UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF AN IOT-BASED SMART GARBAGE BIN SYSTEM WITH RFID AND GSM MODULE

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electrical Engineering Technology (Industrial Automation & Robotics) with Honours.

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ABSTRAK

"**Smart Garbage Bin System with RFID and GSM Module**" adalah prototaip baru bagi sistem kitar semula automatik yang boleh memisahkan tiga jenis bahan dan memberi ganjaran kepada pengguna justeru dapat mengurangkan sampah yang melimpah. Objektif utama projek ini adalah untuk memantau tahap sisa sampah sampah melalui laman web untuk memaklumkan telefon pintar pembersih untuk mengumpul tong sampah penuh. Sistem ini telah diintegrasikan dengan IoT untuk memantau tahap sampah melalui pangkalan data awan iaitu Adafruit IO. Selain itu, GSM akan memberitahu pekerja untuk mengumpul tong sampah dan data sistem ini akan dianalisis menggunakan platform Adafruit IO. Di samping itu, masa yang diambil untuk setiap jenis bahan yang dikesan dalam bin juga dianalisis untuk memastikan sistem ini berfungsi dengan cekap. Projek ini dilengkapi dengan kad pintar tanpa sentuh sebagai mata ganjaran elektronik untuk menarik komuniti melibatkan diri dalam aktiviti kitar semula. Kewujudan projek ini kerana peningkatan penduduk Malaysia dan bau busuk yang dihasilkan dari kawasan tercemar dengan limpahan sampah yang tidak terkawal menyebabkan penyakit tersebar. Teknologi IoT menyediakan pengguna dengan sistem pemantauan masa nyata. Agensi yang diberi kuasa boleh memantau tahap sampah tanpa memeriksa tong sampah secara beransur-ansur sewaktu mengumpul sisa. Selain itu, sampah juga dilengkapi dengan sistem penghantaran maklumat melalui mesej ringkas (SMS) kepada pekerja untuk membersihkan pengumpulan sampah yang penuh. Output yang dipaparkan kepada pengguna melalui paparan LCD adalah jenis bahan yang dikesan dan nilai yang dikumpulkan. Projek ini terdiri daripada dua sensor utama yang sensor jarak kapasitif kawasan dan sensor jarak induktif. Pengaturcaraan Arduino yang akan menjadi otak projek ini dan sensor IR digunakan untuk menentukan keadaan bahan. Kemudian, keadaan ini dirangsang oleh kedua-dua sensor jarak kapasitif dan induktif untuk menentukan jenis bahan yang dikesan. Selain itu, projek ini menggunakan sensor ultrasonik untuk mengesan tahap sampah di dalam tong maka akan menghantar status bin tahap kepada pihak berkuasa.

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ABSTRACT

Smart Garbage Bin System with RFID and GSM Module is a new prototype of an automatic recycle system that can separate three different types of materials and giving rewards point to the users thus can reduce the overflowing trash. The main objective of this project is to monitor the level of the waste in the garbage bin through a web page for notifying the cleaner's smartphone to collect a full garbage bin. This system had been integrated with the Internet of Things (IoT) in order to monitor the trash level through a cloud database called Adafruit IO. Besides, GSM will notify the worker to collect garbage bin and the data of this system will be analyzed using Adafruit IO platform. In part of that, time taken for each type of material detected in bin also be analyzed to ensure this system performs efficiently. This project completed with a contactless smartcard as the electronic reward points to attract the community involves in recycling activity. Existence of this project because of the increasing in Malaysia's population and bad smell produced from the polluted area with an uncontrolled overflow of waste cause the disease is spread. An IoT technology provides the user with a real-time monitoring system. The authorized agency can monitor the trash level without check the garbage bin gradually during collects waste. In addition, the trash is also equipped with a system of transmission of information through short messages (SMS) to the workers to make cleanup of garbage collection which is full. The output that displays to the user through the LCD display is the type of material detected and the recent point collected. This project consists of two main sensors which area capacitive proximity sensor and inductive proximity sensor. Arduino programming will be the brain of this project and the IR sensor used to determine the condition of the material. Then, the condition is stimulated by both capacitive and inductive proximity sensor to determine the type of material detected. Besides, this project utilized ultrasonic sensor to detect the trash level in the bin then will send the status of the level bin to authorities.

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DEDICATION

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

Along with all hardworking and respected

Lecturers

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LIST OF ABBREVIATIONS

GSM	Global Mobile Communications System
SMS	Short Message Service
IOT	Internet of Thing
WTE	Waste to Energy
SWM	Solid Waste Management
3R	Reduce, Reuse and Recycling
MSW	Municipal Solid Waste
SWCorp	Solid Waste Management and Public Cleansing Corportion
HTML	Hypertext Markup Language
GPRS	General Purpose Radio Service
LCD	Liquid Crystal Display
ID	Identity Document
RVM	Reverse Vending Machine
PIN	Personal Identification Number
PWM	Pulse Width Modulation
AC	Alternating Current
DC	Direct Current
USB	Universal Serial Bus
I/O	Input/Output

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mA	Mili-ampere
V	Volts
mm	Millimeter
TTL	Transistor Transistor Logic
RF	Radio Frequency
TCP/IP	Transmission Control Protocol/Internet Protocol
SOC	System On Chip
APSD	Antisocial Process Screening Device
VoIP	Voice Over IP
LAN	Local Area Network
MHz	Mega-Hertz
RFID	Radio Frequency Identification
IDE	Integrated Development Environment
LED	Light Emitting Diode
3D	3 Dimension
DOF	Degree of Freedom

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CHAPTER 1

INTRODUCTION

1.1 Project Background

At the present time, society's hygiene and every kind of pollution is a major concern and waste management is a crucial part involved in this cycle. Garbage is left unattended and unnoticed for a longer period of time. These wastes include leftover wastes from the public, industries, etc. As we can see, a waste disposal site for recyclable items is limited quantities somewhere. In fact that society has been mixing recyclable items with wet waste. This makes it difficult for garbage collectors to isolate recyclable items and food waste by taking a long time.

There are three types of recyclables in Malaysia, such as paper, plastics, and bottles, but very little recycling of waste. On average, Malaysians produce 30,000 tons of waste per day and only 5% of it is recycled (Waste Management in Malaysia: In the Dumps, 2015). Municipal solid waste (MSW) monopolizes Malaysia's overall waste composition by 64%, industrial waste by 25%, commercial waste by 8% and building waste by 3% (Khairul Bariyah Abd Hamid et al., 2015). At present, the waste management approach being used is landfill, but due to rapid development and lack of space for new landfills, Malaysian states switch to incineration due to rapid development and lack of room for new landfills (Abdelnaser Omran et al., 2007). Besides, the outdated system monitoring the wastes in garbage bins is complex, requiring human exertion, time and cost that is incompatible with today's technologies. This increases the risk of open pollution, as it takes a long time to

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collect. While there is no systematic schedule for collecting all kinds of garbage thus the overburdened garbage attracts animals and insects. (Mustafa M.R & Ku Azir K.N.F, 2017). In order to solve this problem, the Smart Garbage Bin System, a new system technology has been designed. This system can also provide a systematic route map for garbage collection due to population growth. However, we're going to make an IoT-based Smart Garbage Bin System and warnings the garbage collectors to the bin's fullness by identifying the trash level based on the bin's depth from anywhere in the world over the Internet. This system will notify the worker via mobile phone to collect garbage bin and at the same time, the ESP8266 NodeMCU is used to act as a Wifi module to update the status of bins through a webpage. The connection between the Global Mobile Communications System (GSM) bins will notify the worker by sending a short message (SMS) when the trash is full.

Smart Garbage Bin System has set up to the public area while GSM was fixed for garbage bin location to control room. Using techniques such as RFID (S. Abdouli, 2009) has successfully indicated that technology is capable of providing the authority with an efficient waste management facility, as well as being a contributing factor in recycling and waste management. Furthermore, worldwide experience has shown that rewarding is the most effective technique to maintain a great level of contribution to recycling activities.

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1.2 Problem Statement

Waste management is a crucial area linked to the economic status of Malaysian and its population's routine. The Malaysian government has spent millions of Ringgits on recycling-related advertising and campaigns through the Ministry of Housing and Local Government. These efforts were aimed at increasing public involvement in recycling schemes but the majority of Malaysians are not involved. The most waste ends up in landfills

and this is aggravated by the fact that most landfills are open dumps in Malaysia. Besides, the recent collection of garbage is inefficient, time is wasted and a huge amount of human energy is needed.

Solid waste management that impacts our society's health and environment has been one of the main concerns with our environment. These produce a polluted condition to a nearby location and release bad smell which can disseminate some fatal disease and human disease. In addition, waste detection, monitoring, and management are one of today's primary challenges. Moreover, the outdated waste monitoring system in waste bins is a complicated process and uses more human effort, time and cost that our current technology can easily avoid.

1.3 Objectives

This project's main goal is to implement a Smart Garbage Bin System with an-IoT that provides an efficient collection of waste management:

1. To develop an "IoT-Based Smart Garbage Bin System with RFID and GSM Module System" with a contactless smartcard as the electronic reward points.
2. To analyze and monitor the level of the waste in the garbage bin through a web page for notifying the cleaner's smartphone to collect full garbage bin.
3. To analyze the sorting time for each type of material in the garbage bin.

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1.4 Scope of Project

The scopes of this project can be described as follows:

1. The waste management system can be organized with smart garbage bin performance in focus area which is hypermarket and public places.
2. Process system of garbage level in a bin can be monitored in real-time by login webpage as safeguard authorized entries and the data stored on cloud storage safely.
3. This system will separate three types of material which are plastic, paper and metal that can be detected by sensors.
4. The data measured and collected by each sensor can analyze using Adafruit IO software after the completed system prototype.
5. The main hardware used to execute and compile all programmed code to controlling the whole system working are microcontroller Arduino Mega 2560 and Arduino UNO. Meanwhile, ESP8266 NodeMCU and GSM Module are used as a communication signal to transfer the data on a webpage and notify the worker when the dustbin has full.

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