UNIVERSITI TEKNIKAL MALAYSIA MELAKA

CONCEPT, DESIGN AND IMPLEMENTATION OF SOLAR POWERED SMART WASTE BIN MANAGEMENT SYSTEM WITH ODOR SENSE

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Technology (Computer Systems) with Honours

by

RUKSANA BINTI ANWAR

B071310759

941014055614

FACULTY OF ENGINEERING TECHNOLOGY

2016

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Concept, design and implementation of solar powered smart waste bin management system with odor sense**

SESI PENGAJIAN: **2016/17 Semester 2**

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (System Computer)(Hons.). The member of the supervisory is as follow:

……

(Project Supervisor)

ABSTRAK

Projek ini dicadangkan untuk mereka bentuk sistem elektronik yang boleh membantu untuk menyelesaikan masalah kepada sistem pelupusan sampah yang tidak teratur. Sistem yang direka ini menggunakan sensor gas,suhu dan kelembapan untuk mengesan pencemaran yang disebabkan oleh gas toksik yang tidak diingini daripada tong sampah. Kesemua nilai sensor ini akan dikemaskini dalam pangkalan data MySQL dan Java Scheduler digunakan untuk memangil data kembali dari MySQL. Selain itu, program Java akan menggerakkan modul GSM untuk menghantar pemberitahuan kepada pihak bertanggungjawab mengenai status tong sampah yang telah penuh. Objektif kajian ini adalah untuk menyediakan satu penyelesaian untuk sistem pengurusan sisa. Teknologi yang dicadangkan dalam projek ini, mencapai sistem pengurusan sisa yang berkesan di mana unit sensor digunakan untuk mengesan, Arduino Mega sebagai pengawal mikro untuk mengawal dan komunikasi dengan menggunakan modul GSM. Akhir sekali untuk mengendalikan sistem ia memerlukan kuasa dari sistem tenaga solar.

ABSTRACT

The paper was proposed to design an electronic system, in order to provide a solution to irregular waste disposal system. Objective of the paper is to provide a solution for the waste management system. The technology which are suggested in this paper, achieved effective waste management system where sensors unit are used for sensing, Arduino Mega as microcontroller.The designed system makes use of gas, humidity and temperature sensor to detect extent of pollution caused by unwanted toxic gases from the bin. The sensors value will be updated in MySQL database and the Scheduler Java program will be used to query data from MySQL. Then the Scheduler Program will trigger the GSM module to send the notification to the respective authority regarding the status of the waste bin is full. Finally for operating the system it requires power from the solar energy system.

DEDICATION

To my beloved

parents

Anwar bin Abdullah and Rasidah Bee Bee binti Crinbakas

siblings,

Mohammad Salim and Mohd Akhibal

Dedicated in thankful appreciation for your supporting, encouragement and best wishes.

ACKNOWLEDGEMENT

In preparing this project, I dealt with many people and they have a great contribution towards my understanding and thoughts.

First and foremost, I would like to acknowledge and extend my gratitude to my main supervisor, Puan Norfadzlia binti Mohd Yusof, for the encouragement, guidance and enthusiasm given throughout the completion of this project. In particular, I also wish to express my sincere appreciation to, Dr. Kadir who is willing to spend his precious time to give some ideas and suggestion towards this project. This project would not have been the same as presented here without continued support and interest from them.

My appreciation also goes to my family who has been so tolerant and supports me all these years. Thanks for their encouragement, love and emotional supports that they had given to me.

Furthermore, my great appreciation dedicated to those who involve directly or indirectly with this project. Their views, tips, support, and assistance in various conditions are useful indeed.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

SWCorp	-	Solid Waste Management and Public Cleansing
GPRS	-	General Packet Radio Service
GSM	-	Global System for Mobile communication
RFID	-	Radio Frequency Identification
LCD	-	Liquid Crystal Display

CHAPTER 1

INTRODUCTION

1.0 Introduction

Today, with the rapid growth in the human population and economic development, solid waste has become one of the worst environmental problems in Malaysia. This problem has occurred due to poor handling process of waste collection and management in the country. Without solid waste management effectively and efficiently, wastes generated from various sources, can lead to environmental pollution. In addition, it also can bring into the health threats that encourage breeding insect vectors of disease, animals, scavengers and rats, and cause various diseases. From Business Waste Management"s article enlightened that in Malaysia, the amount of waste is increasing sharply as building activity and it has a problem that came with this waste disposal. At present, the total generation of municipal solid waste (MSW) is growing very strongly with the increase in population, economic revival, industrial development, changes in consumption habits and lifestyle of the city(Sin 2013).

Improper waste management has caused an outbreak of dengue fever and other epidemic threatened in India. In recent years, waste management has become a unifying factor that will lead to public demonstrations across India, after corruption and fuel prices. Efficient management of waste is a global concern that requires a lot of research and development work towards exploring new applications for the management of a more efficient and environmentally

friendly(Reshmi 2014).Waste management problem is the issue of the origin and present in developing countries in Africa, especially Nigeria. The municipal waste management in Nigeria over concerns mainly for human health, air, water and soil pollution, among others. Analysis of key issues affecting the efficiency of the municipal waste management is important to developing a solution that can be used in emerging economies in Nigeria. Therefore, improvement of solid waste management system that is indispensable in the recent past which requires an orderly and appropriate for monitoring the status of solid waste in real time while confirming a green environment and developed an advance viable society(Thompson et al. 2013).

It is a huge challenge to manage solid waste disposal for the responsible party caused by the lack of proper management solutions, a total of 85% of solid waste management budget was spent on waste collection and transportation. In order to know the details of the collection and management of this waste, interviews and site visits were conducted by the company responsible for waste management (Behzad et al. 2011).The study of the waste disposal system is also carried out to determine the type of waste in the country.

Figure 1.1: The waste bin overloaded in residential area

Source: http://www.dreamstime.com

Figure 1.1 above shows the real situation of the problem faced by authorities of this country. There are various factors that causes that situation to occur, one of it is because of the authorities does not know the current statues of the waste bin. The authorities in this country have their fixed schedule of waste collection, so when the waste bin is full, the waste collector will wait for the collection day. The schedule system that they use will generate problem when there are some events on the area that causes the waste bin loaded rapidly. Basically, the authorities have a fixed place and specific places for the waste bin especially in residential area. Though the authorities are instructed worker under a clear away the wastages within a specific time period, they end up clearing them after a few days by the time. Therefore, the dustbin starts overflowing and smelling. Thus, this lead to degradation of the waste causes affecting the general public health.

1.1 Problem Background

In Malaysia, the problem of solid waste is one of the environmental issues that are the worst. Other issues have gained wide public attention is haze and air emissions. Anthropogenic sources generated from the indiscriminate dumping of toxic and dangerous waste, which is raising sensitive issues in terms of quantity and quality. However, the database of solid waste in Malaysia is limited to managing the data by individual local authorities or waste contractors. In order to know the details of solid waste and related environmental impact Malaysia, the solid waste management requires comprehensive information on solid waste. The main problem of solid waste collection process and the existing management system are as follows: (Arebey et al. 2010)

- Lack of information about the collecting time and area.
- There is no estimate for the amount of solid waste in the trash and the surrounding area because of the spread of waste.

- The lack of a proper system to monitor trucks and trash that had collected in real time.
- Do not have a quick way to respond to customer complaints about uncollected waste.
- No quick response to urgent cases such as truck accidents, damage, long-time idling(Thompson et al. 2013) .

While in Nigeria, the disposal of solid waste irregular contaminates all important components in the environment (ie, air, soil and water) in the local and global levels. Unmanaged heaps of waste cause adverse impacts to the environment as well as human health. Waste can be harmful to health and lead to the spread of infectious diseases. Unsupervised waste attracts flies, rats, and other creatures that cause infectious diseases spread. Air pollution is another factor to consider. Usually it is the wet waste that decomposes and produces smell bad. This leads to unsanitary conditions and thus causes an increase in health problems. On top of that, co-disposal of industrial or residential hazardous waste with municipal waste can expose people to dangerous chemical and radioactive (Afolayan ,2013).

1.2 Problem statement

1. How sensor and wireless communication technologies able to help in making the waste management activities more efficient and effective?
2. How to produce a portable and cost-effective waste bin?

1.3 Objectives of Project

The objectives of this project are:

1) To develop a prototype of solar-powered waste bin management system which able :

- To detect waste odor in waste bin using gas sensor.
- To store the waste gas sensor value into database in real-time manner whenever the waste level is full or empty.
- To send Short Messaging System (SMS) to respective authority whenever the waste bin release unpleasant smell.

2) To provide a portable system with high data rate transmission using Wi-Fi as wireless communication technologies.

3) To provide self-powered and cost effective sustainable waste bin management system using solar energy.

4) To analyse the correlation between odor, humidity and temperature sensor.

1.3 Scopes of Project

This project is divided into hardware and software development. For the hardware development, it can be categorized into three parts:

1.4.1 Transmitter

i. The sensing system
   - Gas sensor
   - Humidity sensor
   - Temperature sensor

ii. Arduino Mega Board

iii. ESP8266 Module

iv. LCD display

v. Real time Clock Module (RTC)

1.4.2 Control Unit

- MySQL Database
- Java Program
- GSM Module

1.4.3 Receiver

- Mobile phone
- GSM Module

In this project, Arduino will be used as a microcontroller. In the transmitter part, the sensing circuit system represent of MQ2,MQ4,humidity and temperature sensor used to detect the presence of methane and other gases in the environment.The WiFi Shield will transfer the sensor reading from the Arduino port to the computer via a notification message. While in the receiver, the Arduino software used to write programming for Arduino microcontroller board. On the other hand, GSM is used for data to be transferred between mobile phone and authoritity. Meanwhile, the MySQL is used to store reading from all sensors and Java program will be develop which act as scheduler that will read sensors data from MySQL every 5 second in order to provide a real time data. If the sensor reading has reaches a certain threshold, the Java Program will trigger GSM to send SMS to authority to collect the garbage.

1.5 Thesis Outlines

There are three chapters in this report which are introduction, literature review and methodology. Each chapter will discuss its own aspects related to the project.

Chapter one is the introduction for the project. Problem statement, object and scope of the project along with the summary of works have been discussed in this chapter. Then, chapter two discusses more on research done related to this project and literature reviews that has been done before by another group or person. Besides that, this chapter also discusses the type of Arduino used for the project, the sensor chosen, and also the software involve in programming the GSM and Arduino

Chapter 3 focuses on the methodology and approaches that will be used in this project. This includes the software implementation and hardware development of the project. This project will involve software and hardware development which include the initial design of the system architecture and system flow chart are also presented in this sections.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter will contain analysis of past research that related to this project and describes the components used in the creation of this prototype. Several studies from related project have been conducted to find new initiative to solve the problem of the authorities.

2.1 Waste management

In the past, solid waste management in Malaysia is like other countries which a responsibility of local authority of Malaysia. Decentralization of this phenomenon is not uncommon for many countries to stimulate greater competition and efficiency in management. Local authority play an important role on land and it has responsibility for the allocation of land for landfills and other facilities. In some places, the management of solid waste by the local authorities gave rise of increasing criticism from the public due to poor quality management. The quality of the service among the local authorities was inadequate because of the limited funding resources, lack of human resources to manage new technologies for disposal and treatment of solid waste. Local government has provided investment in terms of financial support for solid waste management in the range of 15% to 50% from their annual budget. However, most of the urban solid waste management is still encountered with problems. Besides, this implies that the level of solid waste management in our country is risky and inadequate. The phenomenon of ineffectiveness in the solid

waste management is not a new phenomenon occurring in the cities of Malaysia (Behzad 2011).

2.1.1 SWCorp

According to the study, in this Malaysia, SWCorp is a company that operates the largest waste management. SWCorp an agency responsible for the implementation of the solid waste management and public cleansing Act 2007 (Act 672) and Regulations related to solid waste management services and public cleansing. There are nine states under their responsibility. Meanwhile, other countries rely on municipalities in their respective states. The functions of SWCorp are as shown as below:

• Improve service quality Waste Management and Public Cleansing.
• Maintain and improve standards and service levels.
• Implement and enforce the Solid Waste Management and Public Cleansing.
• Increase efforts towards improving the operational efficiency sub Solid Waste Management and Public Cleansing.
• Establish an institution, center and workshop for research and other activities that are necessary for or in connection with the development of services.
• Recommend and ensure compliance standards, specifications and codes of practice.
• Recommend and implement all decisions of government policies, plans, and strategic plans
• Promote public participation and raise public awareness in cooperation with anybody corporate or government agency for the purpose of performing the functions of the Corporation.

Actually, under custody of SWCorp management system, there are three concessions which is in the south, the SWM Environment Sdn. Bhd concession, the northern part is the E-idaman Sdn. Bhd and in the central part of Eat is Alam Flora Sdn.Bhd. (Behzad, 2011).The study was conducted in the southern part of the state

of Malacca, where SWM Environment responsible for organizing waste bin collection in the country. From the studies that have been made, this country used a scheduled system for waste collection. Unfortunately, this system was not too schematic because it is not real time system. For this case, if the bin is overloaded before the time collection, the management will not know about it. Figure below shows the image at SWCorp Company‟s office with their Assistant (Technical Section).

Figure 2.0: Picture with SWCorp‟s Assistant Engineer

2.1.2 SWM Environment

SWM Environment Sdn. Bhd. (SWM), formerly known as Southern Waste Management Sdn. Bhd was established with the co-operation of Malaysian Government's decision on the National Privatization of Solid Waste Management. On December 21, 1995, it was consequently awarded the task of managing the collection, storage, transport, transfer, intermediate processing and disposal of solid waste in the Southern Region of Peninsular Malaysia by the Economic Planning Unit of the Prime Minister's Department. While in April 1996, Government of Malaysia directed SWM to take over the solid waste management and public cleansing services from all Local Authorities within the SWM concession area