: IEEE.
- Batu, A., & Regenstein, J. M. (2014). Halal Food Certification Challenges And Their Implications For Muslim Societies Worldwide. *International Periodical For The Languages, Literature and History of Turkish or Turkic*, 9(11), 111-130.
- Butler, Z., Corket, P., Peterson, R., & Rust, D. (2004). Virtual Fences for Controlling Cows. *IEEE International Conference on Robotics and Automation*, (pp. 4429-4436).
- Buyong, T. (2007). *Spatial Data Analysis for Geographic Information Science*. Penerbit UTM, Skudai, Johor Bahru.
- Castro, J., Delgado, M., Medina, J., & Ruiz-Lozano, M. (2011). Intelligent Surveillance System with Integration of Heterogeneous Information for Intrusion Detection. *Expert Systems with Applications*, 38(9), 11182-11192.
- Chen, J. H., Tseng, T., Lai, C., & Hsieh, S. (2012). An Intelligent Virtual Fence Security System for the Detection of People Invading. *2012 9th International Conference on Ubiquitous Intelligence and Computing and 9th International Conference on Autonomix and Trusted Computing* (pp. 786-791). IEEE Computer Society.
- Chen, R., & Xie, J. (2008). Open Source Databases and Their Spatial Extensions. *Advances in Geographic Information Science* 2, 105-129.
- Doukas, E., & Christos, S., (2011). *Advanced Technologies for Fleet Management System*. International Hellenic University.

- Ge, R., Shan, Z., & Kou, H. (2011). An intelligent surveillance system based on motion detection. *4th IEEE International Conference on Broadband Network and Multimedia Technology (IC-BNMT)*, (p. 306=309).
- Golnaz, R., Zainalabidin, M., Mad Nasir, S., & Eddie Chiew, F. C. (2010). Non-Muslims' awareness of Halal principles and related food products in Malaysia. *International Food Research Journal*, 17, 667-674.
- Iberahim, H., Kamaruddin, R., & Shabudin, A. (2012). Halal Development System : The Institutional Framework, Issues and Challenges for Halal Logistic. *IEEE Symposium on Business, Engineering and Industrial Application (ISBEIA)* (pp. 760-765). Bandung: IEEE.
- Jaafar, H., Endut, I., Faisol, N., & Omar, E. (2011). Innovation in Logistic Services : Halal Logistics. *Proceedings of the 16th International Symposium on Logistics (ISL)*, (pp. 844-851). Berlin, germany.
- Jedermann, R., Garcia, L. R., & Lang, W. (2009). Spatial Temperature Profiling by Semi-Passive RFID Loggers for Perishable Food Transportation. *Computers and Electronics in Agriculture*, 145-154.
- Jung, G., Ji, D., & Jeon, B. (2013). A Stray Sensing Service of a Region Using LBS, *Proceeding of KISM Spring Conference*. 2(1).
- Kim, J. S., Lee, H. J., & Oh, R. D. (2015). Smart Integrated Multiple Tracking System Development for IOT based Target-oriented Logistics Location and Resource Service. *International Journal of Smart Home*, 9(5), 195-204.
- Kjaergaard, M., Wirz, M., Roggen, D., & Troster, G.(2012), Mobile Sensing of Pedestrian Flocks in Indoor Environment using WiFi Signals. *Pervasive Computing and Communications (PerCom)*, 2012 *IEEE International Conference*, 95-102.
- Ko, D., Kwak, Y., & Song, S. (2014). Real Time Traceability and Monitoring System for Agricultural Products Based on Wireless Sensor Network. *International Journal of Distributed Sensor Network*, 1-8.
- Malaysia, D. o. (2011, August 5). *Population Distribution and Basic Demographic Characteristic Report 2010 (Updated: 05/08/2011)*. Retrieved January 30, 2016, from Department of Statistics Malaysia, Official Portal: [www.statistics.gov.my](http://www.statistics.gov.my)
- Management Association, I. R. (2012). *Supply Chain Management: Concepts, Methodologies, Tools, and Applications* . IGI Global.

- Mantoro, T., Akhtaruzzamand, M., Mahmud, M., & Ayu, M. (2015). Design and Development of an Interactive Monitoring System for Pilgrims in Congregation of Hajj Ritual. *Journal of Convergence Information Technology (JCIT)*, 10, 28-58.
- Ming, C. T. (2006). Constructing a logistic tracking system for preventing smuggling risk of transit containers. *Transportation Research Part A: Policy and Practice*, 40(6), 526-536.
- Moloo, R. K., & Digumber, V. K. (2011). Low-cost mobile GPS tracking solution. *2011 International Conference on Business Computing and Global Informatization* (pp. 516-519). IEEE Computer Society.
- Monod, M. O., Faure, P., Moiroux, L., & Rameau, P. (2008). A virtual fence for animals management in rangelands. *14th IEEE Mediterranean Electrotechnical Conference (MELECON 2008)* (pp. 337-342). IEEE.
- Muhammad, N. M., Isa, F. M., & Kifli, B. C. (2009). Positioning Malaysia as Halal-Hub: Integration Role of Supply Chain Strategy and Halal Assurance System. *Asian Social Science*, 44-52.
- Nthoki, M. (2013). *Design and Implementation of a Mobile Phone Based Route Detection System for Security Applications*. Kenyatta University.
- Oliveira, R. R., Noguez, F., Costa, C., Barbosa, J., & Prado, M. (2013). SWTRACK : An intelligent model for cargo tracking based on off-the-shelf mobile device. *Expert Systems with Application*, 2023-2031.
- Omar, E. N., Jaafar, H. S., & Osman, M. R. (2012). Assessing Halalan-Toyyiban Food Supply Chain in the Poultry Industry. *International Halal Conference* (pp. 1-11). Kuala Lumpur, Malaysia: Elsevier.
- Omar, E. N., Jaafar, H. S., Osman, M. R., & Faisal, N. (2013). Halalan Toyyiban Supply Chain The New Insights in Sustainable Supply Chain Management. *International Conference on Logistic & Transport* (pp. 1-9). Kyoto, Japan: Munich Personal RePEc Archive, MPRA.
- Omar, E., Jaafar, H., & Osman, M. (2013). Halalan Toyyiban Supply Chain of the Food Industry. *Journal of Emerging Economies and Islamic Research*, 1(3), 1-12.
- Othman, P., Sungkar, I., & Wan Hussin, W. (2009). Malaysia as an International Halal Food Hub: Competitiveness and Potential of Meat-based Industries. *ASEAN Economic Bulletin*, 26(3), 306-320.
- Petker, J. (2010). *Point-in-Polygon Detection*. University of California, Merced.
- Piorowski, A. (2011). MySQL Spatial and PostGIS- Implementations of Spatial Data Standards. *Electronic Journal of Polish Agricultural University*, 14(1), 1-9.

- Popa, M., & Suta, B. (2011). A Solution for Tracking a Fleet of Vehicles. *19th Telecommunication forum TELFOR 2011* (pp. 1558-1561). Serbia, Belgrade: IEEE.
- Qadeer, M. A., Chandra, A., & Jain, S. (2012). Design and Implementation of Location Awareness and Sharing System using GPS and 3G/GPRS. *International Journal of Multimedia and Ubiquitous Engineering*, 7(4), 125-140.
- Reclus, F., & Drouard, K. (2009). Geofencing for Fleet & Freight Management. *2009 9th International Conference on Intelligent Transport Systems Telecommunications, (ITST)*, (pp. 353-356). Lille: IEEE.
- Regattieri, A., Gamberi, M., & Manzini, R. (2007). Traceability of food products: General Framework and Experimental Evidence. *Journal of Food Engineering*, 81, 347-356.
- Shamsuzzoha, A., & Helo, P. T. (2011). Real Time Tracking and Tracing System : Potentials for the Logistic Network. *Proceedings of the 2011 International Conference on Industrial Engineering and Operations Management*, (pp. 242-250). Kuala Lumpur, Malaysia.
- Standard, D. o. (2010). *MS 2400-1:2010 (P) Halalan-Toyyiban Assurance Pipeline - Part 1: Management System Requirements for Transportation of Goods and/or Cargo Chain Services*. Malaysia Standard.
- Steinoger, S., & Hunter, A. S. (2009). Free and Open Source GIS Software for Building a Spatial Data Infrastructure . *Geospatial Free and Open Source Software in the 21st Century, Proceeding of the First Open Geospatial Research Symposium, OGRS,2009*, (pp. 247-261).
- Suwardi, I. S., Lestari, D. P., & Satya, D. P. (2015). Handling arbitrary polygon query based on the boolean overlay on a geographical information system. *2nd International Conference on Advanced Informatics: Concepts, Theory and Application (ICAICTA)* (pp. 1-4). Chonburi: IEEE.
- Swain, N. S., Latu, K., Christensen, S. D., Jones , N. L., Nelson, E. J., Ames, D. P., et al. (2015). A Review of Open Source Software Solution for Developing Water Resources Web Applications. *Environmental Modelling & Software*, 67, 108-117.
- Tan, M. I., Razali, R. N., & Desa, M. I. (2012). Factors influencing ICT adoption in halal transportations: A case study of Malaysian halal logistics service providers. *International Journal of Computer Science U*, 9(1), 62-71.
- Tan, M. I., Razali, R. N., & Husny, Z. J. (2012). The Adoption of Halal Transportations Technologies for Halal Logistics Service Providers in Malaysia. *International Journal of Mechanical, Aerospace, Industrial, Mechatronic and Manufacturing Engineering*, 6(3), 16-23.

- Tieman, M. (2006). The future of Halal logistic Solutions,. *The Halal Journal*.
- Tieman, M. (2009). Halal Transportation : The Building Blocks of A Halal Transportation System. *The Halal Journal*, 30-31.
- Tieman, M. (2011). The Application of Halal in Supply Chain Management: In-Depth Interviews. *Journal of Islamic Marketing*, 2, 186-195.
- Tieman, M. (2013). Establishing the principle in Halal Logistics. *Journal of Emerging Economies and Islamic Research*, 1(1), 1-13.
- Unde, M., & Borkar , B. (2014). Remote Vehicle Tracking & Driver Health Monitoring System Using GSM Modem & Google Maps. *International Journal of Computer Science and Information Technologies*, 5(3), 2828-2832.
- Verma, G., Verma, H., Singh, I., Vikram, A., Singhal, S., Kumar, A., et al. (2015). Wireless Position Tracking of a DTMF based Mobile Robot using GSM and GPS. *Indian Journal of Science and Technology*, 8(17), 1-6.
- Wang, J., Ni, D., & Li, K. (2014). RFID-Based Vehicle Positioning and Its Applications in Connected Vehicles. *Sensors*, 4225-4238.
- Wang, Y., & Potter, A. (2008). The Application of Real Time Tracking Technologies in Freight Transport. *Third International IEEE Conference on Signal-Image Technologies and Internet-Based System* (pp. 298-304). IEEE Computer Society.
- Williams, G., King, P., & Doughty, K. (2011). Practical issues in the selection and use of GPS tracking and location technologies to support vulnerable people at risk of becoming lost or threatened. *Journal of Assistive Technologies*, 5(3), 146-151.
- Winesett, J. (2012). *Web Application Development with Yii and PHP*. Packt Publishing Ltd.
- Xue, Q., & Zhuo, X. (Copyright 2008-2010). *The Definitive Guide to Yii 1.1*. Retrieved September 24, 2015, from yiiframework: [www.yiiframework.com/files/yii-guide-1.1.1.pdf](http://www.yiiframework.com/files/yii-guide-1.1.1.pdf)
- Yuce, Y. K., Gulkesen, K., & Barcin, E. (2012). Balancing autonomy and security over geotracking patients with Alzheimer's using a personalized geotracking system with social support network. *The 2nd International Workshop on Pervasive and Ambient Applications, Systems and Technologies for Healthcare (PASTH 2012)* (pp. 1064-1072). Elsevier Ltd.

- Zailani, S., Ariffin, Z., Abd Wahid, N., Othman, R., & Fernando, Y. (2010). Halal Traceability and Halal Tracking Systems in Strengthening Halal Food Supply Chain for Food Industry in Malaysia ( A Review). *Journal of Food Technology*, 8(3), 74-81.
- Zhang, G., Zhao, G., Yi, Y., & Wang, Z. (2011). Research and application of steelmaking workplace crane logistics tracking system. *International Conference on electronics and optoelectronics (ICEOE)*, (pp. V3-8 - V3-11).
- Zhu, X., Mukhopadhyay, S. K., & Kurata, H. (2012). A Review of RFID Technology and its Managerial Application in Different Industries. *Journal of Engineering and Technology Management*, 29(1), 152-167.

