Faculty of Electrical and Electronic Engineering Technology

Development of Material Disposal Machine Using Microcontroller

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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Bachelor of Electronics Engineering Technology with Honours

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Development of Material Disposal Machine Using Microcontroller

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A project report submitted
in partial fulfillment of the requirements for the degree of
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Faculty of Electrical and Electronic Engineering Technology

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2023

DECLARATION

I declare that this project report entitled "Development Of Material Disposal Machine Using Microcontroller" is the result of my own research except as cited in the references. The project report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Student Name : NAATHINI VIJAYAN

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APPROVAL

I approve that this Bachelor Degree Project 2 (PSM2) report entitled "Development Of Material Disposal Machine Using Microcontroller" is sufficient for submission.

Signature : .....

Supervisor Name : DR FARID ARAFAT BIN AZIDIN

Date : 26/01/2023

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APPROVAL

I hereby declare that I have checked this project report and in my opinion, this project report is adequate in terms of scope and quality for the award of the degree of Bachelor of Electronics Engineering Technology (Industrial Electronics) with Honours.

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Date : 26/01/2023

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DEDICATION

This research is dedicated to my parents, Vijayan A/L Ramasamy and Ramathilagam, who have always encouraged me. They have given me the discipline and motivation I need to approach a task with eagerness and dedication. Without their love and support, this project would not have been possible.

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ABSTRACT

In this globalization era, according to statistics issued by the National Solid Waste Management Department (JSPN) in 2021 31.52, million were spent on disposing of waste in Malaysia. Disposal for garbage removal by 31.52 per cent in 2022 compared to 2021. This phenomenon is due to lack of public awareness of recycling. With a growing volume of waste produced and limited landfill space for waste disposal, recycling is one of the most important waste management techniques. However, the current manual recycling practice, which requires users to bring waste in quantity to a recycling center, may be uncomfortable and thus discourage users from recycling. To address this issue, in this project a material disposal machine with a reward feature is proposed that derived from a reverse vending machine (RVM) concept. The machine is equipped with an Arduino microcontroller and a collection of sensors to aid in the assembly process. The sensors that detect user input, weigh the scale, and then convert the weight to the relevant points automatically transfer the weight to the appropriate points throughout the process. The user then can exchange their points for cash at a local retailer after completing the process. The prototype is projected to help Malaysians become more motivated to recycle their waste, and it could be one of the frameworks for overcoming urban poverty by utilizing the waste to wealth concept.

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ABSTRAK

Dalam era globalisasi ini, mengikut statistik yang dikeluarkan oleh Jabatan Pengurusan Sisa Pepejal Negara (JSPN) pada 2021 sebanyak 31.52, juta dibelanjakan untuk melupuskan sisa di Malaysia. Pelupusan untuk pembuangan sampah sebanyak 31.52 peratus pada 2021 berbanding 2020. Fenomena ini disebabkan kurangnya kesedaran orang ramai tentang kitar semula. Dengan peningkatan jumlah sampah yang dihasilkan dan ruang tapak pelupusan yang terhad untuk pelupusan sisa, kitar semula adalah salah satu teknik pengurusan sisa yang paling penting dalam amalan kitar semula manual semasa, di mana pengguna mesti membawa sisa secara pukal ke pusat kitar semula, mungkin menyusahkan dan dengan itu tidak menggalakkan pengguna daripada kitar semula. Untuk menangani isu ini, dalam projek ini mesin pelupusan bahan dengan ciri ganjaran dicadangkan yang berasal daripada konsep mesin layan diri terbalik (RVM). Mesin ini dilengkapi dengan mikropengawal Arduino dan koleksi penderia untuk membantu dalam proses pemasangan. Penderia yang mengesan input pengguna, menimbang skala dan kemudian menukar berat kepada titik yang berkaitan secara automatik memindahkan berat ke titik yang sesuai sepanjang proses. Pengguna kemudiannya boleh menukar mata mereka dengan wang tunai di peruncit tempatan selepas menyelesaikan proses tersebut. Prototaip itu dijangka membantu rakyat Malaysia menjadi lebih bermotivasi untuk mengitar semula sisa mereka, dan ia boleh menjadi salah satu rangka kerja untuk mengatasi kemiskinan bandar dengan menggunakan konsep sisa kepada kekayaan.

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA

TABLE OF CONTENTS

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF TABLES

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF FIGURES

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF SYMBOLS

Symbol	Title
%	Percentage
µ	Micro

UTeM
اونيۏرسيتي تيکنيکل مليسيا ملاک
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LIST OF ABBREVIATIONS

mm	-	Milimetre
cm	-	Centimetre
V	-	Voltage
A	-	Ampere

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

LIST OF APPENDICES

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

CHAPTER 1

INTRODUCTION

1.1 Background

Recycling is one of the most important waste management techniques. It is the collection and processing of waste materials in order to make new products. The recycling effort began in 1993, but it has not met its objectives due to a lack of community involvement and sincerity in programmed implementation. When compared to other countries, Malaysia now has a recycling rate of only 10%. Currently, consumers must sort and collect recyclable material in bulk at home. One of the barriers to recycling that Malaysians face is the difficult procedure. Nonetheless, as evidenced by their misuse of available facilities,citizens understanding of garbage recycling is low.

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Malaysians are far from contributing to the country's effective solid waste management system. Due to the lack of landfill space and air pollution, especially waste, recycling is a key issue to be solved in waste management. By 2021, the Department of Housing and Local Government hopes to have a recycling rate of 22%. One possible method to ensure desired goals are achieved is to implement material handling machines, which is a concept where users are rewarded for properly recycling their items.

Material Disposal Machine is a new concept that has been developed to aid in the effective collection of recycling materials, thereby improving recycling activities and waste management and also Material Disposal Machine is typically used to encourage people to dispose of waste properly, particularly recyclable items such as plastic and aluminum. From this machine both users and waste management authorities will benefit.

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1.2 Problem Statement

This machine was created to overcome some problems related to the environment. There are a number of issues. Recycle a variety of materials. Mixed materials are challenging to recycle because they must be separated before they can be processed and reused. Mixed materials, such as water bottles with different types of polymers for the body and cap, one of which is recyclable examples of mixed materials that consumers may not realize. They generate problems when disposed of jointly because existing recycling methods can't separate them without costly human involvement. Even if the distinction is clear, some consumers may find the extra step of separation to be a deterrent to recycling, with many simply tossing the entire product into the recycling bin.

The environment is also dirty, which can lead to serious diseases. It is estimated that 8 million tons of plastic are dumped into the ocean each year, damaging aquatic ecosystems and killing aquatic animals.Long term use of plastic, as well as exposure to high temperatures, can leach harmful chemicals into food, drink and water. Improper handling of ground plastic, as well as outdoor burning, can lead to the release of harmful chemicals into the air, posing a health hazard. Because less than 20% of waste is recycled each year, and large volumes are still disposed of in landfills, the number of waste materials will increase. Hazardous open dump sites are also widely used to dispose of waste, especially in underdeveloped countries. Richer countries produce more trash than poorer countries, but they also have stronger waste management systems to address these challenges.

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1.3 Project Objective

The objectives of this project:

a) To design a prototype material disposal machine with a recycling concept and a reward feature.

b) To design a prototype material disposal machine with weighing scale of recycling material.

c) To implement a user display system of material disposal machine at LCD

1.4 Scope of Project

To avoid the uncertainty of this project due to some limitations and limitations, the scope of the project is defined as:

a) Using Arduino Uno microcontroller as a brain to control the components and sensor in this project.

b) Arduino calculates the HX711 output, converts it to weight values in grammes, and displays it on the LCD.

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c) Inductive proximity sensors detect the presence of metal objects without contact

d) The ky-032 IR sensor detects the presence of plastic objects without any physical contact.

e) This material disposal machine is intended for localised and small-scale applications, such as residential college.

1.5 Expected Outcomes

The expected outcome of this project is:

a) Keep garbage and litter out of landfills, streets, and oceans.

b) Make recycling collection more efficient and cleaner.

c) Reduce the time and mess caused by employees manually handling and counting containers.

d) Engage recyclers in helping to shape a better environment.

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Previous research and analysis on material disposal machines will be conducted in this chapter and compiled for this project's literature review. This chapter provides a review of some of the sources, including papers, previous journals, and websites. This project contains references. All sources have been cited.

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2.2 Theory

Life is getting faster and more automated all the time these days. As a result, new technologies and more advanced devices are being developed. Unfortunately, natural and raw materials have been used to create new technologies, making our lives easier. As a result, one technology, Material Disposal Machine, has been introduced to save our environment. By rewarding users with money, this uses the reverse operating system of a classical vending machine. Recyclable items that can be reverse recycled include cans and bottle.

2.3 Literature Review

In the section, several methods for analyzing the material disposal machine will be discussed. Accordingly, the authors (Kamalanathan.P 2019) in [4], proposed using Mechatronics principles to deliver paper to the public via sensors and microcontrollers for mass production, it will be more affordable and cost-effective, and it will be extremely beneficial to college and high school students. It is designed to deliver sheets by inserting the correct coin into the system. It will save us time and take the place of manual labor. Reduce time waste and unnecessary crowding in stationery stores, particularly during exam season, and offer a solution for faster paper delivery via coin-based dispatch.

Moreover, the author (Bebetto Sabu2018) in [5], A device that accepts pet plastic bottles and rewards users with snacks after crushing the bottles into small particles has been proposed. The output of the E-eco Bin can be used for recycling, road construction, and other purposes. The aim is to determine whether or not the input item is a desired plastic pet bottle. Industrial laser and detection system sensors are used. The microcontroller activates the crusher motor for 3 seconds after the item is inserted, and the output granules are deposited in the collector. Simultaneously, the controller activates the vending system, and the user receives a candy. The amount of crushed plastic in the collector will be tracked by the monitoring system. The advertisements of the benefactors will be displayed on the advertisement display.

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In addition, the authors (K.R. Nimisha2020) in [7], proposed to deliver newspapers to the public through improved user interfaces and microcontrollers based on Mechatronics principles It will be less expensive and more economical, and it will be extremely beneficial to college and high school students. It is intended to deliver the newspaper by scanning the respective RFID tag provided by the agent. It will save us time and eliminate the need for manual labor. Nevertheless, provides a solution for coin usage and faster paper delivery with improved payment and to address today's issues, digitized payments are being used to improve the user interface. This because to reduce time waste and unnecessary crowding in stores, particularly early in the morning.

Furthermore, the authors (Maofic Farhan Karin 2018) in [8], proposed to create an SBRM at a lower cost of production This project was developed with Verilog HDL and the Altera DE2-115 board. This prototype allows users to earn reward points while recycling plastic bottles. This was chosen because implementations of technology microcontrollers are often significantly faster than hardware-based FPGA implementations. When it comes to developing dependable and real-time applications, FPGAs exceed microcontrollers because they can run concurrent parallel processes quickly, whereas the latter can only do so to a limited extent. It is because the product is both eco sustainable and inexpensive.

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Thereafter the authors, (Sumaganday 2021) in [9], proposed in Image processing was used in this study to ensure that the input PET bottles were recyclable. To find its images, the YOLOv3 framework algorithm is used. This algorithm has the advantage of being both fast and accurate. Which used the camera to take the picture to detect the image. The data will then be sent to the Raspberry Pi to classify the input bottles. If the input bottle meets the requirement, the signal will be sent to the DC motor, which will activate the PET bottle base. The corresponding bottle type as well as the PET bottle equivalent time will be displayed on the LCD screen. The investigation went perfectly. This is attributed to it having an accuracy rate of 90 and an error rate of 10%. The machine has a latency of 10,966 seconds. Therefore, a reverse vending machine is one of the recycling options.

Just as important, the authors (Dumpayan, Matthew Lawrence (2018)) in [10], proposed Encourage proper solid waste management at Colegio de San Juan de Letran. The system's heart is a microcontroller, that also regulate the various input sensors, keypad, output display, and motors devices that are connected to it. The machine acknowledges plastic bottles and gets converted them into points that can be used to purchase products. The machine identified RFID accounts accurately, differed between plastic and non-plastic bottles, stored or updated account points, and dispensing products. The machine could operate on either commercial or solar energy. In the event of a commercial power outage, the solar array and battery not only provide renewable energy, but also backup power. This is due to the Colegio's acceptance of the Reverse- Vending Machine concept.

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Next, the authors (Aditya Gaur 2019) in [11], the proposed the system will allow for point accumulation throughout the recycling process. The reward coins and plastic weight increase with each system input. The material is rejected and the system is reset when a user enters an invalid item or item type into the system. The system will be efficient and cost effective in its implementation of the system of the recycle machine's configurable hardware-based detection system, which use a capacitive proximity sensor, an infrared photoelectric sensor, and a strain gauge weight sensor, which are all widely available and inexpensive. The proposed future scope of the reverse vending machine is to implement this same entire system on hardware.

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Table 2.1: Literature Review Comparison

TITLE	TECHNIQUES / COMPONENTS USED	ADVANTAGES	DISADVANTAGES
Automatic papervending machine	PIC16F877A Microcontroller Transformer DC Motor Transmission drives Coin sensor LCD (16x2) display	Paper delivery isfaster with coin-based delivery. Reduces time waste and unnecessary crowding in stationery stores, especially duringexam season. Improves paper counting accuracy, allowing the customer to receive exactly the number of papers requested.	Fake currency coins inside thecurrency collector were unavoidable. Inserting fake coins of the same density and size allowsaccess to the papers.
Plastic Recycling Vending Machine	Microcontroller as a sensor The prototype weighs 110kg and can withstand loads of up to 400kg. Crushing system Monitoring system Advertisement Display	A device that accepts plastic pet bottles and gives the user desserts in exchange. The bottle that has been insertedwill be ground into small granules.	Metal and glass cannot beinserted. Machines is that they have relatively high initial purchaseor leasing costs.

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Development of an Automated Reverse Vending Aluminum CansCrusher	PIC16F877A Microcontroller Limit Switch Optical Sensor Photo-reflective Sensor	Recognize whether the material inserted is aluminum or not a machine forcrushing aluminum cans A machine that distributes money	The parameterthat cannot accept heavierweight could make it more appealing to customers. It could not accept other recyclable materials, suchas PET bottles,to make it more efficient, as the beverageindustry currently uses PET bottle material.
Smart Newspaper Vending Machine	Microcontroller (MSP430G25) RFID Reader Ultrasonic sensor LCD (16x2)display	Reduce the workforce Automate the newspaper distribution process Enhance the user interface	There is no vending machine that delivers newspapers via digital transaction.
Implementation of a bottle recycling machine using FPGA	FPGA (DE2-115) HCSR04 ultrasonic sensor LCD (16x2) display	Lower production costs FPGAs outperform microcontrollers in terms of efficiency Calculated user reward points, respectively	Increased energy consumption is not the sensor system's detection accuracy. There is no sorting system for different materials.

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Vending machine withpower output for mobile devices usingVision	Raspberry Pi 4B RFID reader Camera L298N 7-inch LCD touchscreen display	It is well-known for its rapidity while maintaining high accuracy. The camera will detect the exact or approximate size of each PETbottle. RFID users savetheir credit for future use.	The raspberry pi 4b only has 4GB of RAM,which contributes to slow data processing and increased timelag.
Two-way Powered Microcontroller-based Plastic Bottles 'Drop- and-Tap' Reverse Vending Machine with Stored Value System Using Radio Frequency Identification (RFID) Scanner Technology	MCU Arduino RFID reader Capacitive sensor Photoelectricsensor LCD display(16x2)	The machine could run on either commercialor solar power. Input sensing andpoint addition have perfect accuracy. The RFID cardrecognition mechanism is precise and dependable.	There are no consultant inputs on themachine's business viability. It is not more marketable to large end-userssuch as LGUs in the provinces.
A Simple Approach to Design Reverse Vending Machine	Weight Sensor Capacitive Proximity Sensors Infrared Photoelectric sensor to detect fraud Register Transfer Level	Coin denominations determined by theweight of the item received by Machine Implementation is low-cost.	Sensor system detection accuracy has been improved. Sorting system for various materials Redeeming reward points reduce energy consumption

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2.4 Malaysia's Waste Generation

Malaysia's population is rapidly growing, and the yearly waste generation is shown in Table 2.2. Malaysia generates over 32,939 tonnes of waste per day, according to 2016. However, as shown in Fig 2.3, this amount is expected to rise to nearly 41,035 tonnes by 2026. The linear trend line was plotted with a confidence interval of 99.8%, indicating the strength of the values.

Table 2.2: Day waste generation from Malaysia

Year	Tonnes
2002	21,452
2024	23,073
2006	24,969
2008	26,489
2009	27,284
2012	29,712
2014	31,325
2016	32,939
2018	34,552
2020	36,138
2022	37,770
2024	39,403
2026	41,035

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Figure 2. 3: Malaysia Waste Material

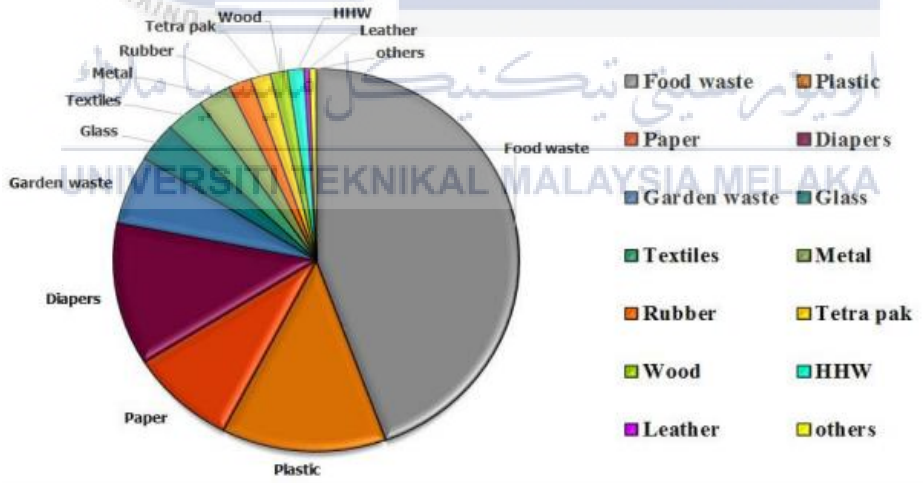

Figure 2.4: Compositions of Malaysian Household Waste

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Malaysia's population is expected to exceed 32.4 million in 2018. Annual population growth is fast, at 1.1% per year. Food waste dominates the Malaysia composition (44.5%), followed by plastic (13.2%), paper (8.5%), diapers (12.1%), garden waste (5.8%), glass (3.3%), textiles (3.1%), metal (2.7%), rubber (1.8%), tetra pak (1.6%), wood+peel/husk (1.4%), Household Hazardous waste (1.3%), leather (0.4%), and others (0.5%).

Malaysia's population has grown by more than 91% since 2011,to population growth, economic growth, and increased business activity. The environment and human health suffer when waste management or waste treatment are not planned for. Malaysia, unfortunately, is not in sync with effective and systematic solid waste management. The new era of waste management is enacting policies that are more adaptable and appropriate, known as the 3Rs (reduce, reuse, recycle). Malaysia suffers from a lack of recycling awareness and stakeholder participation. Malaysians practised solid waste management by collecting all garbage and plastic bags and depositing them in bins. Finally, waste management will collect waste and transport it to a landfill or incinerator.

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Landfills must monitor groundwater contamination, leachate, buried solid waste seepage, and methane gas. Landfills are becoming scarce due to rising land values. Reducing the amount of garbage dumped directly into municipal landfills is an effective improvement. The condition of the garbage is wet and mixed.

2.5 Plastic Waste

One of the world's most pressing human health and environmental issues is plastic waste. Plastic is the world's third-largest source of waste, with total plastic waste rising in full agreement with global population rate growing economy. [12] Plastic packing materials are strong, lightweight, easily processed, high in energy efficiency, and chemically inert. They are unaffected once disposed of and thus are not environmentally friendly. Plastic (Polymers) has received the most public and media attention of any component of the solid waste stream.

The risk of dumping plastic waste, known as "white pollution," has grown more severe (Shah, 2007). Plastic waste is generated during the manufacturing process as well as prior to consumption; plastic waste is disposed of via land filling, incineration, and recycling. Plastic waste, both in quantity and quality, pollutes the environment. Depending on how it is made, Biodegradable plastic can have an impact. Plastic waste is one of the world's most pressing human health and environmental issues. [13]

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The current state of plastic waste production and management in Malaysia is described in this review, which includes landfill, recycling, and incineration options. It identifies key constraints to the success of key policy initiatives for plastic waste management (including plastic alternatives such as biodegradable plastics). Significant internal constraints result from inconsistent policy implementation by state governments, as well as a lack of public awareness and interest in household recycling. [14].

2.6 Cans waste

Cans significantly contribute to society's aluminum waste. Cans are most usually used to store packaged foods and beverages. Cans differ in the types of waste in that they can be completely reprocessed. Furthermore, the energy required to produce new cans from recycled cans is only 5% that required to produce cans from virgin raw materials. In practise, each recycled box can save the same amount of energy.

Recycling is a waste management concept that refers to using unwanted waste as an input into the same process. The terms recycling and reclaiming are sometimes used interchangeably.It is the "processing of damaged, reject, and unwanted outputs into desired output," according to Sushil. Post-consumer waste frequently contains reclaimed materials such as paper, metal, glass, cans, and plastic.

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Large amounts of industrial waste can be recycled, but it is much more expensive than recycling other materials such as steel and glass. PET polymer cuffs that have not been dispersed/disbanded in a boiler, necessitating the challenging 50 process. Recycling small quantities of PET appears to be inefficient. Despite the fact that PET recycling requires only a few hand tools. It is not recommended to mix. Because it reduces production quality, PET should not be mixed with other types of plastics. [19].

2.7 Why Malaysia needs waste recycling?

Productive Malaysia's recycling strategy includes efforts to reduce both air and water pollution, because recycling reduces both the amount of air pollution produced by power plants and the extent of water pollution caused by chemical use in the manufacturing process. The equivalent of 14 million trees recycled reduces air pollution by 165,142 metric tonnes. By preserving trees and water, Malaysia's recycling strategy contributes to the conservation of valuable natural resources.

Malaysia recycles while also employing people. Recycling is a more cost-effective waste management method for cities than landfills or incinerators because it creates more jobs. If everyone has a small landfill in their backyard, there will be little space left in Malaysia's urban areas and capital as landfills expand. Additionally, it reduces the amount of solid waste disposed of in landfills. Because waste has a significant negative impact on nature and the environment, recycling is critical.

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Malaysia's recycling plans contribute to a reduction of greenhouse gases and chemicals released from landfills. It has the potential to reduce land clearing, which is currently occurring in order to prepare for more landfill sites. When materials are manufactured from raw materials, precious energy is also saved. At a time when all Malaysian land sites are expected to be full by 2020, it is critical that alternative Malaysia recycle strategies be investigated in order to develop sustainable waste management practises for Malaysia recycle that contribute to an overall developed country in terms of economy and environmental conservation.

2.8 Recycling in Malaysia

Recycling in Malaysia means recycling to save energy. Because of rising energy demand and the need to conserve energy in an era of volatile energy markets, recycling is an important option for Malaysia. Malaysia recycle plans provide significant environmental benefits because producing new products from recycled materials requires less energy than producing new products from new materials.

For example, recycled aluminum uses 96% less energy during the can manufacturing process than unused aluminum from aluminum. PET bottles use 76% less energy, paper use 45% less, and glass use 21% less, but Malaysia is effectively recycling. Every year, Malaysia recycles enough energy to power nearly one million Malaysian homes, reducing water pollution by more than 21,000 tons. Malaysia emits about 12,000 pounds of CO2 annually through household energy use, personal transportation, and energy used in a variety of products and services.

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2.9 The significance and Value of R

Plastics, papers, glasses, foods, electronics, and other materials contribute to more "WASTE" in today's world. In the main text, these wastes were discussed separately, as well as their expected increase, which will harm the environment. Each waste has a different financial value. These wastes have had serious implications for our natural environment and have the potential to completely devastate the ecosystem. These issues can be controlled and repressed using the four Rs outlined in below. They constantly reduce, recover, recycle, and reuse materials/components/items/parts. It is not only economically beneficial, but also good for the environment.

Figure2. 5 : The Process of Converting Waste into New Product (Source:(Luma A. H. Al- Kindi and Zainab Al-Baldaw 2021)

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2.9.1 Reducing

By recovering, reusing, and recycling materials/items/components, we will reduce our use of natural resources such as water, oil, energy, fuel, metals, and gas. Significantly, the most effective way to reduce environmental negativity is to improve product design for waste prevention. Using fewer new resources and reusing recovered items has numerous advantages. To begin with, it aids in the avoidance of virgin products and the preservation of natural resources. Furthermore, it enables the use of reclaimed components or parts. Third, it lowers procurement costs by removing the need for new resources. Fourth, and most importantly, it helps to reduce pollution and waste. Finally, by focusing on the environment, economy, and society, it contributes to a more sustainable future (Pandey, et. al., 2018).

2.9.2 Recycling

Recycling is the process of reusing old and used materials/components/items/parts for a new or similar use. In other words, recycling means "creating products that can be reprocessed and converted into raw material for use in another or the same product." Recyclable materials/components/items/parts include plastics, papers, glasses, electronics, batteries, textiles, and other waste. It is possible to reduce the use of virgin products by using recycled components. The recovered items save money while also benefiting the ronment by reducing pollution.

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2.9.3 Reusing

Discussed how the recover, reduce, recycle, and reuse concept can aid in environmental preservation, cost savings, and meeting social needs based on the literature reviewed above. Designing products that can be recovered, recycled, and reused is critical. For example, using recycled paper can save up to 4,100 kWh of electricity, 17 trees, 2.5 barrels of oil and 31,780 liters of water. Similarly, one ton of reused steel saves 287 liters of fuel oil, 1.2 tons of iron ore, 0.5 tons of limestone, 0.7 tons of coal and 2.3 cubic meters of landfill, as well as reducing consumption up to 40% water consumption and 58% reduction in CO2 emissions (Gan et al., 2018).

Table2. 6 : Environmental Effects of Recycling Material (Source:(Arokiaraj David 2019)

Material	Energy Saving up to	Air Pollution Reduction up to
Aluminum	95%	95%
Cardboard	24%	—
Glass	40%	20%
Newspaper	40%	73%
Plastic	70%	—
Steel	60%	—

The rate of saving energy and avoiding air pollution is shown in Table 2.6. This not only benefits the environment, society and the economy, but also creates jobs by converting waste into reusable products.. In the recycling sector alone, 150,000 direct jobs and 323,000 indirect jobs would be created. In China, 1.5 million direct jobs and 10 million indirect jobs will be created. In India, roughly 1.75 million people work in metal recycling segments, which contribute up to 28% of the country's GDP (GDP). This is regularly expected to rise by 2030. This sector will employ approximately 10.5 million people and generate 14 lakh crores, accounting for 11% of GDP.

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2.10 Conclusion

Global waste will rise from 1.3 billion tones in 2018 to 27 billion tones by 2050, consistent with the study. Current regulations won't achieve zero waste. Two major changes must be implemented immediately. To begin, they need to extend the responsibility of producers to collect their products at the end of their life cycle. As a result, it's their responsibility to dismantle their products in an environmentally friendly and waste-free manner. Second, it's the responsibility of consumers or users to return the product to the producers and assist them in recycling and reusing the product so that both parties benefit financially. Encourages recyclers to follow international best practices, develop appropriate technologies, and develop an appropriate recycling strategy and system.

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CHAPTER 3

METHODOLOGY

3.1 Introduction

The target of this section is to define the basic methods for implementing the project, as well as the process of putting the research into action to make the project a reality. In addition, this approach is used to achieve the efficiency goals of the project. It will also discuss the software and hardware that will be used in this context. As a result, the following three important steps will be completed : structural planning, desing and implemation.

Figure 3.1: Methodology steps that are significant

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To achieve the objectives of this project, analyzes from books and technical documents were performed. To begin with, the project will undertake a literature review to gather all available information and research on the development of a material disposal machine using a microcontroller. The next step is to learn more about the programming language that will be used to generate the framework code. The study provided the information needed to complete this project.

3.1.1 Planning

The schedule will be guided by a Gantt chart. The schedule must be completed in full. A good plan helps to keep the project going even if some parts go wrong. Additionally, planning is necessary to produce the desired outcomes in PSM 1 and 2 projects.

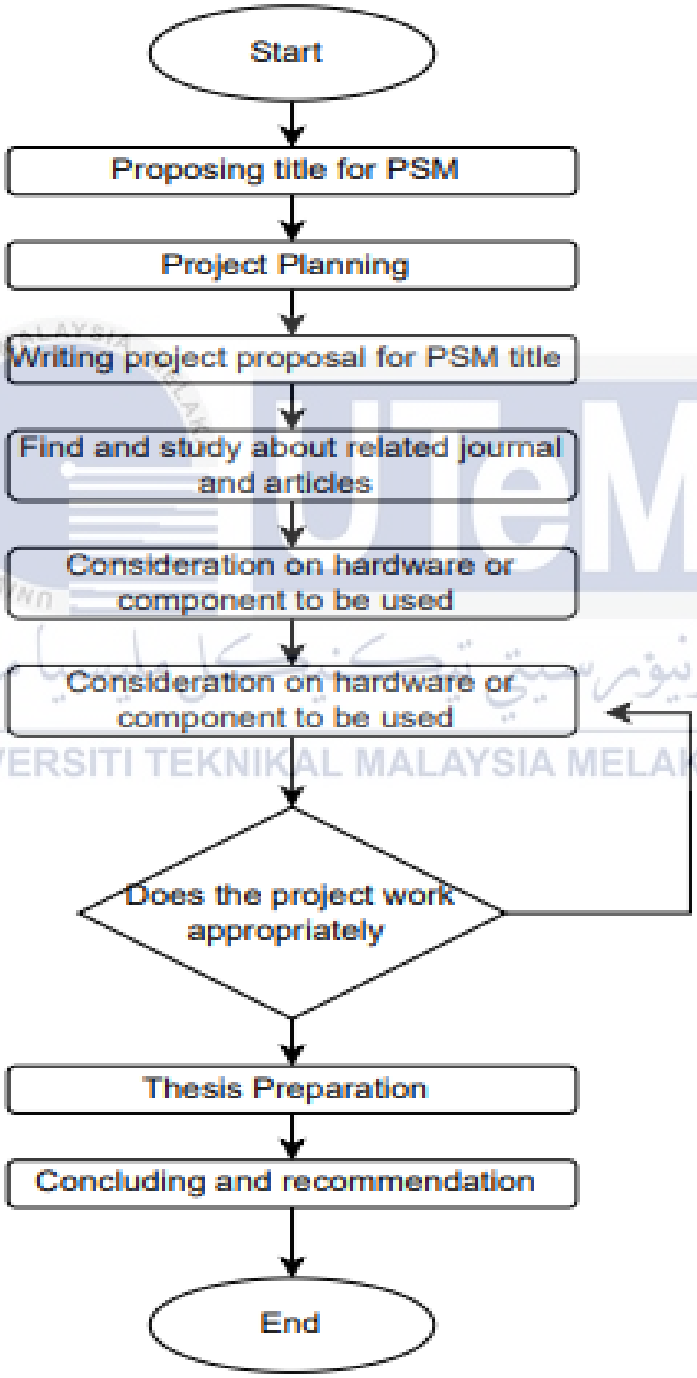

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Figure 3.2: Flowchart of general flow PS

3.2 Project Overview

The material disposal works on the basis of the reverse vending machine. Waste materials are deposited into the inlet during this material disposal. The sensors are configured to identify between plastic and can drinks waste. Servo motor will be used to push the item chosen by the user to dispense it. The HX711load cell module connects the load cell to the Arduino. Waste weight is calculated using the load cell module and supported the amount and reward points are calculated and sent to the LCD and thermal printer. The user can reclaim his reward points at participating retailers.

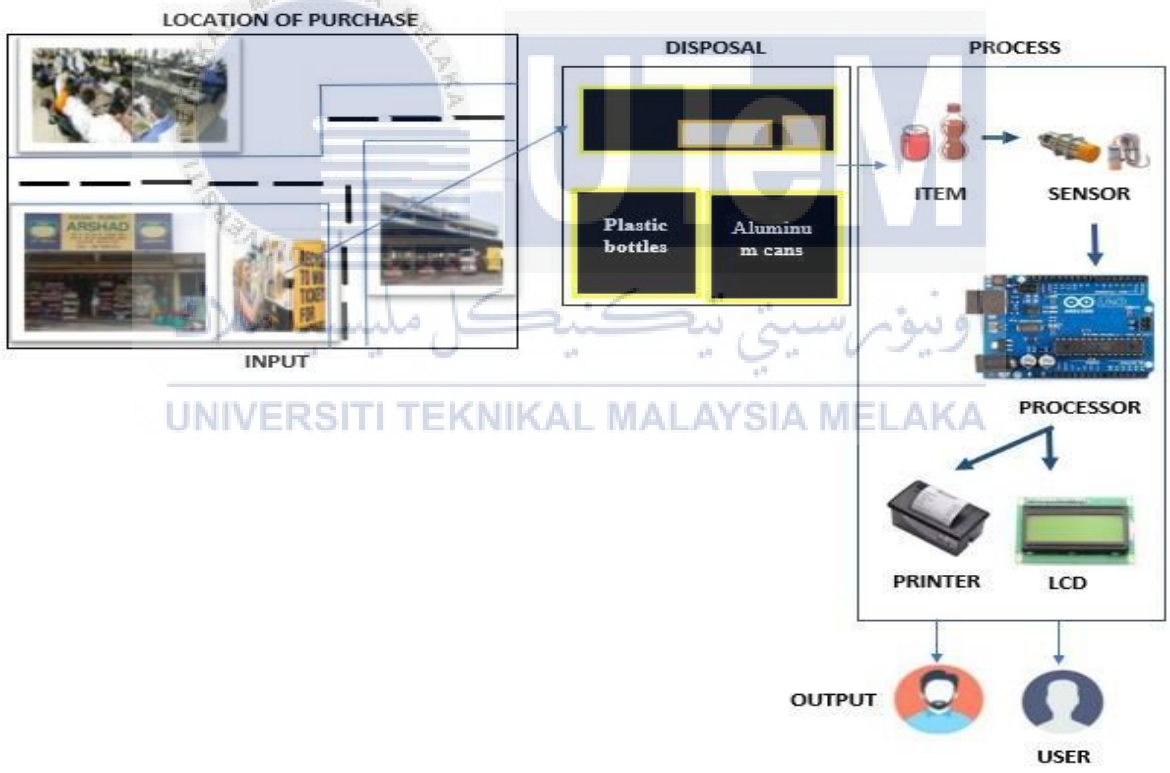

Figure 3.3: Overall Proposed System

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3.3 Flowchart of the project

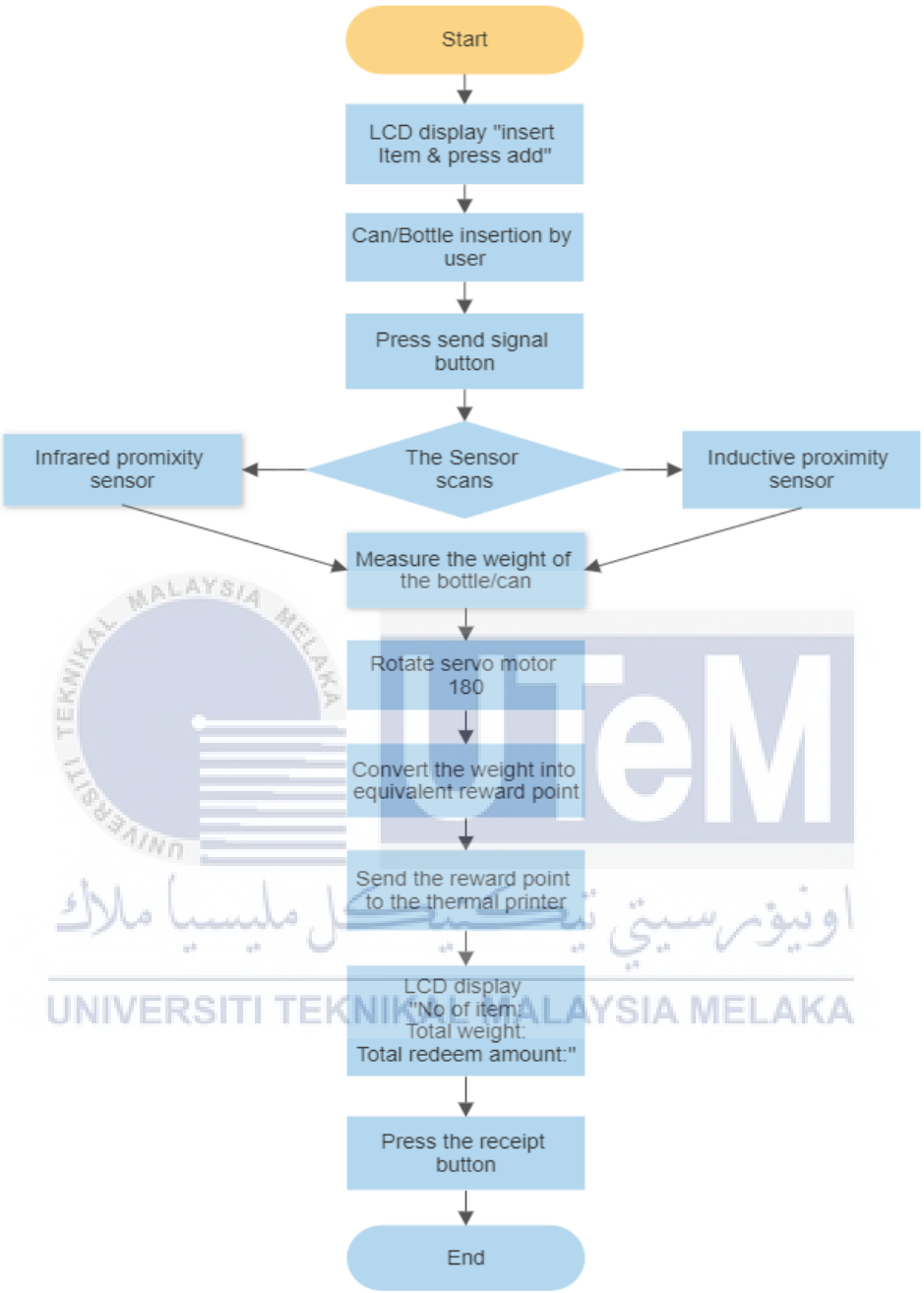

Figure 3.4: Flowchart of whole project

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3.3.1 Parameters

a) **Inductive Proximity Sensor**: Without any physical contact, detect the presence of metal/tin objects. An inductive proximity sensor is a non-contact sensing device that detects metal targets using electromagnetic energy. The sensing range of an inductive proximity sensor varies depending on the metal detected.

b) **Ky-032 Infrared Proximity Sensor**: Without any physical contact, detect the presence of plastic objects. This sensor detects obstacles using infrared light. When infrared light is emitted, it is reflected by the photodiode and detected. This sensor uses infrared light to detect obstacles.

c) **Load Cell and Hx711 Weight Sensor:** The load cell detects the weight and provides an electrical analogue voltage to the HX711 Load Amplifier Module. The HX711 ADC amplifies and digitally converts the Load cell output. The amplified value is then fed to the Arduino. Now, Arduino calculates the output of the HX711, converts it to weight values in grammes, and displays it on the LCD.

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3.4 Equipment

3.4.1 Arduino Uno

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller that was developed and released in 2010 by Arduino.cc. For more information, the ATmega328 is a single-chip microcontroller in the megaAVR family developed by Atmel. This microcontroller has a modified Harvard architecture with an 8-bit reduced instruction set computer or a RISC processor core.It is a computer that is designed to simplify the individual instructions or code given to the computer in order for the computer to complete a task.

The Arduino board includes analogue and digital input/output (I/O) pins that can be used to interface with other circuits. The board has 14 digital input and output pins, with 6 of them capable of PWM output. The Arduino IDE, which stands for integrated development environments, can also be used to programme the six analogue input and output pins. This board can be powered via USB or an external 9V battery. It can also accept voltages ranging from 7 to 20 volts. It is very similar to the Arduino Nano and the Leonardo.

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In addition, the ATmega328 on the board is preprogrammed with a bootloader that allows new code to be uploaded to it without the use of an external hardware programmer. So, user can upload program in the Arduino board as many times as possible since it is a programmable board. The program that has been uploaded in the board can also be cleared by reuploading the new program with minimal or no instruction involving input output or other circuits.

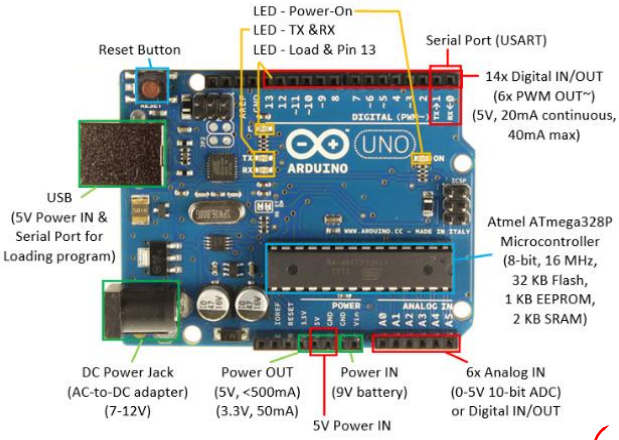

Figure 3.5 : Arduino Uno

Table 3.6 : Specification of Arduino Uno

Microcontroller	Arduino UNO
Voltage Operation	5 Volts
Input Voltage	7 to 20 Volts
I/O Pins	14
PWM Pins	6 (Pin 3, 5, 6, 9, 10 and 11)
UART	1
I2C	1
SPI	1
Analog Input Pins	6
DC Current per I/O Pin	20mA
DC Current for 3.3V Pin	50mA
Flash Memory	32 KB of which 0.5 KB used by bootloader
SRAM	2kB
EEPROM	1kB
Clock Speed	16MHz
Power Sources	DC Power Jack USB Port VIN pin (+5 volt only)

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3.4.2 MG995 Servo Motor

The Servo Motor MG995 is a medium-sized servo with a 180-degree range, good torque, and a moderate speed. The MG995 Servo Motor is a reliable and high-quality servo motor. It is a low-cost, low-power motor. The MG995 is a dual shock-proof ball-bearing servo with a metal gear designed for industrial use. The motor responds quickly and rotates at a high speed. It has excellent holding power and a consistent torque range. They're common in consumer robotics and hobby projects.

This motor operates on the basis of pulse width modulation. The Servo motor in question can only operate at a frequency of 50 MHz. Any value, no matter how large or small, causes the device to malfunction. As a result, each cycle of the PWM signal lasts 20 milliseconds. The position of the motor's axis is determined by the duty cycle of the signal.

There are standard degree rotation calculations. If the PWM signal is high for 0.5ms in a single cycle, the axis moves to zero degrees. To rotate the motor axis to 90 degrees, the signal should be high for 1.5ms. In contrast, a 2.5ms ON-time signal results in a 180-degree axial position.

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Figure 3.7: MG 995 Servo Motor

Table 3.8: Specification of MG 995 Servo Motor

Weight	55g
Dimension	40.7 x 19.7 x 42.9 mm approx.
Stall torque	8.5 kgf·cm (4.8 V)
Operating speed	0.2 s/60° (4.8 V)
Operating voltage	4.8 V
Dead band width	5 µs
Temperature range	0 °C – 55 °C

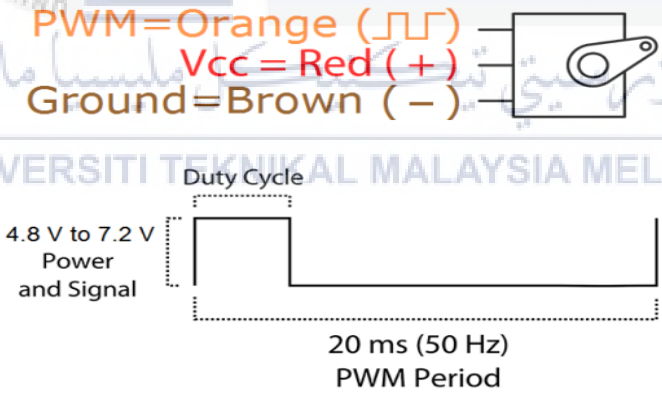

Figure 3.9: PWM Cycle for servo motor

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3.4.3 IC2 serial interface 16x2 Lcd

This is a high-quality 2-line 16-character LCD module with an i2c communication interface and on-board contrast control adjustment. There will be no more difficult or complex LCD driver circuit connections for Arduino newcomers. The real benefit of this i2c Serial LCD module is that it simplifies circuit connections, saves some I/O pins on the Arduino board, and simplifies firmware development with an Arduino library that is widely available. Compatible with Arduino boards and other i2c bus controller boards.

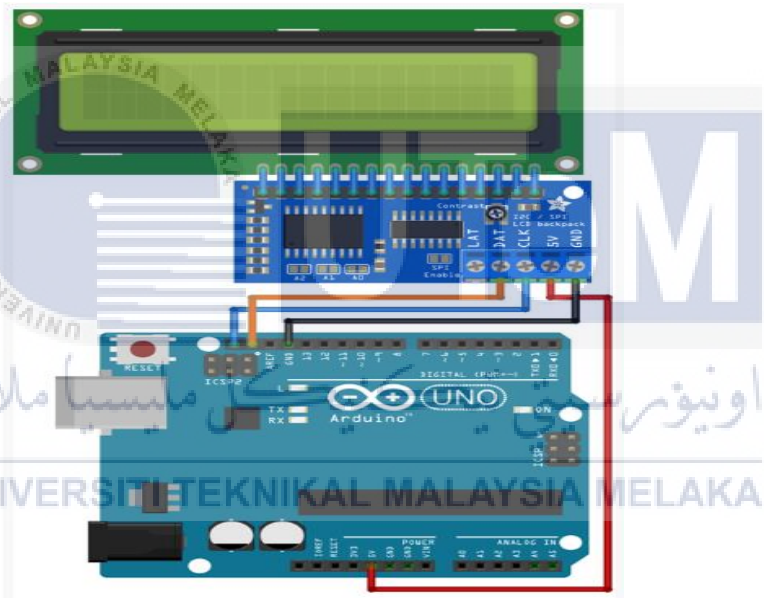

Figure 3.10 : Schematic Circuit for LCD Display System

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Table 3.11: Pin connections for LCD to Arduino Uno

Pin	Name	Pin Function	Connection
1	VCC	Positive Supply for LCD	5V
2	GND	Ground	Ground
3	SDA	Serial Data Line	12C uses two bidirectional open collector or open drain lines
4	SCL	Serial Clock Line	12C uses two bidirectional open collector or open drain lines

Table 3.12: Specification of I2c serial interface 16X2 LCD

Display	Negative white on blue backlight
I2c address	0x38-0x3F(0x3F)
Supply voltage	5V
Interface	I2c to 4 bits LCD date and control lines
Contrast Adjustment	Built – in potentiometer
Backlight Control	Firmware or jumper wire
Board size	80x36mm

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3.4.4 5 Kg Load Cell with HX711 Amplifier

A load cell is a device that converts force or pressure into electrical output. The magnitude of this electrical output is proportional to the applied force. When pressure is applied to a strain gauge in a load cell, it deforms. The strain gauge then generates an electrical signal as its effective resistance changes with deformation. A load cell is typically made up of four strain gauges connected in a Wheatstone bridge configuration.Load cells come in a variety of sizes, such as 5kg, 10kg, 100kg, and more; in this case, we used a Load cell that can hold up to 5kg. Because the Load cell's electrical signals are only a few millivolts, they must be amplified further by an amplifier and thus HX711 Weighing Sensor.

The HX711 Weighing Sensor Module is equipped with the HX711 chip, which is a 24 high precision A/D converter (Analog to digital converter). The HX711 has two analogue input channels that can be programmed to provide gain of up to 128. So the HX711 module amplifies the low power output of the force sensors and feeds this amplified and digitally converted signal into the Arduino for weight calculation.The load cell detects the weight and provides an electrical analogue voltage to the HX711 Load Amplifier Module. The HX711 ADC amplifies and digitally converts the Load cell output. The amplified value is then fed to the Arduino. Now, Arduino calculates the output of the HX711, converts it to weight values in grammes, and displays it on the LCD. The system is calibrated using a push button.

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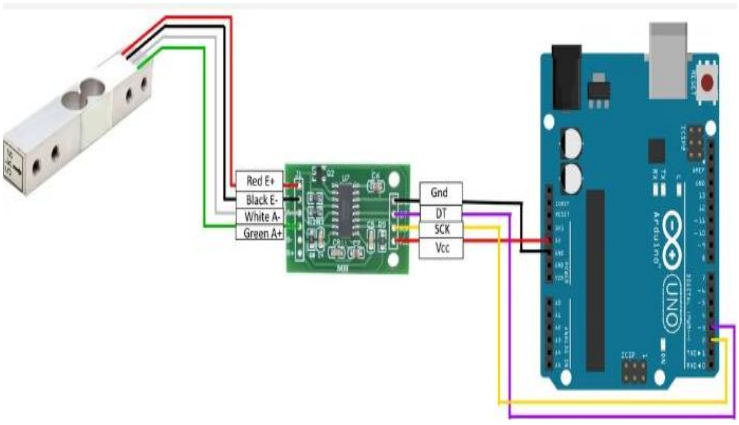

Figure 3.13: Schematic Circuit for 5kg Load Cell with HX711 Amplifier

Table 3.14: Specification of Load Cell with HX711 Amplifier

Operating voltage range	2.6 to 5.5V
Operating temperature range	-20 to + 85 °C
Power consumption (including power supply circuit) Typical operating current:	<1.7mA, shutdown current: <1μA
HX711 output data rate	10Hz or 80Hz optional
Load cell size	12.7 x 12.7 x 75mm

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3.4.5 Embedded Thermal Printer

The embedded thermal printer employs thermal technology, requires no toner or ink, has a stable performance, and is compact in size. Instrumentation and other applications frequently use embedded thermal printers. It can be found in ATMs, lockers, POS systems, and supermarket electronic scales. The printer is powered by a 5V wide voltage supply. The higher the voltage, the clearer the printing effect. It is intended for 58MM wide thermal paper rolls with a print life of 50 kilometres. It works with Arduino. We can use the instruction set to send commands to the thermal printer through the USB serial port or TTL communication interface.The printer will then print the text and characters immediately. Microcontrollers send information to thermal printer and customers can claim money based on quantity of materials via receipt at cashiers. The and prompts the user to enter a push button. Once the user enters the push button, the mini thermal printer prints the receipts.

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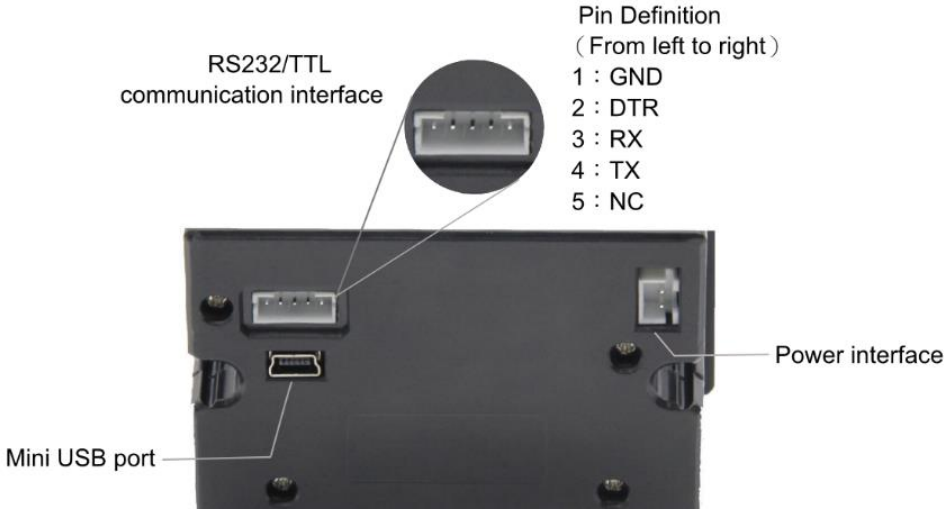

Figure 3.15: Embedded Thermal Printer

Table 3.16: Specification of Embedded Thermal Printer

Operating Voltage	Operating Voltage: 5 ~ 9V (Recommend 9V)
Operating Current	0.8 ~ 1.5A (instantaneous current ≈2A)
Communication interface	TTL + USB
Printing method	thermal dot matrix printing
Print colour	black and white output
Use consumables	thermal ticket roll
Print width	48mm (effective print width)
Printing speed	60mm/s

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3.4.6 IR SENSOR FOR OBSTACLE AVOIDANCE KY-032

The sensor is powered by the NE555 chip which generates a 38 kHz square wave. (SN74LS00 is used in the IR-08H.) The infrared (IR) LED is illuminated by a 38 kHz signal. The Vishay HS0038B IR receiver module detects reflected light from the LED. The receiver module includes an external 950nm optical infrared filter as well as an internal 38kHz electronic bandpass filter, making the module sensitive only to pulsed infrared light at this frequency. One of the onboard potentiometers (R6) is used to fine-tune the signal to exactly 38 kHz. The other (R5) varies the duty cycle of the signal, controlling the brightness of the IR LEDs.

Therefore, the use of the 'EN' or 'Enable' pin is absolutely necessary for the device to function properly. The device will reach its maximum sensitivity if the Trigger function is used correctly. The infrared (IR) LED on most versions of this unit is already covered by a small piece of black heat-shrink tubing, but I've found that an additional optical shield is required. A small cardboard tube is often used as packaging material, as well as a variety of other materials.

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When the GREEN JUMPER is installed on the board (as shown), the IR LED will blink continuously at 38kHz. The jumper must be set if the Enable (EN) function is not used. When the jumper is removed, R3, a 22K pull-down resistor, keeps pin 4 of the 555 timer LOW (RESET). Then, if a HIGH condition is applied to the EN pin, the reset condition is released and the 555 timer is fired.

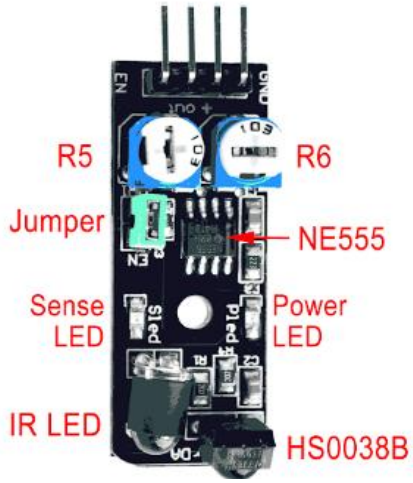

Figure 3.17: Ir Sensor For Obstacle Avoidance Ky-032

Table 3.18: Specification of Ir Sensor For Obstacle Avoidance Ky-032

Working voltage	3.3V to 5VDC
Working current	≥ 20mA
Operating temperature	-10°C to +50°C
Detection distance	2 to 40cm
IO Interface	4-pin (EN / +V / S / GND)
Output signal	TTL level
Adjustment	two single-turn variable resistors
Effective angle	±35°
Size	28mm × 23mm

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3.4.7 Inductive Proximity Sensor

Inductive proximity sensors are used to detect metallic objects without touching them. Their operation is based on a coil and oscillator that generates an electromagnetic field in the vicinity of the sensing surface. The presence of a metallic object in the operating area reduces the amplitude of the oscillation. A threshold circuit detects the rise and fall of such oscillations and changes the sensor's output. The sensor's operating distance is determined by the shape and size of the actuator, as well as the nature of the material.

In front of the face, the coil produces a high frequency magnetic field. When a metallic target enters this magnetic field, some of the energy is absorbed. When a conductive metal enters the zone defined by the electromagnetic field's boundaries, some of the oscillation's energy is transferred into the target's metal. This transferred energy manifests itself as a tiny circulating electrical current known as eddy current. Because of this, inductive proximity sensors are also known as eddy current sensors.

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This causes a small amount of power to be lost as heat (similar to a small electric heater), causing the amplitude (degree or magnitude) of the sensor oscillations to drop to a level where another internal circuitry known as the Schmitt Trigger discovered that the presence of a mental target was confirmed with certainty. When the Schmitt Trigger detects a target, the sensor output is activated.

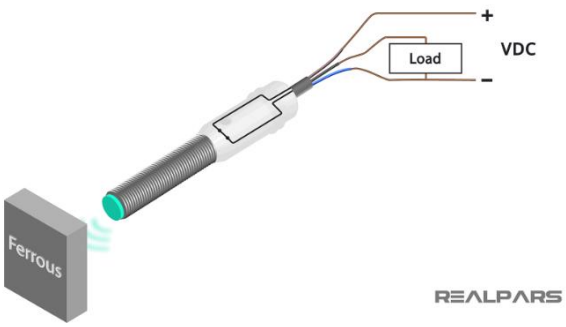

Figure 3.19: Inductive Proximity sensor

Table 3.20: Specification of Inductive Proximity Sensor

Weight	0.053kg
Model	LJ12A3-4-Z/BY Wire Type Cylindrical DC 3 Wire Type Switch Appearance Type Cylinder Type Theory Inductive Sensor Output Type PNP NO(Normal open)
Diameter of Head	12mm Detecting
Distance	4mm
Supply Voltage DC	6-36V
Current Output	300mA
Response Frequency	0.5KHz
Detect Object	Iron
Temperature	25°C to +55°C (Non-freezing Condition

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3.4.8 LM2596 Step-Down Adjustable DC-DC Switching Buck Converter

This module employs an adjustable LM2596 step-down (buck) switching regulator capable of driving a 3A load with excellent line and load regulation. This module includes a multi-turn trim pot (potentiometer) for adjusting the LM2596's output voltage. The trim pot has 25 turns of adjustment, allowing the module's output to be easily adjusted to the precise voltage required. The simplest way to reduce the voltage of a DC supply voltage is with a linear voltage regulator (LDO), but linear regulators step down voltage by dissipating excess energy as heat and do not produce any current step up. Buck converters, on the other hand, can be extremely efficient and increase current output significantly. Buck converters are some of the most efficient.

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Figure 3.21: LM2596 Step-Down Adjustable DC-DC Switching Buck Converter

Table 3.22: Specification of LM2596 Step-Down Adjustable DC-DC Switching Buck Converter

Input Voltage	3 to 40 V
Output Voltage Range	1.23 to 37 V
Max Output Current	3 A
Adjustment	25-Turn Trimpot
Efficiency	up to ~93%
Switching Frequency	150 kHz
Built-In Protection	thermal shutdown and current limit

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3.5 Software Development

Arduino is an open-source electronics platform with a built-in programming environment (IDE) that is used with various operating systems. The IDE's primary function is to translate C-language code into executable code, which is then loaded by the programmer onto the Arduino microcontroller for execution. Arduino boards can read inputs such as sensors and pushbuttons and convert them into desired outputs such as turning on an LED and activating a motor. The user can control or instruct the board by sending a set of instructions to the board's microcontroller. The programming language is designed to perform a specific task.Other than that, Arduino also simplifies the process of working with microcontrollers. There are many advantages of Arduino:

1. Inexpensive.
2. Cross-platform.
3. Clear programming environments.
4. Open source and extensible software and hardware.

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3.6 Summary

In short, after the components have been decided and meet all the requirements of the objective and scope the construction of the hardware and software can be proceeded. Any issues or problems that happen during the construction of the project later on will be addressed and troubleshooted in order to accomplish the goals. Testing will be done and examined in detail in the chapter. The testing that will be collected upon the project's hardware and software is complete.

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CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

In this chapter, it will discuss project result and test that will obtain according to the studies' focus on the previous chapter. Project progress and how the project is expected to be completed will also be discussed. The process in this chapter is based on the flow process that consist of flow process of software, hardware, data collection and development parts that are included within the application of the system.

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4.2 Results and Analysis

The expected outcome for this project is computation on how the project will work according to the specification that is set to the sensors so that system will work properly. In order to obtain it, there are three parameters that are set and must be followed so that the system will work properly. The parameter that considered is inductive proximity sensor, ky-032 infrared proximity sensor and Load Cell and Hx711 Weight Sensor. The data and analysis will be taken based on these three main components in this material disposal machine.

4.2.1 Ky 032 infrared proximity sensor testing simulation

This testing by using proteus simulation to check the sensor accuracy. When an object is placed in front of the Ky-032 infrared proximity sensor, the potentiometer must be adjusted upward 2< 40cm, and the led attached to the Arduino board should be turned on. If the sensor does not detect the object, adjust the potentiometer downward to 0 >2. The detection range for the object is 2<40. The sensor cannot detect the object outside of this range.

The Ky-032 infrared proximity sensor detects obstacles in their path. Typically used to detect objects such as plastic and avoid obstacles. To detect reflections, the Ky-032 infrared proximity sensor includes an IR LED and light detectors (Photodiode). By emitting infrared light rays, the ir sensor detects the presence of an object.

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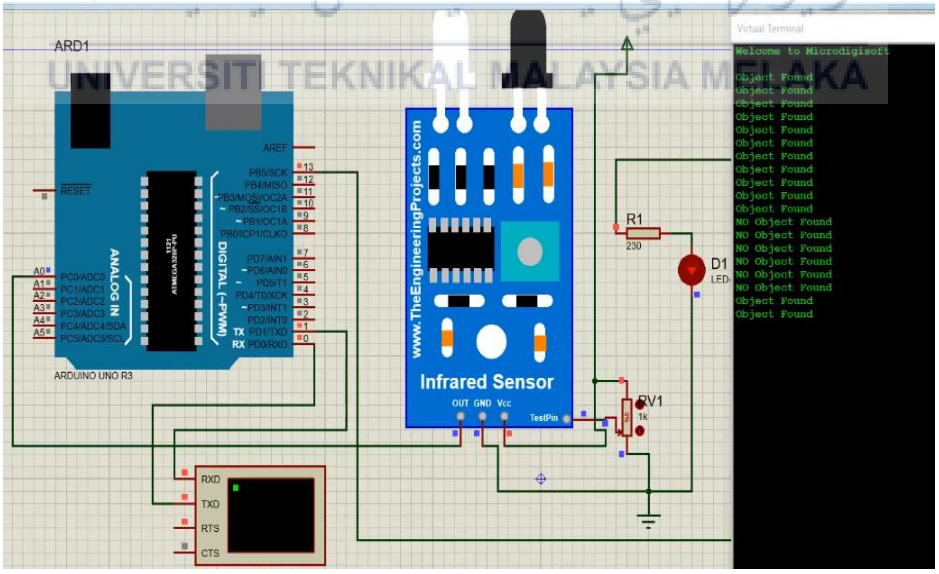

Figure 4.1: Simulation Ky- 032 Infrared Proximity Sensor

Table 4.2 Testing coding for Ky 032 infrared proximity sensor

```
//Setup function initialize Serial monitor and Read the
Analog Data
void setup() {
  Serial.begin(9600);
  delay(500);
  Serial.println("Welcome to Microdigisoft \n");
  pinMode(A0, INPUT);// Define pin A0 as a input
  Serial.begin(9600);
  pinMode(13, OUTPUT);// Define pin 13 as a output  }
void loop () {
  delay (500);
  Serial.println("");
  //Serial.println(digitalRead(A0));
  if (digitalRead(A0) == 0)
  {
    digitalWrite(13, HIGH);
    Serial.print("Object Found ");
  }
  else {
    digital Write (13, LOW);
    Serial.print("NO Object Found ");}}
```

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4.2.2 Inductive proximity sensor testing simulation

This testing will taking by manual.Proximity sensors detect the presence of objects nearby. The sensor has three pins, two of which are connected to a 6 V power supply. PNP and NO are the output pins (Normal Open). That is, it is normally low and becomes HIGH when it detects an object. It has a detection distance of 0mm to 4 mm and only can detect metal objects like can drinks. Reduce the Arduino input voltage from 9 V to 4.5 V using the pull down resistor . Then connect the voltage divider circuit's middle end to an Arduino input pin.The next step is to upload the code to Arduino. Take a look at the sensor output. If it is LOW, no object is near the sensor; if it is HIGH, an object has been detected. This occurs every half second. The result is shown below.

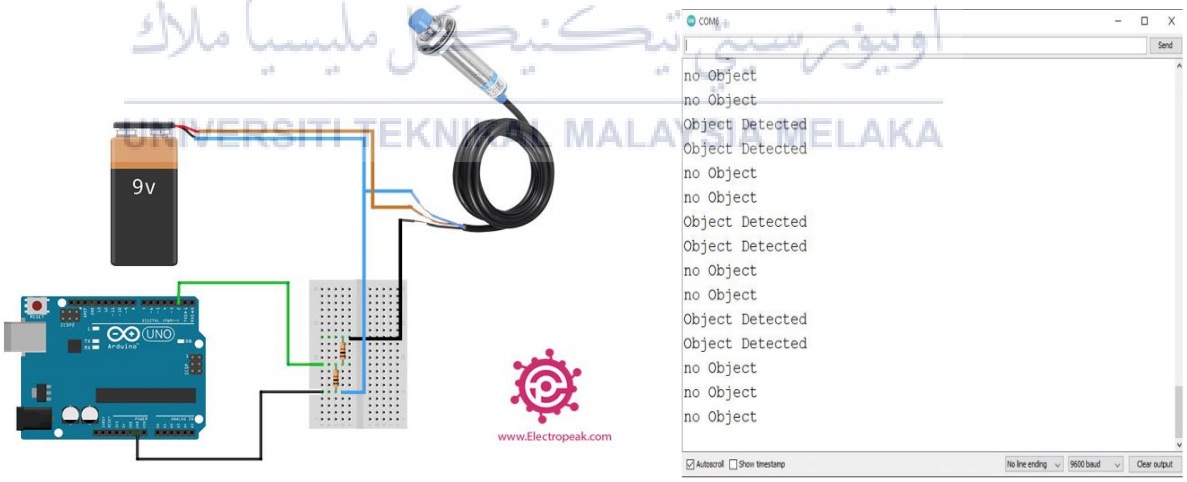

Figure 4.3: simulation inductive proximity sensor

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Table 4.4: Testing coding for inductive proximity sensor

```
const int Pin=2;

void setup() {
   pinMode(Pin, INPUT);
   Serial.begin(9600);
}

void loop() {
   int sensorValue = digitalRead(Pin);
   if(sensorValue==HIGH){
      Serial.println("no Object");
      delay(500);
   }
   else{
      Serial.println("Object Detected");
      delay(500);
   }
}
```

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4.2.3 Full Circuit design

After testing and troubleshooting sensor separately, the full circuit is combined to simulate the full function of the project. The full simulation circuit is constructed using proteus and fritzing software. As a result, the component used in this circuit include an Arduino Uno, battery 9v, button, capacitor, hx711 inductor obstacle sensor, ir740, lm0167, loadcell, minres20k, motor servo, thermal printer and PCF 8574. The 5V supply voltage is connected to the VCC inductive proximity sensor, button, LCD and servo motor. The 9V supply voltage is connected to the battery with thermal printer, ky-032 infrared proximity. Each connected device's ground is connected to the Arduino Uno and buck converter ground.

So, in this case, Dc to Dc buck converter is used in real life circuit replacing voltage regulator as it is more compatible with 9V adapter supply. In this project, the buck converter used is a step-down voltage. The 5v supply voltage that is also the output from Dc to Dc buck converter is connected 5V Arduino, MG 995 servo motor, IC2 serial interface 16 x 2 LCD and 5KG load cell with HX711 amplifier. The sensor is connected to digital input of the Arduino Uno.

As for interfacing of proximity sensor, a pulldwon resistor is added to the connection. A 10k pullup reduce the arduino input voltage sensor output voltage from 9v to 4.5v . Due to overvoltage, 9v will damage the Arduino. It is required to use a 10K resistor in series.

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Pull down resistor are resistor with a fixed value that are connected between a voltage source and a specific pin in a digital logic circuit. The purpose is to ensure the voltage between Ground and VCC is actively controlled.

The coding is also combined in order to simulate the full function of the circuit. When developing the coding, a library should be added to the Arduino software so that there will be no errors when compiling the coding for HX711 sensor. The library which is HX711 scale contains instructions for retrieving hx711 scale reading from the sensor.

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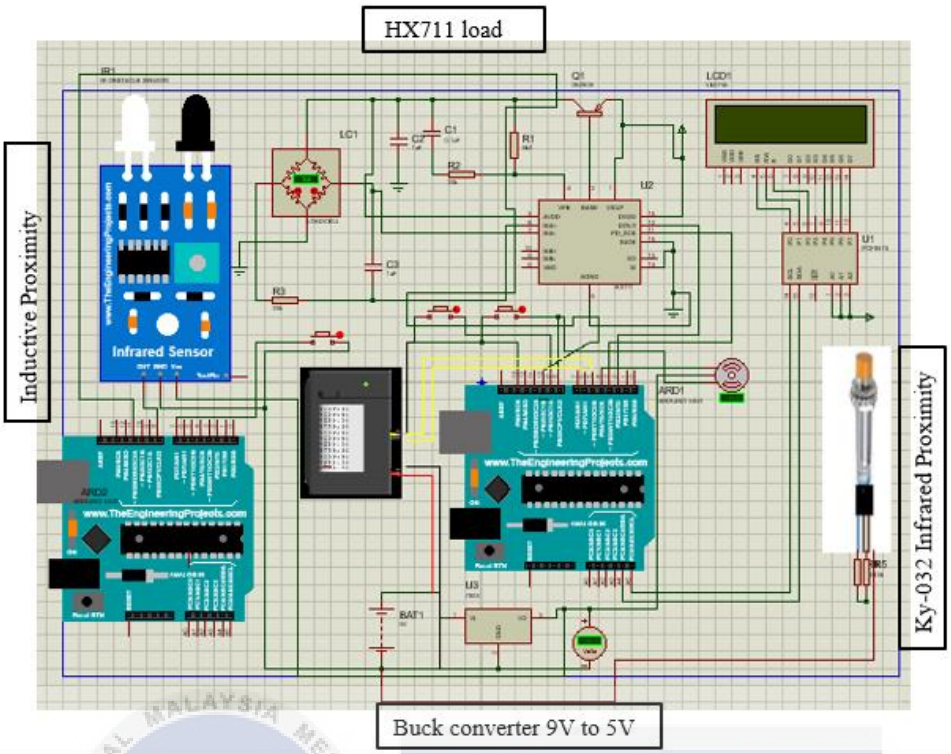

Figure 4.5: Full Simulation Circuit

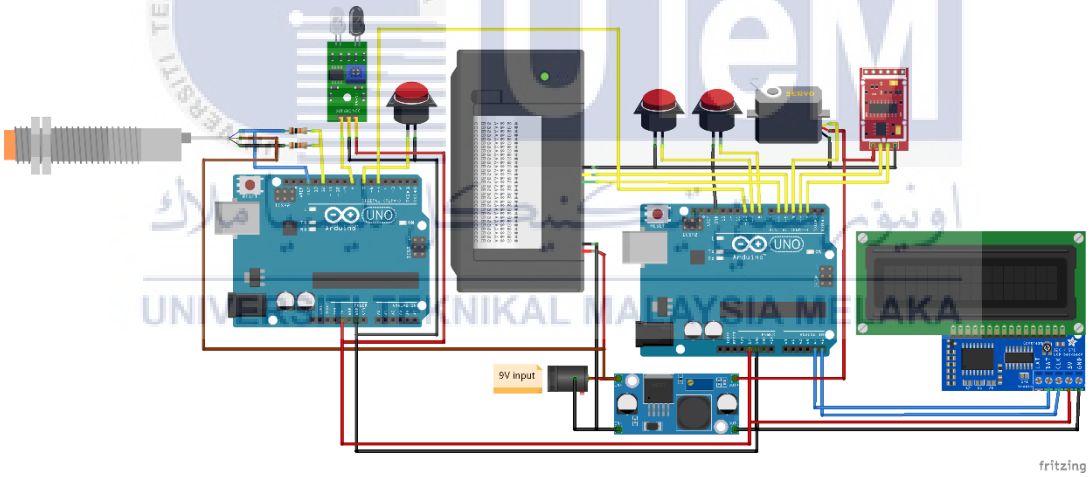

Figure 4.6: Full Simulation Circuit

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Table 4.7: Full Coding

```
#include "HX711.h"
#include <Servo.h>
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include "Adafruit_Thermal.h"
#include "SoftwareSerial.h"
#define TX_PIN 6
#define RX_PIN 5
#define calibration_factor 430.0
#define DOUT 2
#define SCK 3

HX711 scale;
SoftwareSerial mySerial(RX_PIN, TX_PIN);
Adafruit_Thermal printer(&mySerial);
LiquidCrystal_I2C lcd(0x27,16,2);
Servo myservo;
float units;
float weight = 0.0;
int item = 8;
int receipt = 9;
int detector = 10;
int detect;
int count;
int printr;
int ctr = 0;

void setup()
{
  pinMode(7, OUTPUT); digitalWrite(7, LOW);
  Serial.begin(9600);
  mySerial.begin(9600);
  scale.begin(DOUT,SCK);
  scale.set_scale(calibration_factor);
  scale.tare();
  pinMode(item,INPUT_PULLUP);
  pinMode(receipt,INPUT_PULLUP);
  pinMode(detector,INPUT);
  myservo.attach(4);
  myservo.write(180);
  lcd.init();
  lcd.backlight();
  lcd.setCursor(0,0);
  lcd.print("Disposal Vending");
  lcd.setCursor(0,1);
  lcd.print("    Machine     ");
  delay(3000);
  lcd.setCursor(0,0);
```

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```
  lcd.print("  Insert ITEM &  ");
  lcd.setCursor(0,1);
  lcd.print("   Press ADD    ");
}

void loop()
{
  detect = digitalRead(detector);
  count = digitalRead(item);
  printr = digitalRead(receipt);
  units = scale.get_units(), 5;
  if (units < 1.0)
  {
    units = 0.00;
  }
  Serial.print(units);
  Serial.print("        ");
  Serial.println(weight);
  if (detect == HIGH && count == LOW && units > 0.0)
  {
    myservo.write(40);
    weight = weight + units;
    ctr = ctr + 1;
    delay(2000);
    myservo.write(180);
    scale.tare();
    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("Insert more ITEM &");
    lcd.setCursor(0,1);
    lcd.print("   Press ADD    ");
    delay(2000);
    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("To Print RECEIPT");
    lcd.setCursor(0,1);
    lcd.print("  Press REDEEM  ");
  }
  else
  {
    weight = weight;
    ctr = ctr;
    myservo.write(180);
  }

  if(printr == LOW && weight > 0.0)
  {
    myservo.write(180);
    lcd.clear();
    lcd.setCursor(0,0);
```

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```
    lcd.print("Total :");
    lcd.print(weight);
    lcd.print("g");
    lcd.setCursor(0,1);
    lcd.print("Redeem : RM ");
    lcd.print(0.01*weight);
    delay(2000);
    printer.justify('C');
    printer.setSize('M');
    printer.boldOn();
    printer.doubleHeightOn();
    printer.println(F("Disposal Vending Machine"));
    printer.boldOff();
    printer.doubleHeightOff();
    printer.print(F("No. of item: "));
    printer.println(ctr);
    printer.print(F("Total weight: "));
    printer.print(weight);
    printer.println(F("g"));
    printer.print(F("Total redeem amount: RM "));
    printer.println(0.01*weight);
    printer.println(F("Thank you! Let's go green"));
    printer.println(F(""));
    printer.println(F(""));
    printer.println(F(""));
    delay(2000);
    weight = 0.0;
    ctr = 0;
    lcd.clear();
    lcd.setCursor(0,0);
    lcd.print("Disposal Vending");
    lcd.setCursor(0,1);
    lcd.print("    Machine     ");
    delay(3000);
    lcd.setCursor(0,0);
    lcd.print("  Insert ITEM &  ");
    lcd.setCursor(0,1);
    lcd.print("   Press ADD    ");
  }
}
```

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4.2.4 Block diagram

Based on the block diagram below, present a study of the project's flow. Figure 4.8 represent the block diagram of the Development of Material Disposal Machine Using Microcontroller. The system is divided into four sections, which are processing, scanning, weighing scale and receiving.

Arduino Uno as a microcontroller will process the data from the sensor to classify the item based on the category. An inductive proximity sensor and Infrared proximity sensor scanning metal and nonmetal objects without the need for physical contact. The HX711 amplifier is a breakout board that makes it simple to read load cells for weight measuremen.t Furthermore, the servo motor arrangement pushes the waste material into the machine. The i2c / spi character LCD backpack to display the information. The output information is interfaced with thermal printer so that the information can be print.

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Figure 4.8 : Block diagram of the project

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4.3 Data analysis

4.3.1 5kg Load Cell with HX711 Amplifier

Widely known that load cell sensor is used to measure the weight of object. In this project, load cell and inductive proximity sensor is the most sensitive components as it need to be calibrated. The load cell is used to measure the gram. There are steps of doing calibration. Inductive Proximity Sensor

4.3.2 Calibrate through coding

There are two programs one is the calibration program finding the calibration factor. Another code is weight measurement program, the calibration factor found from the calibration program code need to be entered in weight measurement program. The calibration factor determines the accuracy of the weight measurement.

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To started the calibration example included with the "Hx711 ADC" library. Open the Arduino IDE and then select from the menu.For the calibration place load cell, a level stable surface. Remove load applied to the load cell. File->Examples->HX711_ADC->Calibration. Load the example code to Arduino. It should work without any modifications if you connected the DT output of the HX711 module to the Arduino pin 4, and SCK to the Arduino pin 5.

Place the load cell a level stable surface. Remove load applied to the load cell. Send ‘t’ from serial monitor to set the tare offset. Tare complete. Now, place known mass on the loadcell. New calibration value has been set to is based on the calibration Value after fixing the load cell is 430.0, use this as calibration value (calibration Value) in project sketch.

The calibration factor (Calibration value) determines the accuracy of the weight measurement. The calibration factor (Calibration value) is 430.0 that I found. Another code is weight measurement program (Testing), the calibration factor 430.0 found from the calibration program code need to be entered in weight measurement program. Open the Arduino IDE and then select from the menu. File->Examples->HX711 ADC->Testing. Now it can measure unknown weights.

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4.3.2 Testing the Load Cell5kg Load Cell with HX711 Amplifier function

Once the calibration is done, can include that factor in our code. Thus, this will make the scale precise and accurate. The calibration factor 430.0 found from the calibration program code need to be entered in weight measurement program.

```
#define TX_PIN 6
#define RX_PIN 5
#define calibration_factor 430.0
#define DOUT 2
#define SCK 3
```

Figure 4.9 : Coding Calibration For 5kg Load Cell with HX711 Amplifier

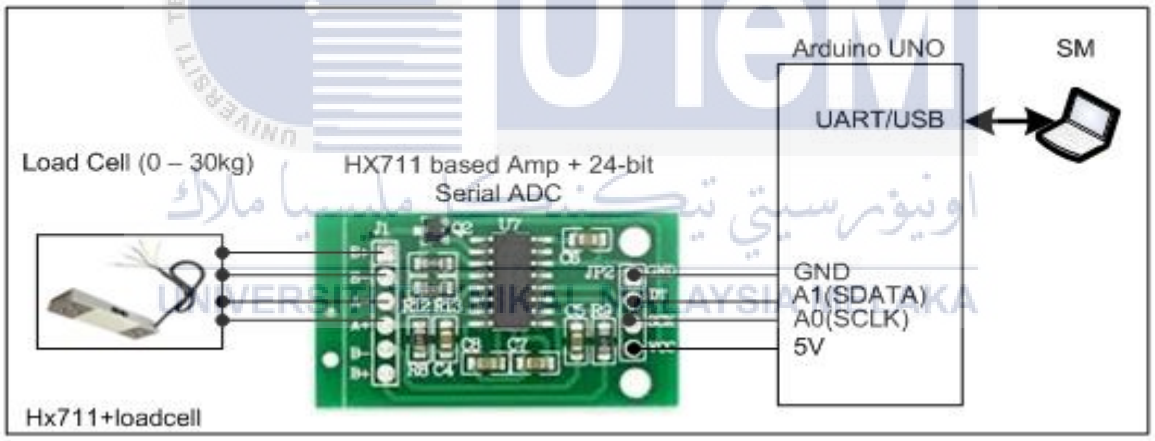

Figure 4.10 : Schematic Circuit for calibrating 5kg Load Cell with HX711 Amplifier

Table 4.11: Shows the test results by a Material

No material	Total weight(g)	Total redeem amount	Type of material
1	17.90g	RM 0.18	Tin 100 plus
2	351.67g	RM 3.52	Plastic bottle (50ml)
3	465.63g	RM 4.66	Plastic bottle (250ml)
4	28.43g	RM 0.28	Plastic bottle(0ml)
5	680.16g	RM6.80	Plastic bottle(500ml)
6	46.12g	RM0.46	
7	193.23g	RM 1.93	Tin milo
8	6.74g	RM0.07	Empty tin sardin
9	-	-	Plastic bag
10	-	-	Stone
11	-	-	Leaf
12	-	-	Paper
13	18.00g	RM 0.18	Tin soya ben

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The actual value for each material is shown in table 4.11. The HX711 is a 24bit ADC that amplifies and digitally converts the Load cell output. The amplified value is then fed to the Arduino. Now, Arduino calculates the output of the HX711, converts it to weight values in grammes, and displays it on the LCD. The system is calibrated using a push button. In coding, the amount of material time the total gram the set value is to 0.01.

Table 4.12: Data for Ky 032 infrared proximity sensor

NO	Distance	Object Detected / No detected
1	10cm	Object Detected
2	20 cm	Object Detected
3	30cm	Object Detected
4	40cm	Object Detected
5	50cm	No object
6	60cm	No Object
7	70cm	No Object
8	0mm	No Object
9	40cm	Object Detected
10	8cm	Object Detected
11	6cm	Object Detected
12	1cm	No Object
13	20cm	Object Detected
14	2cm	Object Detected
15	10cm	Object Detected
16	30cm	Object detected
17	0cm	No object
18	30cm	Object Detected
19	10cm	Object Detected
20	2cm	Obejctive detected

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The table 4.12 show the distance of Ky 032 infrared proximity sensor detect the object.The sensor only detect the object 2<40 cm range.If the distance less than 2cm the sensor can not detect the object.The distance is more then 40cm the sensor can not detect the object.So from this data can conclude the suitable range to the object detected is 2<40cm .

Table 4.13: Data for inductive proximity sensor

	1mm	2mm	3mm	4mm
Cycle 1	1	0	0	0
Cycle 2	1	0	0	0
Cycle 3	1	0	0	0
Cycle 4	0	0	0	4
Cycle 5	1	0	0	0
Cycle 6	1	0	0	0
Cycle 7	0	0	3	0
Cycle 8	0	2	0	0
Cycle 9	1	0	0	0
Cycle 10	0	2	0	0
Cycle 11	0	0	0	4
Cycle 12	1	0	0	0
Cycle 13	1	0	0	0
Cycle 14	1	0	0	0
Cycle 15	1	0	0	0
Cycle 16	0	0	0	4
Cycle 17	1	0	0	0
Cycle 18	0	2	0	0
Cycle 19	1	0	0	0
Cycle 20	1	0	0	0

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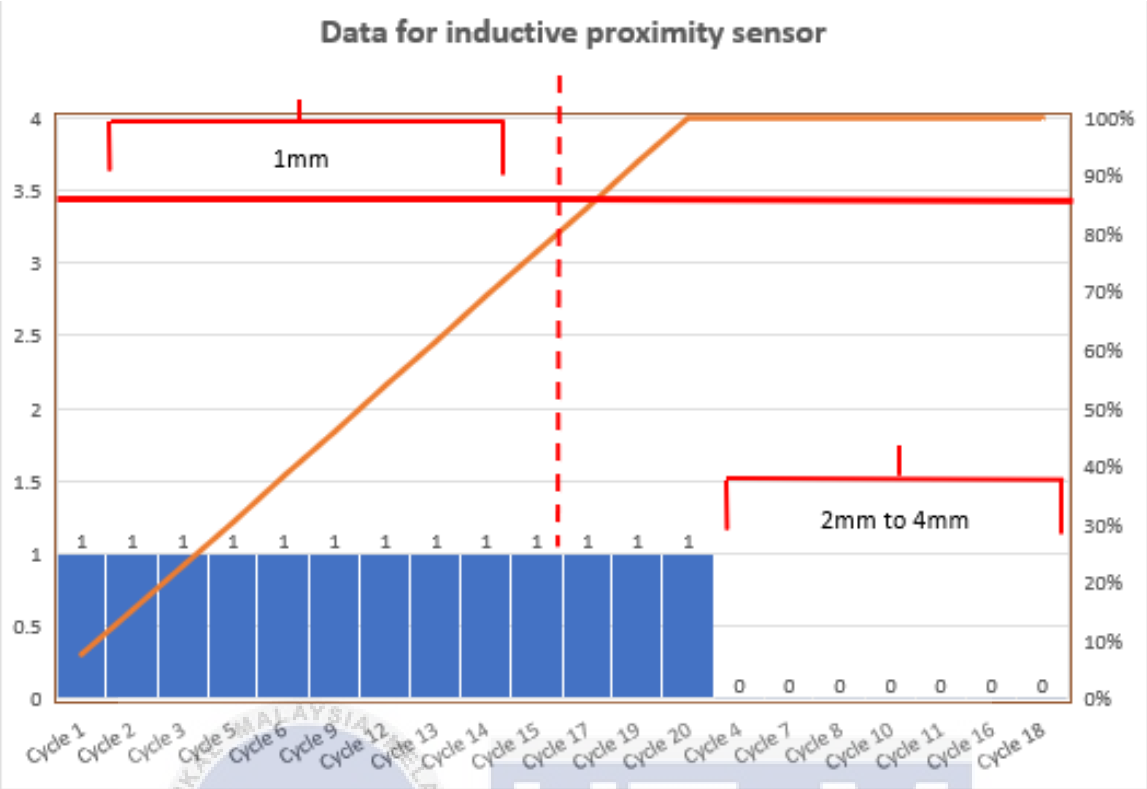

Figure 4.14 : Date for inductive proximity sensor ref.

In datasheet, an inductive proximity sensor's measurable distance is a minimum of 0mm and a maximum of 4mm as theoretical date. The inductive proximity sensor passed 20 cycles of testing as shown in table 4.13. The distance valve was identical to the theoretical data sheet. The inductive proximity sensor will respond best between 1mm distances, as shown in Figure 4.14. Based on these findings, it is possible to conclude that the inductive proximity sensor can detect objects in close proximity. The date analysis is shown in the figure using the pareto chart principle and the 80/20 rule. 80% detect the object in 1mm, 20% in 2mm to 4mm.

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4.4 Result

4.4.1 Display system

The Arduino Uno can also display user prompts and messages on the LCD. It is critical that the display sequences correspond to the events and user input. The LCD system is tested by simulating sensor inputs and outputs for a Thermal Printer with a receipt. During idle mode, prior to recycling, a "Disposal Vending Machine" , inset item&press add message will be displayed on the LCD.

Figure 4.15: LCD displays "Disposal Vending Machine"

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Figure 4.16: LCD displays "Insert item&Press Add"

During the recycling process, the recycler inserts a can or plastic and closes the inductive sensor and the ir proximity sensor, which triggers the sensor.Once the sensor tiggering press the send signal button.The signal button send the signal to material disposal arduino.The system is not able to detect unrecognised object.

Figure 4.17:Insert the plastic bottel

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Figure 4.18:Insert the can drink

Next,need press the detect item button for calibrating the system. Arduino calculates the output of HX711 and converts that into the weight values in grams and shows it on LCD. The figure 4.19 show the total weight and price of material.

Figure 4.19: LCD displays"Total in gram and price"

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Figure 4.20: LCD displays"To Print Receipt"

4.5 Reward System Using Thermal printer

To print on this paper, a thermal printer uses a special heating process. To maintain a constant temperature, the printer head is heated in a special electrical circuit. The thermal paper's thermal coating turns black where the head is heated when it passes through its head. The Rx Tx connection to the Arduino Uno unit is provided by the TTL connector.

The 9V power connector is used to power the printer, and the button is used to printer receipts. When the Arduino calculates the output of HX711 and converts that into the weight values in grams and shows it on LCD and pressing the button causes it to print a sheet with specifications. Button is pressed will become high and this condition is used to trigger the printing.

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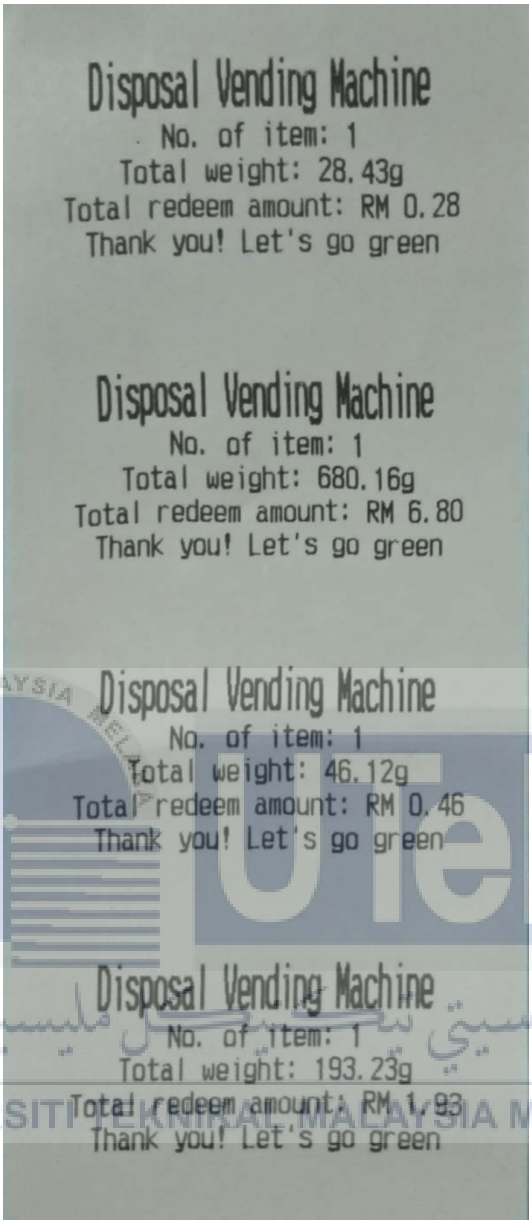

Figure 4.21 : User Receipt

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4.6 System Design

Below is the design for developement material disposal machine using microcontroller. 29.972cm x 42.418cm which is the smallest size of material disposal machine.For this project, this size have been choose as a prototype because this cheapest but this system can be develop for largest. To develop the prototype of material disposal machine , it has been started with the software implementation using Autocad. The final material disposal machine implementation is shown in Figures with one (1) holes to accept e aluminum cans, plastic.

Figure 4.22 : Actual prototype implementation

4.7 Summary

An experiment analysis was performed in this work to obtain the calibration of the load cell connected with Arduino. An Arduino programme was written to collect the data provided by the load cells. The load cells were connected in series for the experimental tests, so that the reading represented the load on the entire surface. The load cells' readings pass through the HX711 module, where their signals are amplified, allowing the microcontroller to read them. The Arduino, in turn, has been programmed to convert the module's voltage date to mass values. The Arduino supplies a 5V voltage to both the HX711 module and the load cell.This testing used an Arduino uno as a date acquisition system with known mass fo load application.

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CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The conclusion section wraps up the report by summarising the content. The findings' potential applications, as well as recommendations for future research, are also included. The goals of this project have been met. The material disposal machine prototype was successfully built, and the system is operational. Messages and user prompts for the material disposal machine development display system To receive data from sensor circuits and control the LCD, the Arduino Uno microcontroller board was successfully implemented. The Arduino programming language was used to programme the microcontroller. All messages and user prompts that occur as a result of the event conditions are included in the programmed. Furthermore, the programme allows for point accumulation throughout the recycling process.

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The electronic reward system with thermal printer accomplished its goal of storing reward points in the thermal. Interact with the microcontroller, which receives sensor inputs from the material recognition system. The HX711 load cell module measures the weight of both items. The weight is then converted into the corresponding reward point. Send the reward points to the thermal printer. The user will be given receipts and can claim their money. The prototype, however, has some limitations. The system itself is still flawed, with some flaws. This chapter will discuss some possible future works. Overall, the system can

be implemented successfully. Overall, the system provides a low-cost and simple solution for implementing Reverse Vending Machines in our country.

5.2 Recommendations

The system is still in its infancy as a prototype for the Material disposal machine, and further development should be made to improve its reliability, accuracy, and functions. According to our project's overview, there are numerous barriers to system optimization. The available budget for resources restricts the purchase of high-end devices, and there is a lack of research on Material disposal machine in Malaysia.

5.3 Potential Applications

Material Disposal Machine Development the use of a microcontroller is intended to motivate people to recycle by rewarding them with points. As a result, the machine should be placed in public places like residential. college and shopping malls. In addition to sponsoring the machines, the private sector can play an important role. Take, for example, the college, which sponsors the machine and encourages its customers to recycle. In exchange, student can collect their reward points using a thermal printer. The reward points can be redeemed near the store**.**

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5.4 Future Works

Here is serval recommendation that could be applied in this system which are Use ESP 32 is a better and more powerful microcontroller board than Arduino. Compared to the Arduino Uno, the ESP32 can fit more sensors and modules because it has more GPIO pins. This also means that it has more PWM and analog pins.

Table 5.1 : Comparison between Arduino Uno and Esp. 32

Specs/board	Esp32	Arduino uno
Number of cores	2	1
Architecture	32 bit	8 bit
1CPU frequency	160Mhz	16Mhz
Wifi	Yes	No
Bluetooth	Yes	No
Busses	SPI,12C, URAT,12S, CAN	SPI,12C, UART
ADC pin	18	6
DAC pin	2	0

The following recommendation for future work could be used in this project, which developed this system using IOT, or internet of things, where users can Duit Now Qr Scan &Pay for users to receive cash payment directly into their bank account or e wallet. By continuing this project, the next researcher will have a new and brilliant idea to design new equipment using new other materials and devices, which will work out to be the most efficient development of material disposal machine using microcontroller.

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APPENDICES

PSM 1 GANTT CHART

PROGRESS WEEK	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
List&Buy All components Use														
Construct Simulation Circuit in Proteus														
Develop coding in Arduino														
Test Simulation&Coding														
Construct Hardware At Breadboard														
Burn coding To the Hardware Circuit														
Calibaration load cell														
Test Sensor Accuracy														
Collate Date														
Construct Hardware At Stripboard														
Burn Final Coding														
Design Cover For circuit														
Put Cicuit into the cover														
Build disposal vending machine														
Write Final Report														
Develop Presantation Slide														
Create poster /PSM 2 presentation														

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PSM 2 GANTT CHART

PROGRESS WEEK	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14
Completion project planning														
Completion of research about project														
Completion Discussion with supervisor														
Chapter 1														
Table of comparisons from a previous project														
Flow chart and a block diagram														
chapter 2														
Finalise the components used														
Chapter 3														
Draft report submission														
Slide presentation														
Final report Submission														
Presentation PSM1														

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