Faculty of Information and Communication Technology

ECOMMUNITY: A MOBILE E-WASTE COMMUNITY FRAMEWORK

Siti Feirusz Binti Ahmad Fesol

Master of Computer Science in Database Technology

2014

ECOMMUNITY: A MOBILE E-WASTE COMMUNITY FRAMEWORK

SITI FEIRUSZ BINTI AHMAD FESOL

A thesis submitted
In fulfillment of the requirements for the Master of Computer Science
In Database Technology

Faculty of Information and Communication Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2014

APPROVAL

I hereby declare that I have read this dissertation/report and in my opinion this dissertation/report is sufficient in terms of scope and quality as a partial fulfillment of Master of Computer Science (Database Technology).

Signature   :………………………………

Supervisor Name   : PM Dr. Sazilah Bt. Salam

Date   : July 2014

DECLARATION

I declare that this thesis entitle "eCommunity: A Mobile Social Communication Framework For E-Waste Management" is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature   :……………………………

Supervisor Name   :Siti Feirusz Binti Ahmad Fesol

Date   : 11 July 2014

DEDICATION

This thesis is dedicated to my husband Muhammad Hanif Bin Abdul Azis, my son

Hadi Bin Muhammad Hanif, my parent, and all my family members.

ABSTRACT

The utilization of electronics in our everyday life is almost as important as our very existence in this fast-paced globalized world, but the effective management and long term effects of the resultant waste has not fully been grasped by consumers. As reported by UNEP, 20 to 50 million metric tonnes of e-waste are generated worldwide every year are comprising more than 5 percent of all municipal solid waste and approximately less than 25 percent out of these amount of e-waste being recycle. The remaining of e-waste are either stockpiled in garages, closets or when thrown away they end up in landfills or incinerators and more recently they are exported to Asia. In order to highlight this concern, the purpose of this research is to figure out the level of awareness among the community in practicing proper e-waste management. The research case study will take place in Universiti Teknikal Malaysia Melaka (UTeM). This study will review and analyse the level of knowledge and awareness from the perspective of UTeM community which include the staffs and students, in handling their e-waste. There are two main approaches which are combination of qualitative and quantitative techniques being implemented in this research in order to get the most accurate result. From the result gathered, a mobile social communication framework for e-waste management will be proposed which function as a platform to inform, alert and update the community on the issues with regards to e-waste. This system aimed able to educate and increase the awareness among the community in taking care of their environment.

ABSTRAK

Kepentingan penggunaan barangan electrik dan elektronik dalam kehidupan seharian harian kita adalah hampir sama dengan kewujudan kita dalam dunia globalisasi ini, tetapi pengurusan yang berkesan dan kesan-kesan jangka panjang sisa elektronik yang terhasil ini tidak sepenuhnya telah difahami oleh masyarakat. Seperti yang dilaporkan oleh UNEP,terdapat sebanyak 20 ribu hingga 50 ribu tan metrik sisa elektronik yang dihasilkan di seluruh dunia setiap tahun dan kurang daripada 25 peratus daripada jumlah sisa ini kitar semula. Baki sisa elektronik sama ada di simpanan di tempat simpan kereta, almari atau apabila dibuang mereka berakhir di tapak pelupusan atau insinerator dan terbaru, sebahagian besar sisa elektronik ini di eksport ke Asia. Bertunjangkan kepada masaalah ini, tujuan utama kajian ini di jalankan adalah untuk mengetahui tahap kesedaran di kalangan masyarakat dalam mengamalkan pengurusan sisa elektronik yang betul. Kajian penyelidikan ini mengambil tempat di Universiti Teknikal Malaysia Melaka (UTeM). Kajian ini akan mengkaji dan menganalisis tahap pengetahuan dan kesedaran dari perspektif komuniti UTeM termasuk staf dan pelajar, dalam mengendalikan sisa elektronik mereka. Terdapat dua pendekatan utama iaitu gabungan teknik kualitatif dan kuantitatif yang dilaksanakan dalam kajian ini untuk mendapatkan hasil yang tepat. Daripada hasil yang dikumpulkan, satu rangka kerja komunikasi sosial mudah alih untuk pengurusan sisa elektronik akan dicadangkan yang berfungsi sebagai platform untuk memberitahu dan mewawarkan kepada masyarakat tentang isu-isu berkaitan dengan pengurusan sisa elektronik. Sistem ini diharap dapat mendidik dan meningkatkan kesedaran di kalangan masyarakat dalam menjaga dan memelihara kebersihan alam sekitar kita.

ACKNOWLEDGEMENT

Alhamdulillah, all praise and gratefulness is due to Allah. Thank you Allah for giving me good health and strength throughout my journey in completing this study.

First and foremost, I would like to take this opportunity to express my deepest appreciation and sincere acknowledgement to my supervisor Professor Madys Dr. Sazilah Binti Salam from Faculty of Information and Communication Technology, Universiti Teknikal Malaysia Melaka (UTeM) for the supervision and constant support. This thesis would not have been possible without her valuable help, support, motivation, enthusiasm and patience in guiding me to the success of this study.

I also would like to take this opportunity to thank all my lecturers, my colleagues and friends who have provided assistance and moral support at every occasion of the study. A special thanks goes to respective officers of Department of Environmental Melaka for their continuous cooperation in providing information for this research and also to all those who filled in the questionnaire.

Last but not least, my deepest gratitude and truthful love goes to my beloved husband, my son, my parents and all my family members for their endless love, prayers, and encouragement. Thank you very much.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

© Universiti Teknikal Malaysia Melaka

LIST OF ABBREVIATIONS

DOE - Department of Environment

EE - Environmental education

EEE - Electrical and electronic equipment

EPA - Environmental Protection Agency

FTMK - Faculty of Information and Communication Technology

GPS - Global Positioning System

ICT - Information and communication technology

JICA - Japan International Cooperation Agency

NRE - Natural Resources and Environment

PDA - Personal Digital Assistant

SWM - Solid waste management

ML - Mobile learning

UMLS - Usefulness of mobile learning systems

UNEP - United Nations Environment Program

CHAPTER 1

INTRODUCTION

1.0   Introduction

This research is focusing on e-waste management. The term e-waste is generally applied to consumer electronic devices and gadgets that are near or at the end of its immediate useful life. E-waste includes discarded or obsolete cell phones, computers, notebooks, home and office electrical appliances and other electronic devices. This research aimed to figure out the level of awareness among the community in practicing proper e-waste management. The study will review and discuss the present e-waste scenario from the perspective of Universiti Teknikal Malaysia Melaka (UTeM) community which include the staffs and students, in handling their e-waste. From the result gathered, this research will propose a mobile social communication framework for e-waste management which function as a platform to inform, alert and update the community on the issues with regards to e-waste.

1.1   Background of the study

Information and communication technology (ICT) is widely considered as the key driver of the growth in the age of the knowledge economy and globalization. Recently, the world has seen remarkable growth in the use of many different ICT products, such as mobile phones, computers, television sets, audio equipment, printers and many other electronic gadgets. This

has extremely contribute to the huge volume of electronic and electrical wastes (e-waste) generated around the world.

It is reported that 20 to 50 million metric tonnes of e-waste are generated worldwide every year, comprising more than 5 percent of all municipal solid waste (UNEP, 2006). While in developing countries are expected to triple their e-waste production over the next five year. It is not only the developed countries that generate e-waste, Asia itself discards an estimated 12 million tonnes each year (Greenpeace International, 2009). The lifespan and lifecycle of electronic products are fast changing because of rapid technological advancements and of people's changing lifestyles and aspirations.

The Asia-Pacific region is no exception in regard to e-waste generation and import. China and India are in the leading among the growing economies in the region and hence have been the focus of world attention as they have to manage growing volume of e-wastes. They are also the main destinations of the e-waste generated and exported from other parts of the world. A surprising of 80 per cent of the home electronics thrown out by the developed world end up on container ships bound for Asia, with 90 percent of those destined for China (Greenpeace International, 2009).

There are few concerns that must be highlighted with regards to e-waste in Malaysia. The concerns issues are the amount of discarded used electrical and electronic equipment (EEE) in Malaysia and what are the impact of improper e-waste management.

   i. *E-waste statistic in Malaysia.*

  a) E-waste is regulated under the Environmental Quality (Scheduled Wastes) Regulations 2005. Natural Resources and Environment Minister said that the amount of e-waste generated from the industrial sector in 2009 was 134,000 tonnes, or 7.86 percent of the total waste generated in Malaysia. In 2010, the amount of e-waste had increased by 17.9

percent to 163,000 tonnes, or 8.68 percent of the total waste generated (Kumar, 2012). As reported by Department of Environment Malaysia the total of e-waste produced by the industries sectors in Malaysia as much as 152,722 tonnes in 2011 and 78,278 tonnes in 2012 (Ibrahim, 2013), a bit decreasing number when compared to previous years.

b) While the combined e-waste generated by households, businesses and institutions sector was 592,391 tonnes in 2006, 639,493 tonnes in 2007 and 624,143 tonnes in 2008; the annual average generated was 635,030 tonnes (Kumar, 2012).

ii. *Impact of improper of e-waste management.*

a) Electronic waste is not just a waste, it contains some very toxic substances, such as mercury, lead, cadmium, arsenic, beryllium and brominated flame retardants. When it burned at low temperatures they create additional toxins, such as halogenated dioxins and furans, where some of the most toxic substances known to humankind (Department of Environment Malaysia., 2011). If it being dumped in landfill, the toxic chemicals in electronics products can leach into the land over time or are released into the atmosphere, impacting nearby communities and the environment. In Hong Kong for example, it is estimated that 10-20 percent of discarded computers go to landfill (Greenpeace International, 2009).

b) The toxic materials in electronics can cause cancer, reproductive disorders, endocrine disruption, kidney's problem, impact on children's mental development and many other health problems if this waste stream is not properly managed (Causes International (CI), 2011).

3

In conclusion to the above scenario, researchers (Robinson, 2009; Greenpeace International, 2009; Desa, Nor Ba'yah, & Fatimah, 2012) believes that there is a need to come out a study on e-waste awareness program to help public to take appropriate action towards their e-waste so it can be disposed in the correct way.

1.2   Statement of Problem

An incredibly small percentage of e-waste is being recycled in Malaysia. As reported by Department of Environment Malaysia, there are less than 14 percent of the e-waste being recycled every year. The remainder is most often dumped or burned, either in formal landfills and incinerators, or informally dumped or burned. These inappropriate disposal methods for electronic waste fail to reclaim valuable materials or manage the toxic materials safely (Greenpeace International, 2009) (Kumar, 2012). Below are list of the problem that will be answered by conducting this research:

Research question 1: What is the proper way in handling e-waste?

Research question 2: What is the level of awareness among community regarding the e-waste?

Research question 3: What is the proper way to create an awareness among community to handle their e-waste?

4

1.3   Objectives of Study

At the end of the day, the main objective that I try to achieve for this research is to propose a mobile social communication framework for e-waste management and it is aimed able to educate and create awareness among the community of proper e-waste handling. The research objective will be delivered through three main deliverables as per below:

- To answer Research question 1, *research and supporting materials collection method* will be performed. Research and supporting materials collection would be done in the initial phase in order to gather useful information which will be focused on the issues related to proper e-waste management and previous successful e-waste management programs in Malaysia and outside Malaysia as well as collecting other supporting sources pertaining to the e-waste. Literature review will be produced which includes journals, past paper works, articles and many other supporting resources with regards to e-waste data.

- For Research question 2, a *survey will be conduct*. A questionnaires will be distribute regarding e-waste to the targeted UTeM community, in order to cater their understanding on e-waste. The result will be analyze in order to figure out the level of awareness on proper e-waste management.

- Answer for Research question 3. In order to answer the question of the effective way to create an awareness among community to handle their e-waste, a mobile system application will be develop. The main function of the system is it will works as a platform to inform, alert and update the community on the issues with regards to e-waste.

By conducting this research, it is aimed able to educate and increase the awareness among the community in taking care of our environment. Besides it will also help the community to practice the three R's which are *Reduce, Reuse and Recycle* on e-waste. By practicing the three R's it will helps us lessen the environmental impact that manufacturing and distributing products have on our environment.

1.4   Scope and Delimitation

1.4.1   Scope of study

The scopes of this research can be divided into two parts which are survey collection and system application development.

- *Survey collection* – A survey will be conducted to the participation from the FTMK staffs and FTMK students, in order to cater their understanding on e-waste. The result will be analyze in order to figure out the level of awareness on proper e-waste management.

- *Semi-structured interview* - In order to get more details on e-waste information, semi-structured interviews will be conducted with the subject matter expert in e-waste, DOE Melaka officers, through telephone call and face-to-face semi-structured interviews.

- *System application development* - An alert system will be develop at the end of this research. The system will be function to send a monthly reminder on the E-waste Green Day in UTeM so that the community be alert on it and can also bring their e-waste during the e-waste collection day.

1.4.2   Limitation of study

There are few limitation that I faced while carry out this research. Below is the list of the boundaries:

i.   *Limited time*

   a. Time constrain is one of the factor that become the drawback in this research. With only limited to 6 months period, the accuracy of the final result on the level of awareness of the community might be less.

ii. *Limited human resources*

   a. As this research is an individual research, it become some limitation for me especially while conducting the survey in collecting the adequate number of respondents to answer the questionnaires.

1.5   Importance of the Study

The utilization of electronics in our everyday life is almost as important as our very existence in this fast-paced globalized world, but the effective management and long term effects of the resultant waste has not fully been grasped by consumers. This is mainly due to the fact that there is only few people have the knowledge on e-waste in the field of waste management; and a limited data on e-waste generation among developed and developing nations. Therefore, by conducting this research it is expected able to educate and increase the awareness in understanding the key concepts of e-waste management and the relationships between the economic impact of e-waste and its negative effects on the community to serve for better environmental and socially friendly practices for e-waste management.

CHAPTER 2

REVIEW OF LITERATURE AND STUDIES

2.0 Introduction to Literature Review

This section will discuss on current practices by each government of respective countries on how they handle their e-waste. This study also will shared several successful e-waste related projects by foreign countries as well as in Malaysia. In the last part of this literature review, the study will share on previous papers that implement the used of mobile application to support environmental awareness.

2.1 Current Practice of E-waste

Nowadays, many old electronic goods gather dust in storage waiting to be reused, recycled or thrown away. As reported by US Environmental Protection Agency (EPA), as much as three quarters of the computers sold in the US are stockpiled in garages and closets. When thrown away, they end up in landfills or incinerators and more recently they are exported to Asia.

E-waste is routinely exported by developed countries to developing ones, often in violation of the international law. From inspections done for 18 European seaports in 2005 found as much as 47 percent of waste destined for export, including e-waste was illegal. In the UK alone, at least 23,000 metric tonnes of undeclared or 'grey' market electronic waste was illegally shipped in 2003 to the Far East, India, Africa and China (Greenpeace International, 2009).

9

Most Asia countries such as in China tried to prevent this trade by banning the import of e-waste starting from 2000. However, investigation discovered that the laws are not working; e-waste is still arriving in Guiya of Guangdong Province, the main centre of e-waste scrapping in China. The same problem also can be found in India. 25,000 workers are employed at scrap yards in Delhi alone, where 10-20000 tonnes of e-waste is handled each year, 25 percent of this being computers. Other e-waste scrap yards have been found in Meerut, Ferozabad, Chennai, Bangalore and Mumbai (Greenpeace International, 2009). Figure 2.1 shows the flow of e-waste as reported by UNEP.

Figure 2.1: The flow of e-waste export and import in Asia (Greenpeace International, 2009).