Faculty of Electrical and Electronic Engineering Technology

DEVELOPMENT OF SMART TRASH BIN SYSTEM FOR SMART CITY USING GSM MODULE

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Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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DEVELOPMENT OF SMART TRASH BIN SYSTEM FOR SMART CITY USING GSM MODULE

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A project report submitted
in partial fulfillment of the requirements for the degree of
Bachelor of Electronics Engineering Technology (Telecommunications) with Honours

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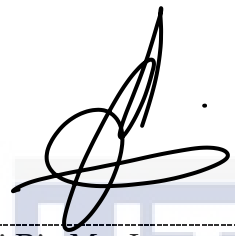
DECLARATION

I declare that this project report development of a Smart Trash Bin System For Smart City Using GSM Module is entitled 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.

Signature : 

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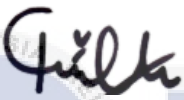
APPROVAL

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 (Telecommunications) with Honours

Signature : 

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Date : 13/1/2023

Signature :

Co-Supervisor :

Name (if any)

Date :

DEDICATION

This thesis is dedicated to whom who have support me from the early and end of the project development:
My beloved parent and family
My supervisors
My lecturers
And all my friend
Thank you for all the guidance, support and encouragement until the end.

ABSTRACT

Waste management is one of the world's most pressing issues, regardless of whether a country is developed or developing. Prior to the start of the next cleaning operation, public trash cans are frequently overflowing, which is the most significant problem in waste management. It may be the main cause of the spread of a number of diseases as a result of the resulting risks, such as foul odours and unsightliness. To avoid all such perilous situations and protect public sanitation and health, we employ a modern waste management system. This project presents a cost-effective design of smart waste containers for small-scale cases. The system is based on board Arduino Nano and ultrasonic sensors to monitor container fullness level and provide SMS alerts using a GSM module. The servo will open and close the lid of the dustbin. The system is powered by a lithium battery . In addition, the system will save usage events, recorded by the IR sensor, and fullness events on the memory card, which are also used to play audio messages using speakers, while the trash can is in use. In the end, the system was successfully implemented with an acceptable total cost for the intended application.

ABSTRAK

Pengurusan sisa adalah salah satu isu yang paling mendesak di dunia, tidak kira sama ada sesebuah negara itu maju atau membangun. Sebelum memulakan operasi pembersihan seterusnya, tong sampah awam kerap melimpah, yang merupakan masalah paling ketara dalam pengurusan sisa. Ia mungkin menjadi punca utama penyebaran beberapa penyakit akibat daripada risiko yang terhasil, seperti bau busuk dan tidak sedap dipandang. Untuk mengelakkan semua situasi berbahaya tersebut dan melindungi sanitasi dan kesihatan awam, kami menggunakan sistem pengurusan sisa moden. Projek ini membentangkan reka bentuk kos efektif bekas sisa pintar untuk kes berskala kecil. Sistem ini berdasarkan papan Arduino Nano dan sensor ultrasonik untuk memantau tahap kepenuhan bekas dan memberikan makluman SMS menggunakan modul GSM. Servo akan membuka dan menutup penutup tong sampah. Sistem ini dikuasakan oleh bateri litium. Selain itu, sistem akan menyimpan peristiwa penggunaan, yang dirakam oleh penderia IR, dan peristiwa kepenuhan pada kad memori, yang juga digunakan untuk memainkan mesej audio menggunakan pembesar suara, semasa tong sampah sedang digunakan. Akhirnya, sistem ini berjaya dilaksanakan dengan jumlah kos yang boleh diterima untuk aplikasi yang dimaksudkan.

ACKNOWLEDGEMENTS

First and foremost, I would like to express my gratitude to my supervisor, Puan Raeihah binti Mohd Zain, for his precious guidance, words of wisdom, and patience throughout this project.

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CHAPTER 1

INTRODUCTION

1.1 Background

Nowdays the population in Malaysia increase rapidly, so the trash also increase which also increase the environmental issue. A dustbin is a bin for collecting trash or storing materials that are recyclable or non-recyclable, decomposable or non-decomposable. The dustbin will be used at the office, house , park and at the roadside.

Almost all dustbins at the public place have problems where dustbins are overflowing, and the trash is spilling out all over the place. The dustbin will fill up very quickly when special period such as festival ,weekend and holidays. They are many impact overflowing dustbin on health and environment. For example overflowing garbage cans provide the perfect breeding habitat for bacteria and insects. Flies that visit the trash are the same flies that fly near our food and drop their offspring on our plate. They raise our chances of getting salmonella, the bacteria that causes typhoid fever, food poisoning, and enteric fever. Beside flies , rats and stay dog also live around the dustbin. Beside that, Garbage that is overflowing is a public nuisance and an eyesore. Everyone wants to live in and visit places that are clean, fresh, and safe. A dirty city with unsatisfactory cleanliness and rubbish all over the place does not attract visitors

This happen because there is no flexible waste collection schedule in our current system. Therefore, the project is design to monitor the fullness level of the dustbin and will give SMS alerts using a GSM module. The user will receive an SMS alert .This will help the dustbin from overflowing.

1.2 Problem Statement

Dustbin wasted is collected at regular intervals by cleaning employees, and the segregation of waste cannot be do in properly way. By using manual way method they are several weakness such as the dustbin fills up really fast and spill out from the dustbin at the crowded area. The dustbin will fill up very quickly when special period such as festival ,weekend and holiday.This bad enviroment this will lead to the addition of pests and will cause various diseases .This happen because the cleaner dont know the level of waste in the dustbin. This method also waste the plastic bag because the cleaner need to pick up the dustbin even dustbin is not full.

1.3 Project Objective

The main of this project is to propose a systematic and user friendly methodology to measure the level of the trash in the dustbin using the arduino and the GSM module .The objectives are as follows:

a) To monitor the fullnes of the dustbin and sent the data when dustbin is full for collect the trash

b) To notify the waste management about the fulness of dustbin through message.

c) To design the smart bin that user-friendly

1.4 Scope of Project

The project scope is to develop technique for monitor the level of dustbin. It may help to prevent the dustbin from spill out. The main aim of this project to monitor the level of trash .The sensor that used in this project could detect the level the trash in the dustbin and can detect the person that come near the dustbin. This project used an Arduino UNO microcontroller to analyse sensor data before sending it to the GSM module, which will communicate with the user via SMS if the level is full.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This initiative aims to identify the problem the dustbin at the cities. With ongoing research moving toward the benefits of lowering the rate of, the lack of a system to monitor the waste level of the dustbin in the cities become significant problem . This chapter looks at the different ways people have tried to solve the problem. Different studies have tried different ways to solve the problem, and some of these methods have been looked at. After looking at what other researchers have done, a brilliant possible solution will be put together using some of the same ideas. Since then, many methods and equipment have been created to measure, analyze, and notify the condition of dustbin.

2.2 Previous Project Research

This chapter analysed and described a few papers and prior journals that traced a similar technique and covered subjects that can be used as references for the Garbage Monitoring System with IoT. This chapter also contains research based on a similar existing system, similar sensors, and an IOT board, which can be used as a guideline or a model for upgrading or developing a new, better system in comparison to the existing system.

2.2.1 Robotic Dustbin on Wheels

. In a paper proposed by a system that proposed to keep the environment clean, in which the robotic dustbin moves along a lined path with the assistance of two infrared sensors located at the robot's base facing forward.[1]This project uses Arduino ATmega 32p.The Arduino will send the signal to the motor driver.They are 4 motors that use in this project for the project to move left, right and forward. Then when the IR sensor detects an object in the path and emits the IR signals, it sends a signal to the microcontroller, which detects black color and causes the system to will stop at that black color. After that, the controller will send a signal to the ultrasonic sensor, which produces sound waves and detects the distance between the garbage and the dustbin's lid. If the dustbin is full the cooperation operation will receive the message using the wifi module.

Figure 2.1 Robotic Dustbin on Wheels

2.2.2 Smart Dustbin for waste management

The project by authors Wikramarathne and R. M. I. S use web application to process and view a collection of Recycling Center data and maintain user profiles. By accessing them, their profiles can see their eyes for the waste of each category, as well as the details of these users[2]. The Recycling Center can also access this web application. The main components of this project are servo motor, ultrasonic sensor, RFID reader, GSM module and load cell. The user need to touches his RFID tag against the RFID reader, the trash can lid will open. The system will then open the lid by confirming the user ID against the server's database using the GSM module. Before the lid opens, an ultrasonic sensor will check the level of rubbish, and if the bin is full, the system will send a warning message to the authorities informing them that the bin is full. The user can then throw the trash in the bin. The garbage's weight will be measured by a load cell and transmitted to the database via a GSM module.

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Figure 2.2 Smart Dustbin for waste management

2.2.3 GSM Based Garbage Monitoring System

In a project done by the author S.Kal ,they propose a system that monitor the dustbin and sends the message to update on the level of the dustbin[3]. This system detects the rubbish level by placing four ultrasonic sensors over the bins and comparing it to the depth of the bins. For data transmission, the system uses an Arduino Uno board, an LCD screen, and a GSM modem. A 12V transformer provides electricity to the system.This system also use the GSM to sent the status of the dustbin.The status will be sent in the form of percentage and it will display at screen.

Figure 2.3 GSM Based Garbage Monitoring System

2.2.4 Smart Dustbin Utility System using IoT

This IoT-based Smart Dustbin Utility System implements an IoT-based dustbin management system that monitors the waste level on a regular basis, calculates the level percentage, and, if completely filled, directs the person near the dustbin to go at the nearest dustbin that is not filled[4]. By using ultrasonic it will detect When the that the dustbin is totally full, it will sends out notifications at regular intervals to empty it. Each dustbin is given a unique Id so that the person in charge may locate it . Blynk Application use in this system to send out the alert message. The data acquired by the ultrasonic sensor for each dustbin is dynamically stored using the phpMyAdmin database offered by Xampp . To calculate the filled percentage, the Node MCU would connect to the local server using WIFI

2.2.5 Garbage Level Monitoring System using Raspberry Pi

The project by author Omkar Patha objective is to track the status of nearby garbage cans in real time. The component that consist in this project are Raspberry pi, Ultrasonic sensor, ESP 8266 and Wi-Fi Module[5]. The application executes and the Ultrasonic sensor is activated after the entire system is installed and electricity is provided to the main processor unit. The The waste level in the bins is detected by the sensor, which sends the information to the server. On the server dashboard, the administrator may see a visual report of the waste level in all of the garbage bins and it can monitor all dustbins levels from a single spot

Figure 2.4 Garbage Level monitoring system using Raspberry Pi

2.2.6 Smart Dustbin The future of waste Management

The waste management system by author N. Sathish Kumar,includes four parts-ultrasonic sensor to measure the level of the dustbin, RFID reader for verification, arduino UNO R3 as a central hub for all these sensors, and a web application for sending alerts or receiving data from all these sensors[6]. The system checks the status of the dustbin every day by measuring its distance from any obstacle using an ultrasonic sensor. If any garbage reached some specific distance in a day then an alert message is sent through ThingSpeak web server technology. RFID tag is used to authenticate the identity of the council staff when they clean your dustbins which means that only authorized people could access your dustbins

2.2.7 Smart Dual Dustbin Model for Waste Management in Smart Cities

. The proposed system by G. S. Rohit, M. B. Chandra, S. Saha, and D. Das,consists of two dustbins, which is the Dustbin B not being used until Dustbin A is completely full. When Dustbin A is full, Dustbin B can only be used, and Dustbin A will not open until the garbage in the bin A is cleaned[7]. Two infrared sensors are will place in front of the dustbin so that when someone walks in front of it, it automatically opens and closes using a servo motor. The ultrasonic sensor is installed within the bins to monitor the level of dustbin filling. When the Dustbin A or B is full, a notification is delivered by GSM module to the appropriate authority.

Figure 2.5 Smart Dual Dustbin Model for Waste Management in Smart Cities

2.2.8 Smart E dustbin

The system includes various IoT techniques considering user convenience. In addition, the project uses an Arduino as a microcontroller and an Espressif ESP8266 as a node MCU. The motors are controlled by L293D motor driver IC's, which can handle up to 5A and up to 30V hence it is best suitable for our driving part[8]. With this smart garbage bins also exchange information with each other using wireless mesh networks, and a router and server collect and analyze the information for the service provider. This project used binary values in order to control our motors in forward, backward, left and right direction according to the weight capacity of the dustbin. This proje use the Battery to provide power to many components. When power-down mode is On , the battery power is optimised. As a result, it is an energy-saving device. The height of the rubbish inside the dustbin is detected using one ultrasonic sensor. The rubbish level is measured in centimetres. As a result, whenever the height of the rubbish is less than 10cm, the esp8266 is interrupted. The Wi-Fi module will be turned on. ESP uses the secured dons link to load the data into the web server. The buzzer is also activated, as is the alert message on the LCD display. A moveable platform is proposed for the dustbin, which is connected to motors and controlled by the motor driver L293D.

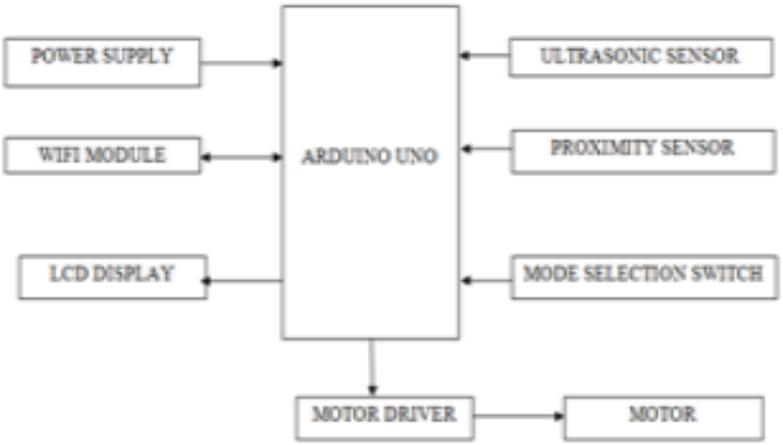

Figure 2.6 The block diagram for smart E dustbin

2.2.9 Smart Waste Management Using Wireless Sensor Network

The project by athour Singh, Mahajan, and Bagai have also worked on wireless sensor networks. An accelerometer sensor use to open the bin when people want to use the dustbin. The temperature and humidity sensor detects the presence of organic waste, and an ultrasonic sensor sensor detects the bin's fullness status in this project's bins. All of these sensors are controlled by the Zigbee Pro microcontroller board, which is includes a Wi-Fi module for sending sensor data to a gateway[9]. The Zigbee Pro operates as a transmitter, sending the data collected to the gateway. The gateway in this project also used the same type of microcontroller board to receive data from the bins and transfer it to a control station.. The data information of the bin, as well as the prior values of the bin's parameters, are saved in the database, allow the user to access them. This data from the bin can be utilised to optimise collection truck routes for the most efficient use of resources in the planned waste management system.

2.2.10 Innovation Waste Collection System Using Wireless Sensor

These containers would be equipped with ultrasonic sensors at various fill levels. Ultrasonic sensors would ensure the system's uninterrupted operation even under extreme conditions of dust, fog, and moisture, making it an almost ideal option. The sensors would be installed at three different levels: 50% of (stage 1), 75% (stage 2), and 95% o(stage 3)[9]. In addition to sensors, the system would include a GSM module for the generation and text message transmission of warning signals to the appropriate authorities. At stage 1, a notification would be sent to the designated waste collector. At stage 2, the regional headquarters is notified, and in stage 3, the relevant municipal corporation is notified. In addition, we intend to use bins with medium, high, and extra-high capacities to ensure collection diversity. The GSM module-generated signal, once received by the authorities, would aid in the constant monitoring of waste collection irregularities

2.2.11 Development Of Automatic Waste Segregator With Monitoring System

The ultrasonic sensor was utilised by the Automatic Waste Segregator to detect the presence of a human in front of the waste separation bin. A few blue light-emitting diodes (LED) are placed in the trash can to illuminate it. This project utilised the Servo motor to lift the trash can lid, allowing users to dispose of their trash[10]. During the sensor scanning process, the liquid crystal display (LCD) will show "SCAN ITEM." After trash segregation has been accomplished, a speaker and audio amplifier are employed to play music as a token of appreciation. Each trash type has its own bin. This project can separate four distinct types of material, including metal, plastic, paper, and wet trash.

Figure 2.7 Development Of Automatic Waste Segregator With Monitoring System

2.2.12 IOT BASED SMART DUSTBIN

The smart trash can use an esp8266 module. It is a Wi-Fi system-on-chip that may host an application or unload all Wi-Fi network functionalities. Therefore, it can link objects and enable Wi-Fi data transfer. The highest working voltage of the esp8266 is 3.6V. Programming the esp8266 with the Arduino IDE. Arduino IDE uses the programming language C to implement programmes[11]. In this system, two checks are taken into consideration. First, the distance between the user or nearest obstruction and the bin, and second, the distance between the trash and the lid. If both of the numbers are less than the threshold value, the predetermined sequence of events will be activated. If the range from the user is less than the threshold level, the bin's lid will open and the user will be allowed to deposit trash. When the amount of garbage increases and the distance between the trash and the lid falls below a certain threshold, the information is sent to a raspberry-pi linked to the monitor via an HDMI cable and shown on the monitor. It includes socket programming, which is repeated until the power supply is turned on.

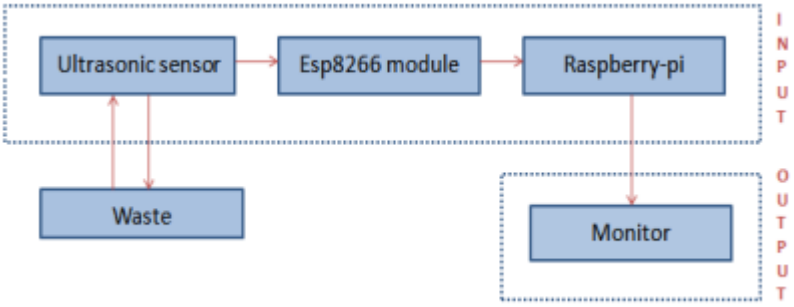

Figure 2.8 The block diagram IOT based smart dustbin

2.3 Comparison

Research title	Software/hardware	Advantage	DI
ROBOTIC DUSTBIN ON WHEELS	Servo motor,Ultrasonic sensor,GSM module,RFID Reader and load cell.	• The dustbin can move • Always update the dustbin status	• The cost is too high • The dustbin doesn't stay in one place.
SMART DUSTBIN FOR WASTE MANAGEMENT	Servor motor,ultrasonic sensor,Gsm module,arduino board load cell and RFID reader.	• Can measure weight waste • Able to know user profile that use the dustbin	• Only people have rfid card can use the dustbin
GSM BASED GARBAGE MONITORING SYSTEM	Arduino uno,LCD screen,GSM modem,ultrasonic sensor.	• Low cost • The user of the dustbin can see the level of the dustbin on LCD	• Need to open the dustbin manually • Components are easily damaged due to exposure
SMART DUSTBIN UTILITY SYSTEM USING IOT	NodeMCU, Ultrasonic sensor and LCD	• directs the person in front to move towards the nearest dustbin if the dustbin that the person wants to use is full • Low cost • Can detect the dustbin without using GPS because Each dustbin is identified by a unique Id	• Need to open the dustbin manually
GARBAGE LEVEL MONITORING SYSTEM USING RASPBERRY PI	Raspberry pi,ultrasonic sensor,ESP 8266 Wifi module and	• Low cost • Store many information for example garbage bin location and the date of last garbage bin collection.	• Need to open the dustbin manually

Research title	Software/hardware	Advantage	DI
ROBOTIC DUSTBIN ON WHEELS	Servo motor,Ultrasonic sensor,GSM module,RFID Reader and load cell.	• The dustbin can move • Always update the dustbin status	• The cost is too high • The dustbin doesn't stay in one place.
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GARBAGE LEVEL MONITORING SYSTEM USING RASPBERRY PI	Raspberry pi,ultrasonic sensor,ESP 8266 Wifi module and	• Low cost • Store many information for example garbage bin location and the date of last garbage bin collection.	• Need to open the dustbin manually

DEVELOPMENT OF AUTOMATIC WASTE SEGREGATOR WITH MONITORING SYSTEM	Arduino Uno,4 ultrasonic sensor,Gsm module mobile phone 4servor motor.	• The dustbin can segregate 4 type of waste which are plastic,metal,paper and waste. • When bin reach 80% the sms will be sent to janitor	• The cost is too high
IOT BASED SMART DUSTBIN	Ultrasonic sensor,Esp8266 module and raspberryy pi	• Low cost • The user of the dustbin can see the level of the dustbin on LCD	• Need to open the dustbin manually

Table 2.1 Comparison previous project

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2.4 Summary

According to the research, Arduino act as the main microcontroller which means its controls all the activities in the circuits. When the PIR sensor detected the motion of the human, the microcontroller will automatically send signal to the servo motor to lift up the lid of the dustbin. Then the ultrasonic will detect the level of waste and sent message to the phone using GSM module

CHAPTER 3

METHODOLOGY

3.1 Introduction

Methodology's main objective is to describe the project's flow in relation to numerous outlines while giving procedures, preparations, electrical components, and data collecting. The project aims to monitor the fullness of Smart Trash Bin and send a message to waste management. It has been revealed that the use of Smart Trash Bin can prevent the trash from spill out. In general, smart trash bin systems are now seen as more modern with the addition of other functions. In general, any smart trash bin must meet two contradictory requirements: accuracy and efficacy. The term "accuracy" refers to how accurate this project to detect the level of the trash in the dustbin

3.2 Methodology

This project demonstrates the development of a Smart Trash Bin in detecting the level of a smart dustbin and sending warning messages to the waste management. The essence of the approach used for this project is an ultrasonic sensor which is used to detect the wasted level in the dustbin, then it will send to the microcontroller to active whole system in this project. By using the right app or software, the simulation can be tested before it is done on a real circuit. Before compiling it on the Arduino Uno R3 the Arduino IDE will use to write the code. The encoding for this system is divided into several parts which are ultrasonic sensor, Infrared sensor (IR sensor), GSM Module,EZMP3 and

Arduino Uno R3 where the encoding is uploaded without error, compiled into a single encoding, and runs without issue.

3.3 Project Flowchart

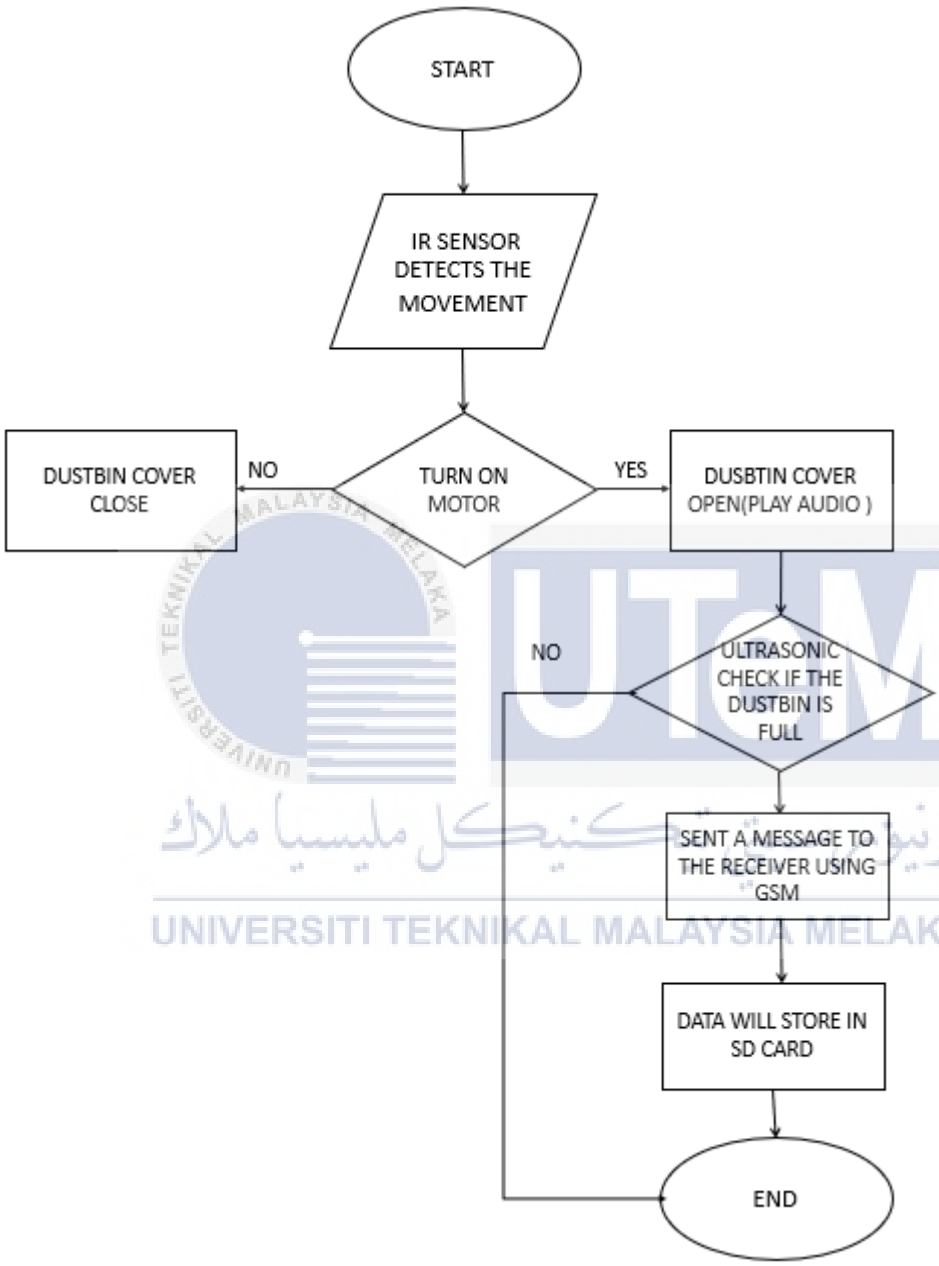

Figure 3.1 The flowchart of the project

3.4 Project Block Diagram

Block diagrams explain the function of the system. Block diagrams help in understanding the operation of a system and in establishing its interconnections. Block diagrams derive their name from the rectangular components contained in them. It is used to represent hardware and software systems as well as processes. Block diagrams are described and characterized based on their structure, function, and relationship to other blocks. The following is the project block diagram

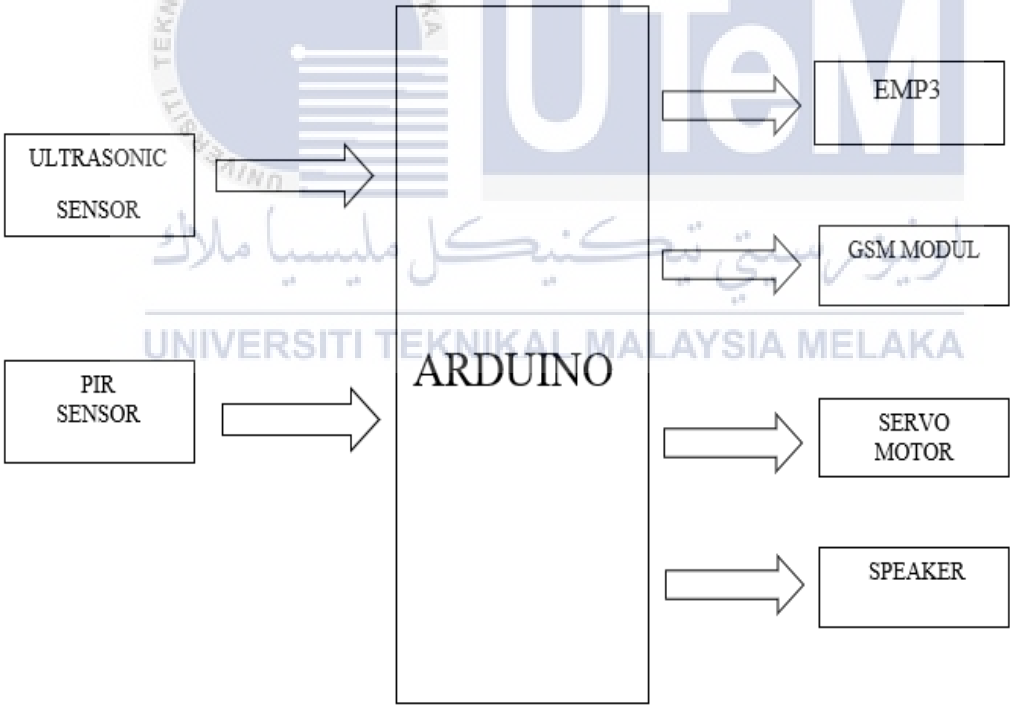

Figure 3.2 The block diagram of the project

Figure 3.2 show the block diagram of the project, the Infrared Sensor (IR) is acting as a detector for people who want to use the dustbin. The ultrasonic sensor is used to detect the level of trash in the dustbin. Then the data from the ultrasonic sensor and infrared will be transferred to Arduino. The Arduino will determine whether the dustbin is full or not. The servo motor will open the lid of the dustbin when people use the dustbin. The level of the dustbin will be sent to the phone by using the GSM module. The speaker will play audio message when people use the dustbin. The data will be save at the SD card

3.5 Hardware Specfication

3.1.1 Arduino Uno R3

Figure 3.3 Arduino R3

Arduino Uno is a microcontroller board with 14 digital I/O pins, of which six are PWM outputs. It also includes six analogue inputs, with a suggested input voltage range of 7-12V and a maximum input voltage range of 6-20V. In addition, it features a 16 MHz ceramic resonator with a USB connection, a power jack with an ICSP header, and a reset button. It performs exceptionally well in its capacity to handle incredibly complex tasks.

3.1.2 Ultrasonic sensor

Figure 3.4 Ultrsonic Sensor HC-SR04

An ultrasonic sensor is a device that measures the distance to an object using ultrasonic sound waves. In an ultrasonic sensor, a transducer is utilised to transmit and receive ultrasonic pulses that convey information about the proximity of an object. Sound waves of a high frequency reverberate off various surfaces, producing a characteristic echo. Ultrasonic sensors operate by producing sound waves that are audible to humans. The sensor measures the interval between the transmission and receiving of an ultrasonic pulse to determine the target's distance.

3.1.3 Servo Motor

Figure 3.5 Servo Motor

A servo motor is a kind of motor with extremely accurate rotation. In order to rotate with remarkable accuracy, servo motors frequently have a control circuit that provides feedback on the motor shaft's current position. When turning an object at a specific angle or distance, a servo motor is used. It merely consists of a simple motor connected to a servo mechanism. While an AC servo motor is powered by an AC power source, a DC servo motor is powered by a DC power source. In addition to these, there are many more servo motor variations based on the type of gear arrangement and properties.

3.1.4 GSM Module

Figure 3.6 SIM900D GSM Module

A GSM modem, also known as a GSM module, is a piece of hardware that utilizes the technology used in GSM mobile telephones in order to provide a wireless data link to a network. GSM modems are utilized in a variety of mobile devices, including mobile telephones, as well as other equipment that is capable of communicating with mobile telephone networks. They identify their devices to the network through the use of SIM cards.

3.1.5 Infrared Sensor (IR)

3.1.5.1 Comparison between IR sensor PIR sensor

IR Sensor	PIR Sensor
By placing the transmitter and receiver so that they are facing the same way and the signal is reflected back, you can detect moving objects.	By measuring the infrared light emitted by the objects in its field of view, one can detect movement.

Table 3.1 comparison between IR and PIR sensor

Figure 3.8 Infrared sensor

The IR sensor, also known as infrared sensor, IR sensor is a type of electronic part that detects the IR radiation to identify specific characteristics in its environment. The IR sensors can also be used to measure or detect a target's motion and heat

3.1.6 EZMP3 (MP3 Shield for Arduino)

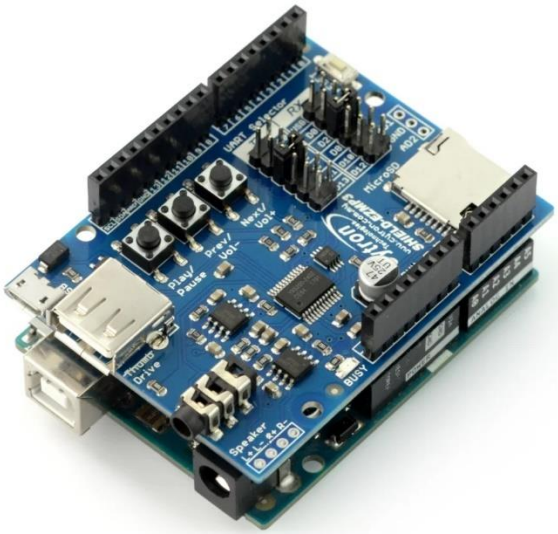

Figure 3.9 EZMP3

The EZMP3 is the for the shield for the Arduino, from the a microSD card it will play the MP3 files. The EZMP3 has a 3.5 mm Jack connector for connecting devices like headphones and a 2-channel amplifier 3 W to control external speakers. It also has buttons to control other player functions. The module uses a UART interface to communicate.

3.6 Software Application

3.6.1 Arduino IDE

Figure 4.0 Logo IDE Arduino

The Arduino software includes a code editor, a message box, a text terminal, and a toolbar with menu and function buttons. The purpose is to connect Arduino to Genuine hardware and apply software to it.

3.6.2 **Protues 8 Professional**

Figure 4.1 Logo Protues

Proteus is an electrical circuit simulation, development, and simulation tool that is used to create 2D circuit simulations for testing the circuit's effectiveness prior to testing the actual circuit. The software also enables the construction and simulation of many electrical and electronic circuits.

3.7 Summary

Chapter 4 present the proposed methodology to developed Smart Trash Bin System For Smart City Using GSM Module.Software that are used in the study such as the Arduino IDE and Proteus are used to achieve the objectives of this project. The study's findings give a clear view of how each component should function to carry out this project.It also provide a detail about the project hardware and software

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter presents the results and analysis on the developing smart trash bin system for smart city using GSM module. The software has been implemented and the hardware that was designed were explained. This system's functionality of this project was test in prototype form

4.2 Software Development

This project uses the Arduino IDE as its software. When writing code in the Arduino IDE, it will deciding which library will be used and then implement it into the programme. The library makes it simpler for the coder to use the component that will be assembled.

MP3_Dustbin_SD

```
#include <SoftwareSerial.h>
#include <CytronEZMP3.h>
#include <Servo.h>
#include <SPI.h>
#include <SD.h>
#define trigPin 4
#define echoPin 5
#define IR  A0
```

Figure 4.1 Library Included

Figure 4.1 show the library that use in this project .For the First library is sofwareSerial .It allow communication to the other pinat Arduino.Next, the second library related to the EasyMP3 shield, the EasyMP3 will decoding the t mp3 files in the microSD card. For the SD.h library it read and write to the SD cards. For line 6 and 7 it related to the ultrasonic. The trigPin will initiate the pulses of ultrasonic sound, for the echo pin when the reflected signal received it will produce pulse.For last library it related to Infrared signal, for the IR will include the transmitter encoding and decoding functionality.

4.3 Circuit diagram

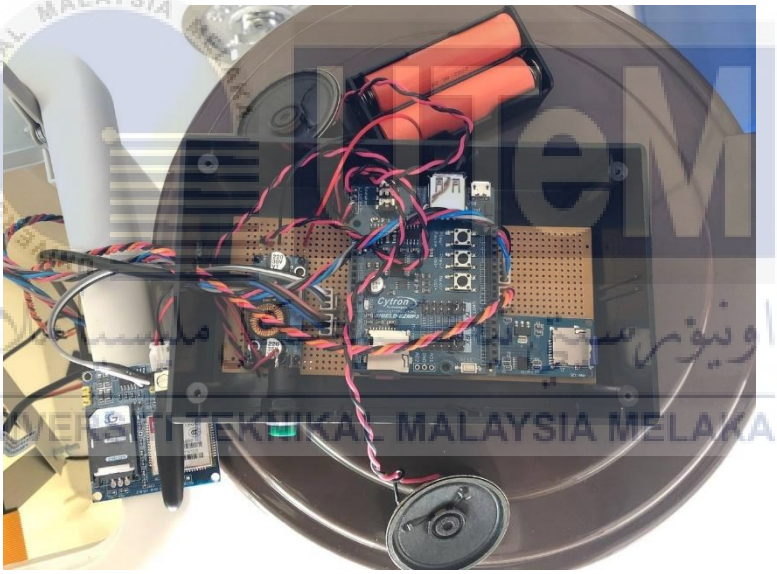

Figure 4.2 The circuit diagram of the project

4.4 Hardware Implementation

For this project Arduino Uno, GSM module , Servo Motor , Infrared Sensor , Ultrasonic Sensor and EZMP3 will be used to assemble the prototype as shown in the figure. The Infrared Sensor will be insert in front of the dustbin , it will act as a sensor to detect any motion on the top of lid dustbin. The Servo motor will connect at the rod behind the dustbin to open the lid of the dustbin when it received the data from the Infrared Sensor. The ultrasonic used to detect the fullness of the dustbin , the ultrasonic will be placed inside the dustbin. Next , the GSM Module will be sent message when the Infrared sensor detect the dustbin is full. The EZMP3 will be the shield for the Arduino, it will be played the MP3 file from the SD Card. Lastly the Arduino will act will act as the bridge to connect to all component.

4.5 Result

In this subsection, the result of the project prototype will be displayed. This project prototype will be run as follow the objective given . The project prototype is build using plastic dustbin. Figure 4.2 and 4.3 show the front and top view of the prototype

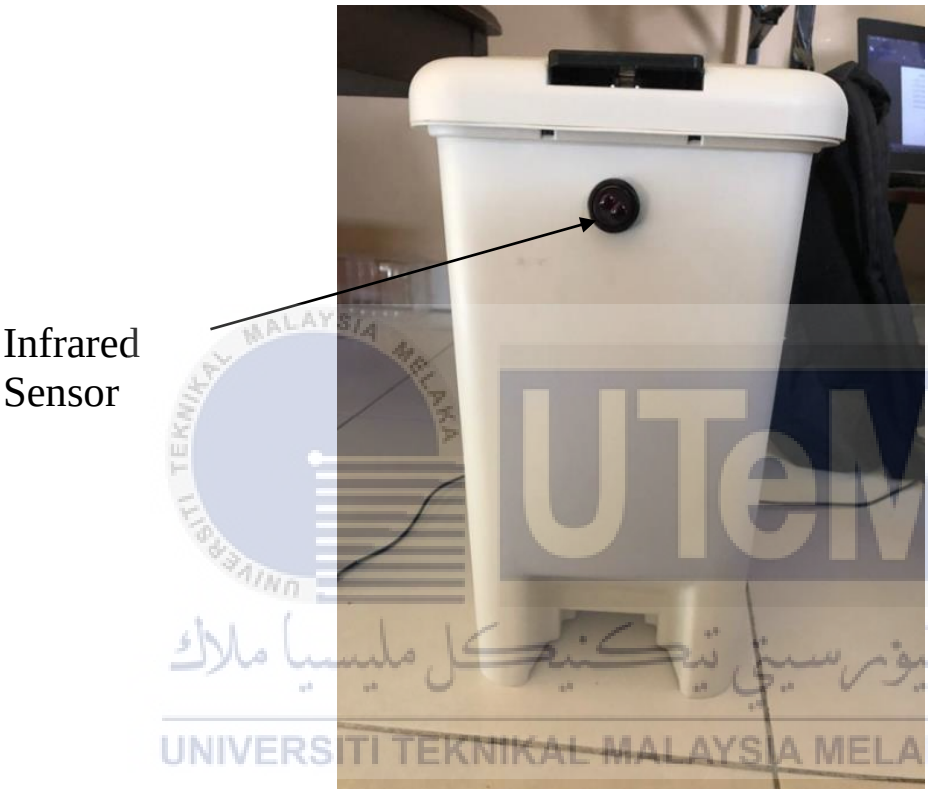

Figure 4.3 The Front View

Figure 4.4 Top view of the smart dustbin

Figure below show the servo motor will be attach to the rod, to open the lid of the dustbin. The servo motor will be move 70 degree to open the lid of the dustbin.The ultrasonic will be place on the top of the lid while the infrared will be place infront of the dustbin

Figure 4.5 The servo motor and the rod connect to the motor

Figure 4.6 The ultrasonic attach below the lid of the dustbin

Figure 4.7 The infrared sensor will open when it detect the hand motion

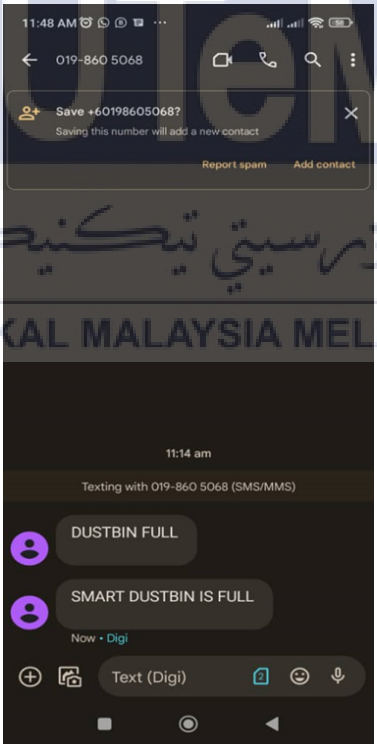

Figure 4.8 show the message receive when the dustbin is full

As show in figure 4.7 when the infrared detect the hand motion the servo motor will push the rod and the lid of the dustbin will open. Then the speaker will make a sound . The dustbin will not close if the infrared still detect hand in front it. If the dustbin full the motor will lock and the lid will keep open until we reset it.The message will be sent to phone as shown as figure 4.8

4.6 Data Analysis

4.6.1 Data Analysis Infrared Sensor

Table below show the analysis between the distance of the Infrared with the hand motion. As we can see the Infrared Sensor only detect the hand motion distance from 0 cm to 40 cm. When the distance reach 40 cm above the infrared don't detect the hand motion so that the servo motor don't push the lid of the dustbin.

Distance	Detect hand Motion
5cm	Yes
10cm	Yes
15cm	Yes
20cm	Yes
25cm	Yes
30cm	Yes
35cm	Yes
40cm	Yes
45cm	No

Table 4.1 Analysis for infrared semsor for distance and hand motion

Figure 4.8 show the motion at the distance of 20cm

4.6.2 The data analysis for the ultrasonic sensor

Table 4.2 show the analysis between the ultrasonic and servo motor. From 6cm to 12 cm the servo motor will push the lid of the dustbin and close it. At 5 cm the servo moto will push the lid of the dustbin and lock it until the program reset and the dustbin close, The ultrasonic will detect the dustbin full at 5cm from the lid of the dustbin.

Distance ultrasonic	Servo Motor
1cm	Lock
2cm	Lock
3cm	Lock
4cm	Lock
5cm	Lock
6cm	Lid open
7cm	Lid Open
8cm	Lid Open
9cm	Lid open
10cm	Lid open
11cm	Lid open
12cm	Lid Open

Table 4.9 data analysis for ultrasonic and servo motor

4.6.3 Data analysis for the GSM module

Table 4.3 show the different Sim card were use on GSM module, which are Umobile , Maxis , Digi and Celcom. Only Digi sim card cant received message when the sim card were attach in GSM module. The led GSM module blink each second when the Digi Simard were attach in GSM module, this mean the GSM unable to find the network. To know if there is a network the led will blink one time at 3 second.

Type of Sim Card	**GSM Message notification**
Umobile	Message received
Celcom	Message received
Maxis	Message received
Digi	Message not received

Table 4.3 Analysis GSM module

Figure 4.8 show the umobile sim card been use in GSM

Figure 4.9 show the DIGI sim card been use in GSM

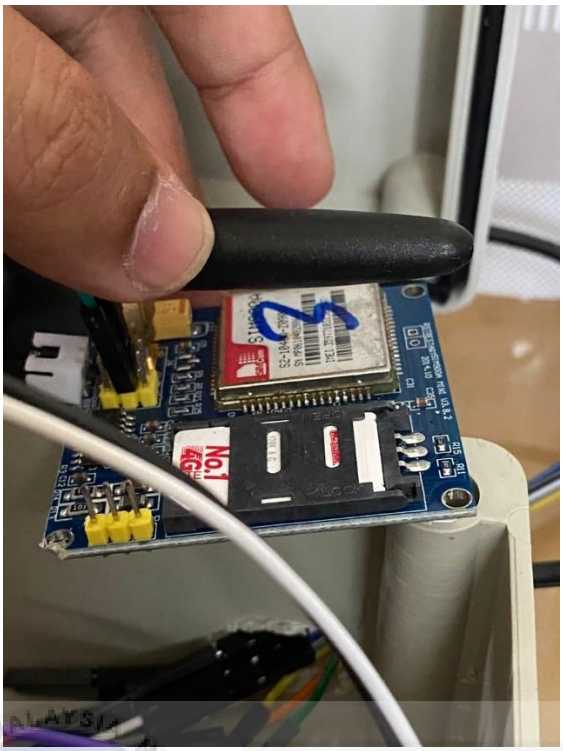

Figure 5.0 show the maxis sim card been use in GSM

Figure 4.8 show the celcom sim card been use in GSM

4.6.4 Data analysis Project perfomance

Table 4.4 show the perfomance of the smart trashbin project,The smart trashbin works well even though the project is continuously tested. The GSM , Infrared sensor , Ultrasonic sensor and servo motor work well without problem.

Number of try	GSM	Infrared sensor	Ultrasonic sensor	Servo motor
1	Work	Work	Work	Work
2	Work	Work	Work	Work
3	Work	Work	Work	Work
4	Work	Work	Work	Work
5	Work	Work	Work	Work
6	Work	Work	Work	Work
7	Work	Work	Work	Work
8	Work	Work	Work	Work
9	Work	Work	Work	Work

Table 4.3 Analysis trashbin perfomance

4.7 Summary

The project's development, including the hardware, software, and system interface, was covered in this chapter. In addition, the analysis of the project's hardware that was done in this chapter

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

They are three objective that we state on chapter 1 which are to monitor the fullness of the dustbin and sent the data when dustbin is full for collect trash .The ultrasonic will detect the level of the dustbin and the data will be save at the micro SD card .Next, the second objective is notify the waste management about the fullness of dustbin through message. The waste management will be received the fullness of the dustbin from the GSM module. Last objective is to design smart bin that user-friendly. The user smart dustbin don't need to touch the lid of the dustbin when to use the dustbin, the infared will detect the motion infront of the dustbin and the servo motor will push the lid of the dustbin.

Based on the result ,we can conclude that we able to archive the developing a prototype that meet the requirement. Future suggestions for this project will also be covered in this chapter for additional development.

5.2 Future Works

In a future work the solar panel can be added at the smart dustbin. The solar panel can power up all the components at the smart dustbin. When the solar panel attach to the smart dustbin it easier to put the smart dustbin in the remote area .Next recommendation add the IOT at the smart dustbin. It easier to monitor the fullness of the smart dustbin

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APPENDICES

Apppendix A

CODING PROGRAM

```
#include <SoftwareSerial.h>
#include <CytronEZMP3.h>
#include <Servo.h>
#include <SPI.h>
#include <SD.h>
#define trigPin 4
#define echoPin 5
#define IR  A0

SoftwareSerial sgsm(2, 3);

Servo myservo;

File dataFile;

CytronEZMP3 mp3;
int lock = 0;
int counter = 0;
//int currentState = 0;
//int previousState = 0;
```

```
int state = 0;

const int chipSelect = 10;

void setup () {

  pinMode(trigPin, OUTPUT);
  pinMode(echoPin, INPUT);
  pinMode(IR, INPUT);

  myservo.attach(7);
  myservo.write(70);


  if (!mp3.begin(0, 1))
  {
    while (1);
  }
  mp3.setVolume(25);
  sgsm.begin(9600);
  if (!SD.begin(chipSelect)) {
    return;
  }

  dataFile = SD.open("LOGDATA.txt", FILE_WRITE);
```

```
  if (dataFile) {
    dataFile.println("Alarm");
  }
  dataFile.close();

}

void loop () {

  int IR_detect = digitalRead(IR);
  long duration, distance;
  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH);
  distance = (duration / 2) / 29.1;


  if ((IR_detect == LOW) && (lock == 0)) {
    myservo.write(0);
    delay(3000);
```

```
  mp3.playTrack(1);
  delay(1000);
  myservo.write(70);
 }


 if ((distance <= 5) && (state == 0)) {
  lock = 1;
  sgsm.print("\r");
  delay(1000);
  sgsm.print("AT+CMGF=1\r");
  delay(1000);
//   sgsm.print("AT+CMGS=\"+601120652169\"\r");
  sgsm.print("AT+CMGS=\"+601136719871\"\r");
  delay(1000);
  sgsm.println("Dustbin Full");
  sgsm.write(0x1A);
  delay(1000);
  state = 1;

  dataFile = SD.open("LOGDATA.txt", FILE_WRITE);


  if (dataFile) {
   dataFile.print("dustbin full");
```

```
      dataFile.print(",");
      dataFile.println();
      dataFile.close();
    }
    delay(15);
  }


  else {
    state = 0;
  }
  delay(15);
}
```

APPENDIX B

Gantt Chart PSM 1

PROJECT ACTIVITY /TASK	WEEK													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Project Briefing	X													
Research project	X													
Background, Problem statement & Objective		X	X	X										
Identify component			X	X	X	X	X	X						
Project flow chart						X	X	X		X	X			
Methodology						X	X	X		X	X			
Review report						X	X	X		X	X	X		
Submit report												X	X	
Presentation														X

APPENDIX C

Gantt Chart PSM 2

PROJECT ACTIVITY /TASK	WEEK													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Preparing hardware	X	X	X	X	X	X	X	X	X					
Researching code				X	X	X	X	X	X	X	X			
Testing Prototype						X	X	X	X	X	X			
Troubleshoot Project						X	X	X	X	X	X	X		
Project Hardware Planning						X	X	X	X	X	X			
Project Design Planning						X	X	X	X	X	X			
Review report						X	X	X	X	X	X			
Final draft submission													X	
Submit PSM 2 Report Panel														X
Presentation														X