



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**SMART WASTE BIN WITH REAL TIME
MONITORING SYSTEM**

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

by

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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 Computer Engineering Technology (Computer System) with Honours. The member of the supervisory is as follow:

.....

(Project Supervisor)

ABSTRAK

Dalam kehidupan teknologi yang semakin berkembang maju ini, pelbagai usaha dan inisiatif telah dijalankan oleh pihak perbandaran pengurusan sisa pepejal dalam mengatasi masalah limpahan sisa buangan sekitar tong sampah serta masalah-masalah lain berkaitan sisa buangan seperti pencemaran bau yang melampau serta lebihan muatan sehingga menyebabkan tong sampah terpaksa ditukar. Antara sistem yang telah sedia ada yang dipraktikkan oleh pihak perbandaran di Malaysia ialah dengan menggunakan jenis tong sampah yang boleh memampatkan sampah untuk menambah muatan kapasiti sampah. Ironinya, sistem tong sampah tersebut tidak mampu untuk menyelesaikan masalah limpahan sisa buangan dari segi keseluruhannya kerana faktor lain seperti sikap pemandu lori sampah yang tidak mematuhi jadual kutipan semasa. Oleh itu, objektif utama projek ini ialah untuk membantu pihak perbandaran dalam memantau aktiviti ataupun keadaan semasa tong sampah untuk mengelakkan permasalahan yang telah dinyatakan. **K**omponen yang digunakan untuk membaca aras sampah dalam tong sampah tersebut ialah Ultrasonic Sensor. Modul WiFi ESP8266 digunakan sebagai perantaraan untuk mendapatkan akses internet serta membolehkan data dihantar ke pengkalan data. Pengkalan data yang digunakan ialah MySQL dimana data dari sensor dihantar masuk ke dalam pengkalan data hanya apabila terdapat pergerakan dari tong sampah yang dikesan oleh PIR Motion Sensor. Data dari pengkalan data kemudiannya dikawal dan diatur oleh web host untuk memaparkan data-data aktiviti yang diperlukan oleh pihak pengurusan sistem pepejal seperti aktiviti semasa setiap tong sampah atau aktiviti keseluruhan tong sampah pada setiap bulan. Dengan cara ini, pihak pengurusan boleh menganalisa serta mengoptimumkan kekerapan pengutipan sisa pepejal di sesebuah tempat serta dapat mengurangkan kos operasi.

ABSTRACT

In the life of a growing advanced technology, numerous efforts and initiatives were carried out by the municipal solid waste management in addressing issues of waste overflowing around the bins and other problems related to waste such as extreme odor pollution and overloaded bins, causing the bins should be changed immediately. Among the already existing system that were practiced by the municipal authorities in Malaysia was using type of trash bin that can compress the waste, this allows the capacity of the waste to be loaded into the trash increases. Ironically, the bin system only can solve the problem with overflowing waste, but the other factor such as the garbage truck collector that does not follow the schedule collection and causes the waste bin to overflow or disposed outside the existing trash bin cannot be monitor by authority. Therefore, the main objective of this project is to assist the waste management in monitoring the activities or the current state of waste bin to avoid the problem stated. PIR Motion sensor was used to detect the movement of people when opening the lid of trash bin to throw the rubbish. In this research, the data of waste materials that were chosen to be controlled and regulated was through the reading of the level of waste in the bin. The components used to read the level of waste in the trash bin was Ultrasonic sensor. ESP8266 Wi-Fi module was used as a medium to get internet access and allows data to be sent to the database. Next, MySQL database was used, where the data from the sensors was sent into the database only when there was motion detected by sensor. Data from the database was then controlled and regulated by a web host to display data activities required by the waste management such as the activities during monthly activities of waste collection or the current activities of garbage collector. In this way, waste management can analyze and optimize the frequency of waste collection in a certain places and also can reduce operating costs.

DEDICATION

Every challenging work needs self-efforts as well as guidance of elders, especially those who were very close to our heart.

My humble effort I dedicate to my sweet loving

Father & Mother,

Whose affection, love, encouragement and prayers of day and night that give me strength and inspiration to be able to get such success and honour,

Along with all hardworking and respected

Lecturers

ACKNOWLEDGMENTS

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

| | | |
|-------|---|--|
| AC-DC | - | Alternative Current/ Direct Current |
| AVR | - | Automatic Voltage Regulator |
| CSS | - | Cascading Style Sheets |
| DTIM | - | Delivery Traffic Indication Message |
| FTDI | - | Future Technology Devices International |
| GIS | - | Geographical Information System |
| GPRS | - | General Packet Radio Services |
| GPS | - | Global Positioning System |
| GSM | - | Global System for Mobile Subscriber Identity |
| GUI | - | Graphical User Interface |
| HTML | - | Hyper Text Markup Language |
| HTTP | - | Hypertext Transfer Protocol |
| IDE | - | Integrated Development Environment |
| IO | - | Input Output |
| IP | - | Internet Protocol |
| IR | - | Infrared |
| LBS | - | Local Base Station |
| LCD | - | Liquid Crystal Display |
| LED | - | Light Emitting Diode |
| MSW | - | Municipal Solid Waste |
| SQL | - | Structured Query Language |
| PHP | - | Hypertext Preprocessor |
| PIC | - | Programmable Interface Controller |
| PIR | - | Passive Infrared |
| RF | - | Radio Frequency |
| RFID | - | Radio Frequency Identification |
| RTC | - | Real Time Clock |
| SCL | - | System Clock Line |

| | | |
|--------|---|--|
| SDA | - | System Data Line |
| SMCH | - | Smart Monitoring and Controlling Hut |
| STS | - | Smart Trash System |
| SVS | - | Smart Vehicle System |
| SWCorp | - | Solid Waste and Public Cleansing Management Corporation |
| SWM | - | Southern Waste Management |
| USB | - | Universal Serial Bus |
| VLR | - | Visitor Location Register |
| XAMPP | - | Cross-Platform (X), Apache (A), MariaDB (M), PHP (P), and Perl (P) |

CHAPTER I

INTRODUCTION

1.1 Background

Nowadays with the rapid growth in the human population and economic development, solid waste has become one of the severe environmental problems in Malaysia. This problem had happen due to poor handling process of waste collection and management in the country. The waste created from various sources will be lead to environmental pollution arising without an effective and well-organized solid waste management. Besides, this can also bring into health hazards that encourage the disease vector breeding insects, carrion animals and rodents, and end in a variety of diseases. From Business Waste Management's article enlightened that the waste generation is increasing staggeringly attributable to its developing activities associated and it's a concomitant drawback with the disposal of this waste in Malaysia. Additional waste product frequently created during increasing of population growth, so to maintain the balance of waste is presently managed waste should be reduced on a private basis. Based on estimates, waste generation has reached one million tons per day in Asia. (Environmental Pollution Technology, 2009).

Improper waste management has caused a infectious disease occurrence and threatens alternative epidemics in Asian nation. In recent years, waste management has been the sole alternative unifying issue resulting in public demonstrations all across Asian nation, once corruption and fuel costs. (A. Ranjith, 2015). Economic management of wastes can become the world's attention that require extensive analysis and development work towards exploring new applications for the management of sustainable and environmentally friendly. The problem of waste management is a primal and present issue in developing countries in Africa, notably Nigeria. Municipal waste management issues in Nigeria cut across issues for human

health, air, water, and land pollution among others. The analysis of the key downside affecting the economic management of municipal waste is vital for evolving a practicable solution in a rising economy like Nigeria. The transform of the prevailing trends in municipal waste management is important for guaranteeing sustainable environments and alternative goals. (B. Abila & J. Kontola, 2013).

It became an enormous challenge to the responsible authority for waste management due to the dearth of proper management solution, a considerable quantity of about 85% of the entire MSW management budget exhausted on waste assortment and transportation (Karadimas, 2007). In order to grasp the details of this waste assortment and management, an interview and a visit site visit been held with the responsible company of the waste management. The analysis regarding to waste disposal system conducted in order to understand the kinds of waste in this country.



Figure 1.1: Waste Overflow

Source: <http://www.dreamstime.com>

Figure 1.1 shows the real scenario occurred due to the problems faced by authority in this country. There are numerous factors that causes the situation to happen, one among of it is because of the authority does not know the current status of the waste bin. Basically, the authority already have their fixed schedule of waste collection, so when the waste bin is full, the waste collector will wait for the collection day to clear the waste bin. The schedule system that they use will generate a problem when there are some events on the certain area that causes the waste bin overloaded and smelly.

Typically in India, which is the smaller cities have adopted open transport system for transporting the waste from the temporary storage points to the disposal site. Manual loading is found to be an intense time and reduces labor productivity as vehicles used for such purposes. Further, manual loading and handling of wastes are posing threat to the health of healthful staff, as the wastes were found extremely contaminated. Wastes are collected from varied temporary storage points and open collection points and are loaded to the transport vehicles manually. This situation had resulted the waste seen lying in heaps or scattered at the unscientifically designed temporary waste storage points giving unsightly appearance besides inflicting nuisance and unhygienic conditions. (V. Kumar, & D. Pandit, 2013).

Most of companies in Malaysia attracted and pay attention to remote sensing system in waste management. For example, Alam Flora has already applied the truck monitoring and tracking system. (Alam Flora, 2009). Real-time analysis of truck locations required truck monitoring and tracking to control solid waste collection process and improve the efficiency of moving truck. To achieve their requirements, the design is selected from the RFID module and the appropriate communication system station reports. The whole system uses RFID, GPS module to control the truck, and a GPRS network control center modules for camera- fixed IP in the internet. The location of the truck, the waste in the trash and the surrounding area was estimated by the software in the control server. The information can be used effectively to detect which truck is near to respective garbage bin and it will reduce wastage of fuel and time. (M.A. Hannan, 2011).

According to research from Timothy Ambrose in 2015 found that a deployment of smart trash cans in Barcelona has been successful and received considerable media attention. These trash cans sense and report their fill levels, with the goal of allowing the city to plan efficient collection routes. Enevo had markets a smart trash monitoring solution, whereas their system is based on a trash can-mounted sensor that uses ultrasonic measurement of the fill level, plus temperature and motion sensors to detect events such as fire and vandalism. The sensor communicates readings over a GSM network.

Roshan Issac describes that the speedy urbanization in Kerela has led to rose generation of MSW, which will seriously have an effect on the society and also the

quality of lifetime of individuals. The poor management of waste has led to pollution and to the emission of greenhouse gases although some accomplishment has taken from the part of government against this problem. The most problems with waste management are the high cost related to no returns, lack of real time feedback from the people regarding unauthorized dumping and numerous transportation problems.

On top of that, this project will help to design more efficient and systematic system for the waste management company. This project is to create an online real time waste bin monitoring system that will make use of wireless sensor network and communication technologies in order to provide a solution for irregular waste management system. Here, a power supply is using to operate the microcontroller unit, sensors and WIFI shield module. Then, the system will make use of motion sensor to detect the motion approach to the waste bin, and then it will directly trigger current data into MySQL. The data in MySQL will be linked into monitoring system and will be display on the html web browser. This monitoring system will be conduct and control by the waste management authorities so that they can monitor and check the current waste bin status. This real time monitoring system's project will help the authorities to obtain information from the bin in current state. The sensor will be implemented on the size of 120L dustbin.



Figure 1.2: Actual measurement size of 120L bin

Figure 1.2 shows that the real dimension of 120L waste bin. There are different types of different sizes that have been provided by the Malaysia government to dispose of recyclable items. These bins come in various sizes which are 120 liters, 140 liters, 240 liters, 660 liters and 1100 liters.



Figure 1.3: Different sizes of waste bin

Source: <http://www.micksbins.com.au/skip-bins-brisbane.html>

1.2 Problem Background

Based on the interview and site visit that was held, there are several problems were found that were faced by the authority of this country regarding to their waste management which are;

- There is no mechanism to manage waste disposal activities even though the waste bin is already full and overloaded.
- There is no mechanism to inform and notify the authority regarding the waste bin status when it is overloaded and need fast collection.
- There is no system to monitor the waste collection activities in real-time.

1.3 Problem Statement

The problem statements of this project are as follows:

- How sensor and wireless communication technologies able to provide a real-time data to monitoring system in order to improve the efficiency of waste management activities?
- How to produce a portable and cost-effective waste bin system?

1.4 Objectives

This study embarks on the following objectives:

- i. To develop a prototype of smart waste bin with real time monitoring system which able
 - To read current waste level in waste bin using level sensor in real-time manner as soon as motion is detected by motion sensor.
 - To store the waste level reading into database.
 - To provide a GUI to display and analyze the collected data.
- ii. To provide a portable system with high data rate transmission using Wi-Fi as wireless communication technologies.

1.5 Scopes of Project

This project is to develop smart waste bin with real time monitoring system that can read the current status of bin from web application. The portable system mentioned in objectives shows that this system are designed with implementation of battery and solar power to give the power to the components. Therefore in designing this monitoring system, this project is divided into two big parts which is for the first part is for transmitter and the second part is for receiver (the control unit section). The transmitter consists of sensors and microcontroller that will be implemented at the waste bin while in the receiver part consist of control units which are MySQL database that will be able to read data from level sensor and will be transmit the data into database and controlled by monitoring system. Figure 1.3 below shows the whole part of high level system architecture of this monitoring system.

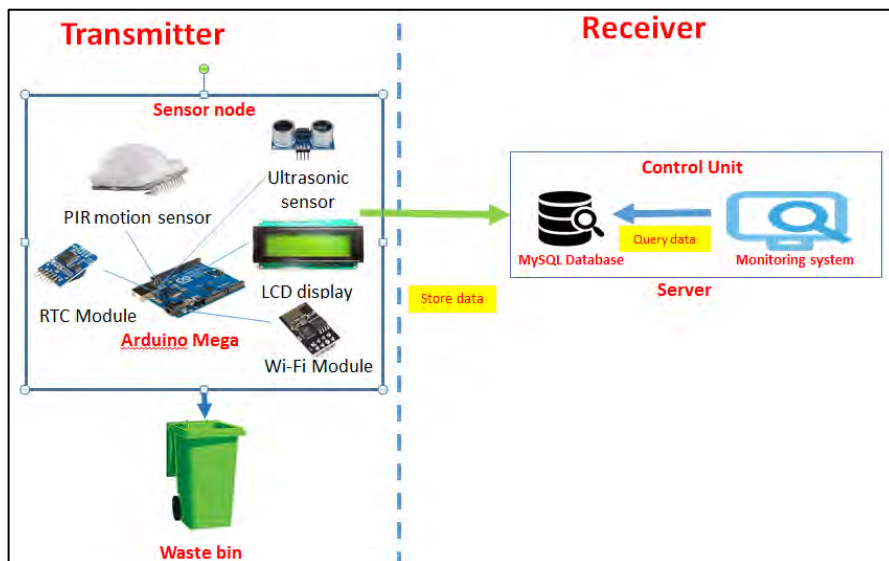


Figure 1.4: High level architecture of real time monitoring system

In this project, the sensors that have been chosen are ultrasonic sensor and PIR motion sensor. Generally, the ultrasonic sensor is able to measure the level of waste inside the bin while PIR motion sensor will be used to detect the movement when someone approach to the waste bin to throw waste product into the waste bin. Both ultrasonic and PIR sensors will be connecting with the Arduino board, and then the use of Wi-Fi module is that to allow the Arduino to have internet connection in it. So, by using this Wi-Fi module, the data from ultrasonic sensor will send and store directly into MySQL database with internet connection. In the other hand, when motion is detected, the notify message will be directly display on the LCD that the motion is detected and then MySQL will be automatically read data from level sensor. In the monitoring system, the web application will be create in web server, the web server that used in this project is webhost from Malaysia which is Exabytes, the language that used to design GUI are PHP language and java script.