

DEVELOPMENT OF WASTE SORTING WITH IOT



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2020



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF WASTE SORTING WITH IOT

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

اونيورسي تيكنيكل مليسيا ملاك by

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

NUR HUSNA BT MOHD HAFIZ

B071710372

960209-14-6384

FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING

TECHNOLOGY

2020

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: DEVELOPMENT OF WASTE SORTING WITH IOT

Sesi Pengajian: 2020

Saya **NUR HUSNA BT MOHD HAFIZ** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. ****Sila tandakan (X)**

- SULIT* Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.
- TERHAD* Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.
- TIDAK TERHAD

Yang benar,

Disahkan oleh penyelia:


.....
NUR HUSNA BT MOHD HAFIZ


.....
TS. GLORIA RAYMOND TANNY

Alamat Tetap:

Cop Rasmi Penyelia

NO, 18 JALAN MERBUK 6/6,
TAMAN BENTARA, 42500,
TELOK PANGLIMA GARANG,
SELANGOR

GLORIA RAYMOND TANNY
Jurutera Pengajar
Jabatan Teknologi Kejuruteraan Elektronik dan Komputer
Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik
Universiti Teknikal Malaysia Melaka

Tarikh: 16/ 01/2021

Tarikh: 19 FEBRUARI 2021

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini

DECLARATION

I hereby, declared this report entitled DEVELOPMENT OF WASTE SORTING WITH IOT is the results of my own research except as cited in references.



Signature:

Author : NUR HUSNA BT MOHD HAFIZ

Date: 16/01/2021



اونيورسيتي تيكنيكل مليسيا ملاك

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

APPROVAL

This report is submitted to the Faculty of Electrical and Electronics Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Electronics Engineering Technology (Telecommunications) with Honours. The member of the supervisory is as follow:

 Signature:
Supervisor : TS. GLORIA RAYMOND TANNY

اونيور سيتي تيكنيكل مليسيا ملاك
UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ABSTRAK

Pada era globalisasi Sains dan Teknologi ini, teknologi merupakan perkara yang sangat penting kerana dapat membantu melakukan apa-apa pekerjaan dengan lebih mudah. Selain itu, teknologi adalah salah satu inovasi terbaik untuk meningkatkan pengurusan sampah berasaskan kitar semula. Jumlah sampah harian di Malaysia meningkat kerana kurangnya pengurusan dan penguatkuasaan sampah oleh kerajaan. Ini telah mewujudkan tempat sampah yang tidak menyenangkan di mana terdapat banyak sampah di tempat pelupusan sampah. Kertas kerja ini membentangkan Pengembangan Pengasingan Sisa dengan IoT (PSI) secara automatik dan sistematik. Perkembangan ini dapat mengasingkan pelbagai jenis sisa kitar semula menggunakan pelbagai jenis sensor. Matlamat perkembangan ini adalah untuk membina prototaip tong kitar semula berdasarkan mikrokontroler dengan menggunakan pelbagai jenis sensor yang dapat mengumpulkan dan mengasingkan pelbagai jenis sampah yang boleh dikitar semula seperti logam, kertas, dan plastik. Di samping itu, dengan secara automatik mengalihkan sampah ke partisi tong tertentu mengikut jenis. Pembinaan prototaip tong kitar semula mengandungi kaedah penginderaan. Sistem pengasingan ini menggunakan Arduino Uno sebagai pengawal mikro untuk mengawal data masuk dan data keluar dari sistem pengasingan sisa ini. Bahagian penderiaan mengesan jenis bahan buangan seperti logam, kertas, dan plastik. Mengesan sisa jenis logam dilakukan dengan menggunakan sensor

‘proximity’. Untuk pengesanan kertas, Light Emitting Diode (LED) dan Light Dependent Resistor (LDR) sensor telah digunakan. Sisa berasaskan plastik dikesan juga menggunakan sensor yang sama dengan sensor kertas yang merupakan Light Dependent Resistor (LDR). Pembezaan antara plastik dan kertas merujuk kepada nilai monitor bersiri yang telah ditetapkan pada pengekodan. Sensor Modul Inframerah digunakan untuk mengesan jika ada sisa yang telah dimasukkan ke dalam tong sampah. Pemerhatian telah dibuat untuk sistem pengasingan sampah ini dan sistem biasa. Ini menunjukkan bahawa pengurusan pengasingan sampah lebih senang dan praktikal berbanding sistem biasa. Hasil kerja ini menunjukkan bahawa prototaip tong sampah dapat menyusun sampah dengan jayanya dan sangat berpotensi untuk digunakan pada masa akan datang.



ABSTRACT

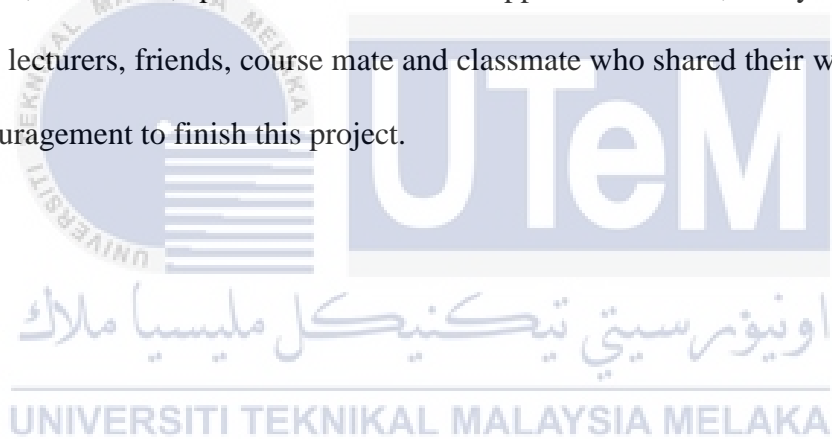
In this era of Science and Technology globalization, technology is really important because it can help us to do any kind of work much easier. Besides that, technology is one of the best innovations to improve the management of recycle-based waste. Amount of waste day by day in Malaysia has increase because of lack of waste control and enforcement by the government. This has created an uncomfortable garbage scene where there is a lots of waste at the rubbish disposal site. This paper provides the automated and systematic Development of Waste Sorting with IoT (WSI). This development is able to sort different types of recycled waste using different types of sensors. The purpose of this work is to build a recycling container prototype based on a microcontroller by the use of two type of sensors that could gather various varieties of recyclable waste including metal, paper, and plastic. In addition, it automatically redirects waste to precise bin partitions by type. The construction of a recycling bin prototype contains methods of sensing. This sorting system used an Arduino Uno as a microcontroller to control input and the output of this waste sorting system. The sensing part detects type of waste including metal, paper, and plastic. Detecting metal type waste is done using a proximity sensor. As for paper detector, a Light Emitting Diode (LED) and a Light Dependent Resistor (LDR) sensor are used. The plastic-based waste is detected also using the same sensor that as the paper sensor which is Light Dependent Resistor (LDR). The

differentiation between the plastic and paper is referred to the value of serial monitor that has been set in the coding. The Infrared Sensor Module is used to detect if there are any presence of waste in the dustbin. Observation have been made for this waste sorting system and normal system. This waste sorting system shows that it is more convenient and practical compared to normal system. The results of this work show that this waste sorting system prototype is able to isolate the waste successfully and it is highly potential to be used in the future.



DEDICATION

Firstly, I dedicated this project to Allah the Almighty God, thank you for the guidance, strength, power of mind, protection and skills and for giving me a healthy life. This project is wholeheartedly dedicated to my beloved parents, who have been my source of inspiration and gave me strength when I thought of giving up, who continually provide their moral, emotional, spiritual and financial support. In addition, to my brothers, sister, relatives, lecturers, friends, course mate and classmate who shared their words of advice and encouragement to finish this project.



ACKNOWLEDGEMENTS

First and foremost, thanks to Allah S.W.T., Most Gracious and Most Merciful for blessing me with a great health. Finally, I had completed my project paper to be submitted. As for this occasion, I would like to dedicate my thanks, appreciation and gratitude to those who are involved, guided and supported me in completing my project especially to my supervisor TS Gloria Raymond Tanny for her guidance and advices throughout the course in preparing the project paper, also to ensure that this project is being carried out in the most objective manner. Without her advices and encouragement, this report may not be submitted. Last but not least, my special gratitude goes to my parents and family who had given me their fullest support and encouragement as well as delivering valuable advice and guidance in completing this meaningful project

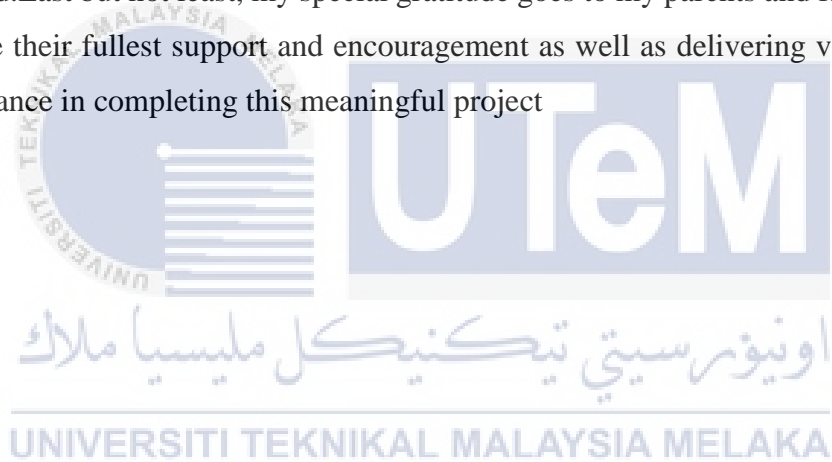


TABLE OF CONTENTS

	PAGE
TABLE OF CONTENTS	xi
LIST OF TABLES	xv
LIST OF FIGURES	xvii
CHAPTER 1 INTRODUCTION	1
1.1 Background	1
1.2 Problem Statement	2
1.3 Objectives	2
1.4 Scope of Project	2
CHAPTER 2 LITERATURE REVIEW	4
2.1 Introduction	4
2.2 Development from previous project	4
2.2.1 Development of Automatic Smart Waste Sorter Machine	4
2.2.2 Sample of a Very Long Heading Level 3	5
2.2.3 Automatic Waste Sorting Using Shortwave Infrared Hyperspectral Imaging System	7
2.2.4 A discrimination model in waste plastics sorting using NIR	

hyperspectral Imaging System	8
2.2.5 Sorting and Miniaturization of Household Waste	8
2.2.6 Intelligent Solid Waste Processing Using Optical Sensor Based Sorting Technology	9
2.3 Review of Project's Hardware and Software	11
2.3.1 Review on Internet of Things (IoT): Making the World Smart	11
2.3.2 Internet of Things (IoT): A review of enabling technologies, challenges and open research issues	11
2.3.3 A study on Internet of Thing (IoT) Technology in Upgrading Traditional Industries	12
2.3.4 Working Operation and Typea of Arduino Microcontroller	12
2.3.5 Choosing an Arduino for Beginners	14
2.3.6 Arduino in RC -Home Automatic using LDR and IR Sensor	14
2.3.7 Super Sensitive Intruder Alarm	15
2.4 Journal Comparison	15
CHAPTER 3 METHODOLOGY	19
3.1 Introduction	19
3.2 Project Implementation	19
3.3 Development of Project	21
3.3.1 Software Flowchart Development	21
3.3.2 Hardware Flowchart Development	22

3.4	Schematic Diagram	24
3.4.1	Circuit Design	24
3.5	Expected Result	26
CHAPTER 4	RESULTS AND DISCUSSION	28
4.1	Introduction	28
4.2	Simulation circuit	28
4.2.1	Proteus Software	28
4.2.2	Verification type of metal waste material	29
4.2.3	Verification type of paper waste material	31
4.2.4	Verification type of plastic waste material	33
4.3	Hardware Implementation	35
4.3.1	Wifi Coding by using Arduino IDE software	35
4.3.2	Waste Sorting Coding by using Arduino IDE software	37
4.3.2.1	Metal Coding	37
4.3.2.2	Paper Coding	38
4.3.2.3	Plastic Coding	39
4.3.3	Hardware Circuit	40
4.3.4	Blynk Application	42
4.3.5	Prototype	43
4.4	Analysis	45

CHAPTER 5	CONCLUSION AND RECOMMENDATION	49
5.1	Introduction	49
5.2	Conclusion	49
5.3	Future Recommendation	50
REFERENCES		51



LIST OF TABLES

TABLE	TITLE	PAGE
Table 2.1:	Comparison of Journal	16
Table 4.1:	Percentage of Sorting Material	44



LIST OF FIGURES

FIGURE	TITLE	PAGE
Figure 2.1:	Block diagram that has been used in the system	5
Figure 2.2:	Schematic diagram of prototype	7
Figure 2.3:	Hyperspectral imaging system	8
Figure 2.4:	The material that being used in this experiment	8
Figure 2.5:	3D visual sensor installation	10
Figure 2.6:	Geometry Triangulation	11
Figure 2.7:	Component of Arduino Mega	13
Figure 2.8:	Component of Arduino Uno	14
Figure 3.1:	Flowchart of the project development implementation	20
Figure 3.2:	Development software flowchart of this project	21
Figure 3.3:	Development hardware flowchart of this project	22
Figure 3.4:	Circuit design of the project before the presence of waste	24
Figure 3.5:	Circuit design of the circuit design of the project if there any presence of waste	25
Figure 4.1:	Design of circuit is constructed by using Protues software	29
Figure 4.2:	Simulation of complete detection of metal material	30
Figure 4.3:	Output data of metal waste material has been detected	30
Figure 4.4:	Amount output data of metal waste that has been detected	31

Figure 4.5:	Simulation of complete detection of paper material	32
Figure 4.6:	Output data of paper waste material has been detected	32
Figure 4.7:	Amount output data of paper waste that has been detected	32
Figure 4.8:	Simulation of complete detection of plastic	33
Figure 4.9:	Output data of plastic waste material has been detected	34
Figure 4.10:	Amount output data of plastic waste that has been detected	34
Figure 4.11:	Wifi coding of the project	35
Figure 4.12:	Waste Sorting coding of the project	36
Figure 4.13:	Coding of metal detection	37
Figure 4.14:	Coding of paper detection	38
Figure 4.15:	Coding of plastic detection	38
Figure 4.16:	Circuit of the project	39
Figure 4.17:	Paper servo motor will rotate from 90° to 180°	40
Figure 4.18:	Paper servo motor will rotate from 90° to 180°	40
Figure 4.19:	Output display from Blynk application	41
Figure 4.20:	Prototype of this project	43
Figure 4.21:	Coding of plastic detection	45
Figure 4.22:	Troubleshooting coding of plastic detection	46
Figure 4.23:	The output display from Blynk application	46

CHAPTER 1

INTRODUCTION

1.1 Background

Nowadays, throwing rubbish carelessly is very common among our society. In most parts of Malaysia throwing trash in the apartment and filling a full bin and overflowing is a sad thing. In year 2014, the announcement of new rule in implementation of waste management has been announced in Malaysia. It required Malaysian households to separate the rubbish in different type before collection or dumping. In July 2015, the announcement of the implementation of separation of household solid wastes came into effect on September 1, 2015. It begins with Putrajaya, Johor, Kuala Lumpur, Pahang, Melaka, Sembilan Negeri, Kedah and Perlis (Datuk Abdul Rahman Dahlan, 2014).

Recycling is a method in which waste material is turned into new goods that can be reused and which. As Malaysian, by observing that I had been made, the recycling awareness still low among the Malaysian. In Malaysia, the system of recycling already have with three separate bins. The bins was created with different colours represent different materials. As is known, cans is in yellow bin, papers is in blue bin and plastics is in red bin. Apparently, people have to make the decision to dump their trash. Of course there will be people who have a sense of inadequacy by just throwing trash at their own will.

In addition, the purpose of Development of Waste Sorting with IoT (WSI) is to sort wastes separately based on the different materials of the waste. Waste, on the other

hand, has value and only needs to be properly sorted. Waste sorting can be done manually in residential areas or in residential gardens or automatically separated in materials recovery facilities. Therefore, there is a need in developing a system with sensors that can sort wastes depending on the types of waste's material automatically.

1.2 Problem Statement

With the increase in population and economy, there will be a significant amount of waste disposal. This will cause problems for waste management facilities, where there is already a short supply problem which leads to increased complexity of waste streams due to urbanisation and industrialisation. The rubbish complexity flow directly affects the management of all waste mixed with general waste.

In Malaysia, the waste management system is still poor because of the lack of technology in terms of sorting waste. There is an infrastructure presence that can enable separate residues at source and redirections of waste fluxes to recover materials.

1.3 Objectives

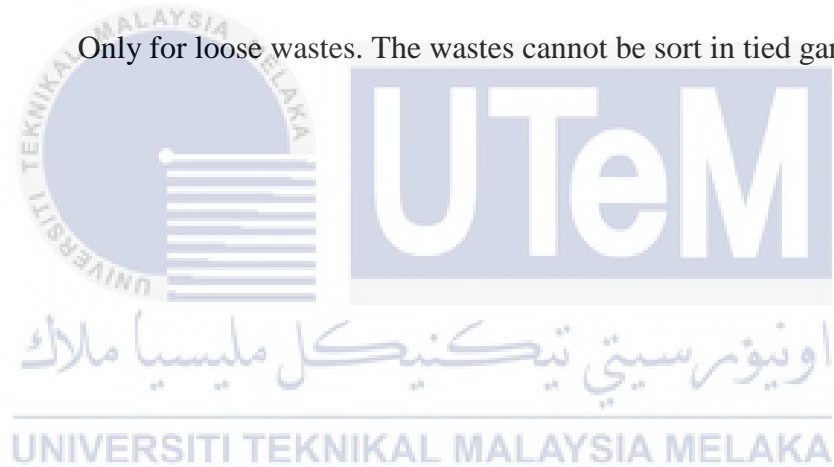
The main aim of this research is to propose a systematic and effective methodology for Development Waste Sorting with IoT. The objectives of the project are:

- a) To develop a waste sorting system using IoT
- b) To sort waste of three different material waste by using two type of sensors which are proximity for metal material and LDR sensor for paper and plastic material.
- c) To make the management of waste disposal easier and faster.

1.4 Scope of Project

Scope of project is used to describe the most significant outcomes of a project. These include the specification of the hardware and software, and the limitations. Apart from that, it also sets out the constraints of a specific project and makes clear which deliverables are within and outside the scope. This project has several scope, which are:

- This project is to use sensors as a main device to sort waste including metal, plastic and paper.
- This sorting system use an Arduino as a microcontroller.
- Usage of Blynk platform as this project's database.
- Only for loose wastes. The wastes cannot be sort in tied garbage plastic.



CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This literature review is a summary of the research that were related to the development of Waste Sorting with IoT. Majority of the related information is comes from the appropriate journal, article and website. In this chapter, a background and how to set up the waste sorting will be covered. The literature review accesses project-related terms more in depth and detailed to better illustrate the concept.

2.2 Development from the previous project

This section addresses the previous work performed on this device using various research methodologies and techniques. However, there are some limitation on proposed techniques such as poor classification accuracies, created for personal use and unsorted municipal waste.

2.2.1 Development of Automatic Smart Waste Sorter Machine

Mahmudul et al. (2013) proposed an automatic sorter machine. The machine enable to sort out the wastes in different type of materials to create the efficient and systematic waste management. This system is being tested in Bangladesh. The comparative waste generation corresponding data has been generated from year 2006 – 2019. The data was taken from CEWEP and EES portal. Light Dependent Resister (LDR), Infrared (IR) transmitter and receiver, LASER ,Metal Sensor, glass sensor, a Liquid

Crystal Display and weight sensor system, all of these component had been used in this system. Hence it can be used in houses, industries and offices .At the first process, the IR sensor will detect some sort of material on the system tray. This process is to make the system activated. Moreover, the function of the weight sensor is to activates and find out the weight of the trash. After that, glass and metal sensor will detect the wastes. The metal waste will be sort in bin three through a servo motor when the detection of metal is done. The detection of glass is done by using the glass sensor and it will sort the waste in bin four. However, if both sensors fail to detect metal or glass, the LASER and LDR will be activated. Bin 2 will be filled when wastes can pass through the LASER. As for paper detection, if the wastes failed to pass through LASER, the wastes will sort into Bin 1.

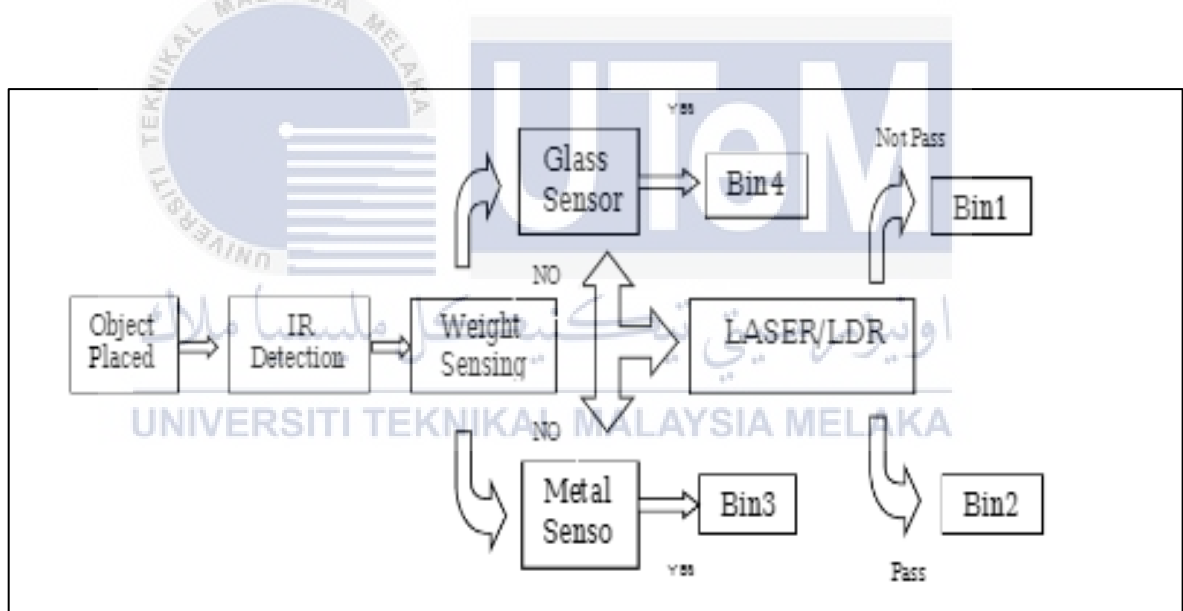


Figure 2.1 shows the block diagram that has been used in the system.