GARBAGE MONITORING SYSTEM
USING IOT

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MAY 2018
DECLARATION

I hereby declare that this report is based on my original work except for quotations and citations, which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at University Sultan Zainal Abidin or other institutions.

________________________________

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Date : .............................................
CONFIRMATION

This is to confirm that:
The research conducted and the writing of this report was under my supervision.

________________________________
Name : Prof Madya Dr. Engku Fadzli Hasan Bin Syed Abdullah

Date : .................................................
DEDICATION

To my beloved mother, Mrs Rohani Binti Mat Idris and father, Mr Mohamad Zaki Bin Abdul Rahman thank you for all the support, love, and continuous encouragement for me to finish this Final Year Project. Without their encouragement, I will never able to finish my Final Year Project.

Thank you.
ABSTRACT

The idea of this project introduces the development of a smart Garbage Monitoring System by measuring the garbage level in real time and to alert the hostel management whenever the bin is full. The proposed system consisted the ultrasonic sensors placed over the bins to detect the garbage level and compare it with the dustbins depth. The system shows the status of garbage through LCD in a real-time to store the data. The problem are the current garbage collection is inefficient, time waste and required a huge amount of human energy. When the garbage is overloaded, it results to an unhygienic condition for surrounding environment and creates bad smell which can led to spread some deadly disease. It is expected that this system can create a greener environment by monitoring and control the collection of garbage smartly through Internet of Things.
Idea projek ini memperkenalkan pembangunan sistem Pemantauan Sampah yang bijak dengan mengukur tahap sampah dalam masa nyata dan untuk memberi amaran kepada pihak pengurusan asrama setiap kali tong sampah penuh. Sistem yang dicadangkan terdiri daripada sensor ultrasonik yang diletakkan di atas tong untuk mengesan tahap sampah dan bandingkan dengan kedalaman sampah. Sistem ini menunjukkan status sampah melalui LCD dalam masa nyata untuk menyimpan data. Masalahnya ialah kutipan sampah semasa tidak cekap, sisa masa dan memerlukan sejumlah besar tenaga manusia. Apabila sampah terlalu penuh dan terkeluar, ia mengakibatkan keadaan tidak bersih untuk persekitaran sekitar dan mencipta bau busuk yang boleh menyebabkan penyebaran penyakit berbahaya. Diharapkan sistem ini dapat mewujudkan persekitaran yang lebih hijau dengan memantau dan mengawal pengumpulan sampah secara bijak melalui Internet of Things.
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CHAPTER I

INTRODUCTION

1.1 Project Background

In UniSZA, there is no innovative and systematic system to monitor and collect the garbage. Monitoring garbage is very important to optimize management, resources, and cost and reduces manpower to handle the garbage collection.

In UniSZA’s hostel, each level of the hostel is provided with four garbage bins for students. In the existing system, the employees will monitor and collect the garbage every day except for Friday. The employees have to pick up the garbage to every floor level of the hostel for three blocks which are block A, block B and block C.

The disadvantages of the existing system are the employees have to go and check the bins daily whether they are full or not, it results in high cost. If the bin does not get emptied on time then the environment becomes unhygienic and illness could be spread. Overloaded garbage can increase the risk of getting illness which are typhoid fever, food poisoning, gastroenteritis, and other major illnesses where it comes from the flies.
In this paper, Garbage Monitoring System Using IOT was proposed for UniSZA management system to help to remove all these disadvantages. As garbage bin is very important to maintain the cleanliness of the hostel, so it is very important to empty all the garbage bins as soon as they get filled. We will use sensor which is ultrasonic sensor that will be placed on top of the bin which enables it to send the information to the office hostel management. It will send an alert the employees if the garbage has reached its maximum level and need to empty it out.

This will helps to reduce the manpower to collect the garbage and cost as the employees will have to go only at a certain time when the bin is full. And then, this innovative system will help to optimize the resources and make the environment free from illnesses.
1.2 Problem Statement

There are several problems with the current existing system that are being identified. This will reflect the need for a new efficient system for monitoring and manage the garbage. The problems are listed as below:

1. Current garbage collection is inefficient, time waste and required a huge amount of human energy.
2. It will create an unhygienic condition for surrounding environment and creates bad smell which can lead to spread some deadly disease.

1.3 Objectives

The main objectives of the project are:

1. To study the use of IoT in garbage monitoring system.
2. To design a systematic garbage monitoring system.
3. To develop a systematic garbage monitoring system.
1.4 Scope

The scope of the project are:

1. Admin
   - Admin can monitor the system
   - Admin can manage the collected data

2. UniSZA Waste Management System
   - Receive notification / alert
   - Can view data of the system

1.5 Excepted Outcome

It is expected that user able to get notification when the garbage is full. User can collect the garbage immediately when they get alert or a notification.
CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter discussed and describe selected paper and previous journal that trace a similar technique and topics that can be referenced for the Garbage Monitoring System using IOT. This chapter also provides research based on the similar existing system, similar sensors used and IOT board that can be a guideline or a sample to upgrade or to develop a new better system compared the existing system.

2.2 Research

2.2.1 Monitoring System

The fundamental principle of a monitoring system is to allow users to capture data, process and disseminate information in a systematic way. Monitoring system enables us to measure trends of various indicators based on the data collected in the field.

An effective and efficient monitoring system is needed to observe the system activities, check if the applications are running and will alert the user if needed.
2.2.2 Example of Research Paper

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Kanchan Mahajan et.al described a system by using two technologies. The two technologies, Zigbee and Global system for mobile communication (GSM) are the latest trends. This combination of the technologies is one of the best combinations which is used in that system. There is a number of techniques which are used as well as are being built up for good management of garbage. To give a brief description of the system, the sensors are placed in the common garbage bins, which are placed at public places. In that, a ARM7 controller is used when the garbage reaches the level of the sensor, then the indication will be given to controller. This ARM7 controller will give information to the driver of garbage collection truck as to which garbage bin is completely filled. ARM7 will give an indication with the help of GSM technology by sending SMS [1].

Monika K A et.al proposed A Smart Dustbin based on IoT in which the smart bin was built on a platform which was based on Arduino Uno board which was interfaced with a GSM modem and an ultrasonic sensor. The sensor was placed on the top of the bin. A threshold level was set as 10cm. As the garbage reaches the level of threshold, the sensor triggers the GSM modem which alerts the associated authority till the garbage in the bin is emptied. At the end, a conclusion was made that various issues like affordability, maintenance and durability were addressed when these smart bins were designed. It also contributed towards a hygienic and clean environment in the process of building a smart city [2].
Meghana K C and Dr. K R Nataraj proposed paper is IoT Based Intelligent Bin for Smart Cities which equipped the smart bins with ultrasonic sensors which measure the level of dustbin being filled up. The container is divided into three levels of garbage being collected in it. Every time the garbage crosses a level the sensors receives the data of the filled level. This data is further sent to the garbage analyzer as an instant message using GSM module. Placing three ultrasonic sensors at three different levels of the container may be a disadvantage as the cost of the dustbin increases due to the sensors and also the sensors can be damaged due to the rough action by the users. An IoT-based smart garbage system (SGS) is proposed to reduce the amount of food waste [3].

2.2.4 Research Paper Using Node MCU (ESP8266)

Navghane S S et.al in his proposed paper, IoT Based Smart Garbage and Waste Collection Bin suggests the method for garbage management which is as follows. The bin was interfaced with a system based on the microcontroller which had IR wireless systems with a central system that showed the current status of the garbage in the bin. The status was seen on a mobile-based web browser with html page by using Wi-Fi. To reduce the cost, they only used weight-based sensors and on the sender's side they only used a Wi-Fi module to send and receive the data. In the end, the sensor could only detect the weight of waste present in the bin but not the level of waste [4].
Bolívar et.al in his proposed paper, Solar radiation monitoring using electronic embedded system Raspberry Pi database connection MySQL, Ubidots and TCS-230 sensor shows the process of the system will repeat continuously until the power supply is shut down. Based on the circuit operation, an Echo pin will send a signal to determine whether the full or not. If there is a signal that returns back, it indicates that the garbage is full. Then, the triggered pin will send a pulse for the sensor to go into the range mode for the object detection. The data will be sent to the microcontroller which is Wemos D1 Mini in order to interpret it to the digital signal [5].

Then, the digital signal will be sent to the Ubidots platform through ESP 8266 to visualize it through a graph. The ESP 8266 is a low-cost Wi-Fi chip with full TCP/IP stack and MCU (microcontroller unit) capability. Meanwhile, Ubidots is a codeless IoT Platform which provides a friendly, customizable Application Enablement Platform that provides users with real-time data and visualization of sensor inputs using a secure cloud [5].

This real-time waste management will visualize the output in two different approaches. First, the system uses a wireless module to monitor the garbage based on the IoT cloud database in a real-time system. The online concept will enable the responsible authorities to monitor the garbage level themselves. By using an Ubidots platform, an alert message will be sent through an email and messages. On the other
hand, this system also used LED indicator to alert the user when the garbage is full [5].

Dr. Sandeep M. Chaware et.al developed an integrated system of Wi-Fi modem, IoT, GSM, Ultrasonic Sensor. It was introduced for efficient and economic garbage collection. The developed system provides improved database collection time and waste amount at each location [6].

2.3 Internet of Things

The IOT concept was coined by a member of the Radio Frequency Identification (RFID) development community in 1999, and it has recently become more relevant to the practical world largely because of the growth of mobile devices, embedded and ubiquitous communication, cloud computing and data analytics [7].

Imagine a world where billions of objects can sense, communicate and share information, all interconnected over public or private Internet Protocol (IP) networks. These interconnected objects have data regularly collected, analysed and used to initiate action, providing a wealth of intelligence for planning, management and decision making. This is the world of the Internet of Things (IoT) [7, 8].
Internet of things common definition is defining as a network of physical objects. The internet is not only a network of computers, but it has evolved into a network of device of all type and sizes, vehicles, smartphones, home appliances, toys, cameras, medical instruments and industrial systems, animals, people, buildings, all connected, all communicating & sharing information based on stipulated protocols in order to achieve smart reorganizations, positioning, tracing, safe & control & even personal real-time online monitoring, online upgrade, process control & administration [7, 8].

Internet of Things is refers to the general idea of things, especially everyday objects, that are readable, recognisable, locatable, addressable through information sensing device and/or controllable via the Internet, irrespective of the communication means (whether via RFID, wireless LAN, wide area networks, or other means). Everyday objects include not only the electronic devices we encounter or the products of higher technological development such as vehicles and equipment but things that we do not ordinarily think of as electronic at all - such as food, clothing, chair, animal, tree, water and others [7, 8].

The goal of the Internet of Things is to enable things to be connected anytime, anyplace, with anything and anyone ideally using any path/network and any service. The Internet of Things is not a single technology, but it is a mixture of different hardware & software technology. The Internet of Things provides solutions based on the integration of information technology, which refers to hardware and software used to store, retrieve, and process data and communications technology which includes electronic systems used for communication between individuals or groups [7, 8].
2.4 **Summary**

The system that are developed can monitor the garbage level and sent a notification to the user’s mobile phone. The method that will be applied in this system are the same as the system studied but will be added some improvement which by using a Node MCU (ESP8266) as IoT board and GSM Modem to give an alert to the user directly through SMS.
CHAPTER 3

METHODOLOGY

3.1 Introduction

This chapter discusses the methods that have been used from the beginning which is planning phase until the end of this project. Methodology used has been discussed more details to give more understanding the whole development processes of this project. For this project, Iterative and incremental model has been chosen in developing the project. By using this model, project can be developed through repeated cycles.

The advantages of this model are analysing risk better than other model and it support changing requirement. The developing process of this model can still be proceeding even there is some problem arise or there is any changes needed in the middle of development process.

Iterative and incremental model included six phases which consist of planning phase, requirement analysis phase, design phase, implementation phase, testing phase and deployment phase.
3.2 Methodology Phases

3.2.1 Planning Phase

Planning phase is the first phase and the most important phase in an early phase of development project. The planning for this project is to develop a garbage monitoring system based on Internet of Things (IoT). This suggestion project needs to be discussed and get supervisor agreement before proceeding to another phase.

To make this system possible, an ultrasonic sensor will be used to detect the level of the garbage in the garbage bin. This system will also use a GSM Modem to notify the user whenever the garbage bin is full. All the required materials have been prepared.
3.2.2 Requirement Analysis Phase

For this phase, a lot of information about the system is gathered. As the system is about garbage monitoring system based on Internet of Things (IoT), a lot of information about the previous or latest technology of garbage monitoring system is identified. The most important information needed is a user requirement. After requiring a user requirement, information about garbage, ultrasonic sensor, IoT, GSM Modem, Liquid Crystal Display and Node MCU are identified.

3.2.3 Design Phase

Design phase is the third phase or stage that is used to show the flow of the system so that it will be successful. After a process of gathering all the information required in this system, a framework is done to show the flow of the whole system. A framework is important to make a flow system be easy to be understood.

In this phase, a design of context diagram, data flow diagram and entity relationship diagram to show the flow of the system specifically. Then, a setup of an ultrasonic sensor with breadboard, LCD, and Node MCU is created. This system is able to show the flow of garbage monitor system based on Internet of Things (IoT).
3.2.4 Implementation Phase

After gathering all the information and design has been created, this phase is to develop a connection for an ultrasonic sensor using code. If there is any errors or changes needed, it will be solved at this phase.

3.2.5 Testing Phase

During testing phase, the system will be tested. During this phase, if there is any problem arise or any changes needed, it will be solved immediately by turning back to design phase to make a revision of the flow.

3.2.6 Deployment Phase

After the system has been completely developed and there are no more errors after testing, the system will be deployed for its end of this product.
3.3 System Design

i) Framework of Garbage Monitoring System using IoT

Figure 3.2 shows the framework for garbage monitoring system based on IoT. An ultrasonic sensor that embedded inside garbage bin will check the distance of garbage and compare it with garbage bin depth. Data collected from the ultrasonic sensor will be sent to the IoT Board. An IoT Board will send it to the cloud and if the garbage it loaded, the cloud will notify the user through mobile phone. On the other hand, Admin able to view the report of the garbage. After getting the notification, the user will collect the garbage at the hostel.

Figure 3.2 Framework Design
ii) Context Diagram

Figure 3.3 shows the context diagram for garbage monitoring system. In this diagram, an ultrasonic will send a garbage details to the cloud and cloud will send notification to the user’s mobile phone. The admin can view log report of garbage details.
iii) Data Flow Diagram (DFD)

Figure 3.4 shows the data flow diagram of the garbage monitoring system. In this diagram, all the data and details from garbage will be sent to the cloud and a notification will be sent to the user’s mobile phone for user to collect the garbage.

![Data Flow Diagram](image)

Figure 3.4 Data Flow Diagram (DFD)
iv) Entity Relationship Diagram (ERD)

Figure 3.5 shows the relationship between an ultrasonic sensor with the garbage. In this diagram, an ultrasonic sensor monitors the garbage and compare the garbage with bin depth to check if the bin is full or not.
Figure 3.6 shows a sketch of connection devices or sensors using Fritzing software. This figure shows the Node MCU connected to the ultrasonic sensor and LCD. An ultrasonic sensor will read the distance of the garbage and compare with the bin depth. The LCD will show the output such as percentage of the garbage level in the bin. This sketch is one of the important part of the Garbage Monitoring System using IoT.
3.4 Conclusion

In this chapter, it is explained about the methodology used for garbage monitoring system. As explained, an Iterative and incremental model is the most suitable methodology used for this project. Then, it is explained also the flow of the system by using context diagram, data flow diagram, entity relationship diagram, and framework of the system to make it more understandable.

Based on this three chapter, we can continue to the next phase which is implementation phase. All the information obtained can be used to undergo this phase and continue to another phase until the last phase, deployment phase.
REFERENCES


Table 1: Activities and Milestone