School of
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SEG202D Project

Smart Rubbish Bin System

by

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Diploma in Information Technology

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Student Academic Honesty Acknowledgement

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Project title : Smart Rubbish Bin System
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Abstract

In the present day , the scenario of cleanliness with respect to garbage management is degrading tremendously. Many times we saw that the garbage bins are overflowing due to improper waste management. The overflowing garbage bins creates an unhygienic condition and leads in spreading deadly diseases [1]. In this project, Smart Rubbish Bin is built on a microcontroller based platform Cytron Uno board which is interfaced with GSM modem and ultrasonic sensor. In the proposed system , the level of garbage bin is detected with the help of ultrasonic sensor and communicated to the authority through GSM module.The author added a new functionality to address the problem of people throwing the garbage outside the bin because sometimes the lid of the bin is too dirty for the people to touch it. It is expected that this system can create a clean environment by monitoring and controlling the collection of garbage smartly through Internet-of-Things(IoT).

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1 Introduction

The garbage around the urban areas increases tremendously due to the increase in population. We can see the scenario of overflowing rubbish bins and littering happening around the cities. The concept of smart cities came into action nowadays and the main concern in these smart cities is the cleanliness and hygiene of the environment [2].

The traditional way of garbage collection process is a cumbersome process that utilize more human effort and time which is not congruous with technologies nowadays. Irregular management of waste typically domestic waste ,industrial waste and environmental waste is the root cause for many diseases and has adverse effect on the hygiene of living beings.

Smart Rubbish Bin System aims to develop a garbage management system that can create a clean environment .This is compatible mainly with the concept of smart cities . This system consists of a sensor in order to detect the level of garbage in the bin and send SMS to notify the user when the garbage reaches its threshold level.
Smart bin is built using microcontroller, sensor and communication module.

As a result, the project was able to achieve all the aim and objectives proposed in the proposal , and the author further improved the project by adding a new functionality which is enable the garbage bin to open and close its lid automatically when the user passed the hands in front of the sensor.

Moving on , Chapter 2 will be reviewing the similar projects or researches and compare them with Smart Rubbish Bin System. Chapter 3 will describe the steps and approach taken to attain the aim and objectives of this project. Chapter 4 will discuss about the work done and the problem encountered and how the author solve it. After that Chapter 5 shows the final outcome and discuss the result of the project. Lastly, Chapter 6 will conclude the report and discuss future works that can be done to improve the project.

1.1 Problem Statement

Traditionally waste collections have been inefficient as a person needs to keep track about the level of garbage so that it can be emptied and does not overflow.

The garbage truck used to go around the town to collect the rubbish twice a day. Unfortunately in some rural areas ,the level of garbage might not fill up as fast as the one in the cities but the garbage collectors have to go to collect without really knowing if the bins were full or empty. Checking the bins regularly might have been difficult due to remote location. On the other hand, the garbage bins in busy street might fill up faster than ever and inevitably many of the bins end up overflowing before collected which cause a negative health and environmental impacts.

Therefore, Smart Rubbish Bin is here to solve the problem. What smart bin does is it will notify the user to clean up the garbage bin when the garbage level had reached its threshold value. This result in minimize the logistic resources while increasing collection ,delivery costs and time.

1.2 Aim and Objectives

1.2.1 Aim

The aim of Smart Bin System is to develop a waste management system that can detect the condition of the rubbish bin and send SMS to notify the user once it is full.

1.2.2 Objectives

Smart Bin System intends to enhance the waste management process effectively.
The objectives of this project are as shown below :

i. Figure out the hardware components that is required to develop the system.

ii. Compare the pros and cons of the hardware components.

iii. Gather and purchase the required hardware components.

iv. Assemble the hardware components according to the circuit diagram.

1.3 Scope of Work

Smart bin is built on a microcontroller based platform Cytron Uno board which is interfaced with GSM module and ultrasonic sensor.

The ultrasonic sensor is placed on top of the lid to detect the level of the garbage .As trash increases, the distance between the ultrasonic sensor and trash decreases.

Once the garbage reaches the maximum level, ultrasonic sensor will trigger the GSM module to send SMS to the authorities.

All the tools used are low in cost yet powerful enough to develop an effective smart bin system. Both functional and non-functional requirements are as shown below:

- Functional requirements:

  -The sensor must detect the level of garbage in the bin accurately.
  -Users can track the status of the bin in real time.
  -The system can notify the authorities once the bin is full.

- Non-functional requirements:

  -The system is code using Arduino IDE.
  -The system should be available for use 24 hours per day, 365 days per year.

2 Literature Review

As seen in headings 2.1[3] , 2.2[4] and 2.3[5] ,project[3],[4] and [5] are similar project to the author's project. Heading 2.1, 2.2, 2.3 will describe projects [3],[4] and [5] in detailed.
In heading 2.4 , the author will compare the author's project "Smart Rubbish Bin System" against projects [3],[4],[5].

2.1 IoT Based Waste Management for Smart City [3]

In the research report[3],the author built a waste management system using 8051 microcontroller,RF module ,IR sensor and Intel Galileo microcontroller. This system works in such a way that the IR sensor detects the level of the dust in dustbin and sends the signals to the 8051 microcontroller.The 8051 microcontroller reads the data from the sensor and process the data received from sensor.The same signal are encoded and send through RF Transmitter and it is received and decoded by RF receiver at the Central System(Intel Galileo) .An Internet connection is enabled through a LAN cable from the modem and processed in the cloud and the status of the garbage in the dustbin is displayed on the GUI on the web browser .

2.2 Smart Trash :An Application using ZigBee [4]

In the research report[4],this system consists of three modules namely smart trash, truck, corporation office. The trash module consists of two sensors namely IR sensor which are used to detect level of trash whereas gas sensors is use to sense the toxic gases. Once the trash is filled , alarm in the trash rings. The ZigBee is placed in three places ; The ZigBee placed inside the trash will intimate about the overflowing of trash to the corporation office. The ZigBee placed at corporation office is serial interfaced with PC. The ZigBee also placed at the truck to inform the driver about the location of the field trash can.

2.3 Iot Based Smart Garbage and Waste Collection Bin [5]

In the research report[5], smart collection bin consists of ARM LCP2148 microcontrollers ,Wi-Fi module with the combination of weight sensor and IR sensor that indicate the weight and different levels respectively. The IR sensor show the various levels of garbage in the bin while weight sensor gets activated to send its output when its threshold level is crossed. The information is passes to LPC2148 microcontroller and the controller gives the details to the Wi-Fi module. The details is displayed on to the HTML page in web browser of mobile handset.

2.4 Smart Rubbish Bin versus 2.1[3] ,2.2[4] , 2.3[5]

From the research reports[3],[4] and [5], author found out that many different technologies are available out there for developing waste monitoring and management system. Each of the projects has their own capabilities and several limitations.Smart Rubbish Bin System will address those limitations in project[3],[4]and [5].
After read through the research reports, author found out that the three main hardware components that are used to develop the waste monitoring and management system consist of:

i. Sensors
ii. Communication module
iii. Microcontroller

Table 2-1 shows the summary of the literature review in project [3],[4],[5] and author's project.

No.	Title of Ref. paper	Sensor	Microcontroller	Communication Module	Servo motor
2.1	IoT Based Waste Management for Smart City [3]	IR sensor	family of 8051	RF module	N/A
2.2	Smart Trash :An Application using ZigBee [4]	IR sensor, gas sensor	N/A	ZigBee	N/A
2.3	Iot Based Smart Garbage and Waste Collection Bin [5]	IR sensor , weight sensor	ARM LCP2148	Wi-Fi module	N/A
2.4	Author's project : Smart Rubbish Bin System	Ultrasonic sensor	Cytron Uno(Arduino)	GSM	Micro servo SG90

Table 2-1 Summary of Literature Review

2.4.1 Sensor

For detecting the garbage , different types of sensors can be used .As shown in Table 2-2 above , Infrared (IR) sensor is used to detect the level of garbage in the bin in all the project[3] ,[4] and [5]. A combination of IR sensor with gas sensor and weight sensor is proposed in project [4] and [5] respectively. However , weight sensor will only give the information about the weight of the garbage which is not efficient because the it does not identify the level of garbage . Besides , gas sensor will only sense the toxic gases. These two sensors need to combine with IR sensor to have a better functionality. After doing some research about IR sensor , author found out that it works on the principle of reflected light waves.
The limitation of IR sensor is the inability to use it in sunlight due to interference . IR sensor has better performance in detecting bright surfaces than dark surfaces which is may has a poor performance as the condition inside the bin is dark when the lid is closed. The IR sensor values normally fluctuate in variant light conditions.

So, author has decided to use ultrasonic sensor in Smart Rubbish Bin System. Ultrasonic sensor works on the principle of reflected sound waves so detecting obstacles is not affected by as many factors as IR sensor. IR sensor cannot work in dark environments while ultrasonic sensor can.Ultrasonic sensor has higher frequency, sensitivity and penetrating power so it can detect objects easily and accurately which suits the needs of the rubbish bin system to detect the level of garbage. Moreover, ultrasonic sensor has high compatibility to interface with most of the microcontrollers .It could also easily sense the nature and shape of specific objects which is within the area of these sensors.

2.4.2 Communication Module

Smart Rubbish Bin System functions in such a way that when the threshold level is reached, it will notify the user that the bin is fully filled .Wireless communication can be achieved using many devices. In project[3], RF module is used ; ZigBee is used in project[4] while Wi-fi module is used in project[5]. After doing research , author has decided to use GSM (Global System for Mobile communication) in the project as a communication backbone for the whole system for various reasons. RF module, ZigBee and Wi-Fi module can also be used but they have shorter range , lower complexity and lower data speed when compared to GSM.GSM has more advantages over them for communication because it is simple to use ,has low cost easy to implement and less signal deterioration. A GSM modem is a specialized type wireless modem. It accepts a SIM card which can provides mobile internet connectivity and also can be used for sending and receiving SMS ; whereas the other three communication modules do not have this function , they needs Wi-Fi or Bluetooth connection to operate. So, GSM is more suitable for the author's project as it can send message to notify the user when the bin is fully filled.

.2.4.3 Microcontroller

Microcontroller of family 8051 is used in project[3] while ARM LCP2148 is used in project[5] .Systems engineers use to work with microcontrollers of family 8051, PIC microcontroller ,ARM and ATMega microcontroller before the invention of Arduino electronics. However , due to the complexity of the circuit board of these microcontrollers , the development time increases and cost increases. So , author is using Cytron Uno which is Cytron version of Arduino Uno and the same functionality. Arduino is more user friendly , easy to understand and operate.

Some of the comparison between microcontrollers and Arduino are shown in table below:

Microcontroller (8051 /ARM LCP5148)	Arduino (Cytron Uno)
• Require knowledge about the registers and pin definitions by compiler for coding.	• Easy to learn,understand and coding using Arduino IDE.
• Need an external programmer to upload code in flash.	• Upload code by connecting the board to USB port with computers.
• Some development kits are available in market, but the support is poor.	• Many development kits are available in market, with strong support

Table 2-2 Microcontroller Comparison

3 Methodology

For developing Smart Rubbish Bin System ,the author are using waterfall methodology to develop Planning , Analysis , Design and Implementation and Testing phases.

3.1 Planning

In the planning phase, task such as doing research online for the project title that had been chosen help the author have a better understanding regarding the requirements of the project is carried out. The author read various researches and watched various videos regarding similar projects. The author had review the projects of others and figured out the hardware components required for the Smart Rubbish Bin System.

3.2 Analysis

In analysis phase , the author determined the problem of the existing systems that are using different hardware components. The author found some information about pros and cons of different types of microcontrollers ,sensors , communication modules and made comparison between them to decide which components to be used in the system. The author gathered all the hardware components that were required to complete project .
The hardware and software that will be used for this project will be listed on below :

3.2.1 Hardware

This section will list out all the hardware components that are being used in this project. Most of the components below were bought from “QQ Trading” in Pudu or borrowed from HOME Lab from Sunway University.

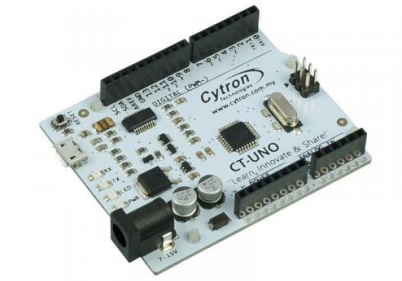

Figure 3-1 Cytron Uno

Figure 3-1 shows the Cytron Uno that is used as the main board of the system.Cytron Uno is the Cytron version of the Arduino Uno. It is a microcontroller board based on the ATmega 328. It has 14 digital input/output pins and 6 analog inputs ,a 16 MHz crystal oscillator , a USB connection, a power jack an ICSP header and a reset button. It can be powered up by using USB cable or AC-to-DC adapter or battery. Cytron Uno is able to operate on 5V where all the components in this project operates on as well.

Figure 3-2 GSM module(SIM 900A)

Figure 3-2 shows the GSM SIM900A module that is used as the communication module of the project. GSM modem is a specialized type wireless modem that works with a GSM wireless network. This module is used as the main way of communicating with the user by sending and receiving SMS which can be done by using AT commands. To get easily connected to various devices , it has communication interfaces like serial port and USB .

Figure 3-3 Rechargeable Battery and battery holder

Figure 3-3 shows the rechargeable battery which is used to power up the Cytron Uno.This makes the smart rubbish bin portable without connecting to the power adapter to obtain the power supply.

Figure 3-4 Ultrasonic sensor

Figure 3-4 shows the ultrasonic sensors that is used in the project. In this project, author uses two ultrasonic sensors .One ultrasonic sensor is placed on top of the lid which is used to detect the level of garbage in the bin while the another ultrasonic sensor is placed at the side of the bin to detect if there is any object placed in front of the sensor .If someone placed the hands in front of the sensor within certain range, the lid will open automatically by itself. Ultrasonic sensors work on the principle of reflected sound waves and are used to measure distance. Sound waves are emitted by the ultrasonic sensor and they are reflected back if there is an object in front of it. The sensor detects these waves and measures the time it takes between transmitting and receiving those sound waves. The time interval between the transmission and reception of the signal allows us to know the distance of an object.

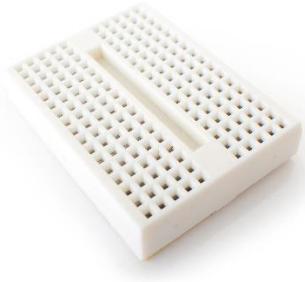

Figure 3-5 Mini solderless Breadboard

Figure 3-5 shows the mini breadboard that is used by the author in this project. The author has decided to use this mini version breadboard as the circuit board as this project does not require much soldering and it makes connecting devices together easier .Its small size helps to save the space in the bin.

Figure 3-6 Jumper Wires

Figure 3-6 shows the jumper wires that are used to connect the devices pin together onto the mini breadboard.

Figure 3-7 Micro Servo SG90

Figure 3-7 shows the servo motor that is used in the project . The author used this servo motor to aid in open and close of the lid. The smart bin will open its lid when someone place the hands in front of the sensor within the range of 20cm (the distance can be changed depending on the user preferences .The servo motor is programmed using Arduino IDE software and connected together with Cytron Uno and ultrasonic sensor to operate. The blade of the lid is set to 180 degree rotation to open and close the lid.

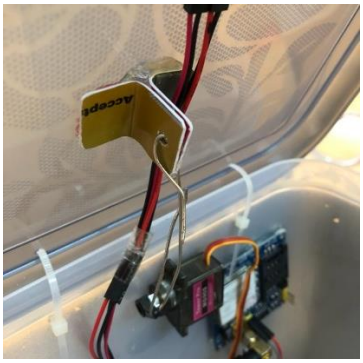

Figure 3-8 Hinge and connection shaft

Figure 3-8 shows the hinge that the author had made from a tin can metal and a connection shaft of huge paper clip .These are used as a mechanism to aid in the open and close of the lid. The idea is to link the arm with the servo motor then the arm rotates as it follows the rotation of the servo motor.

3.2.2 Software

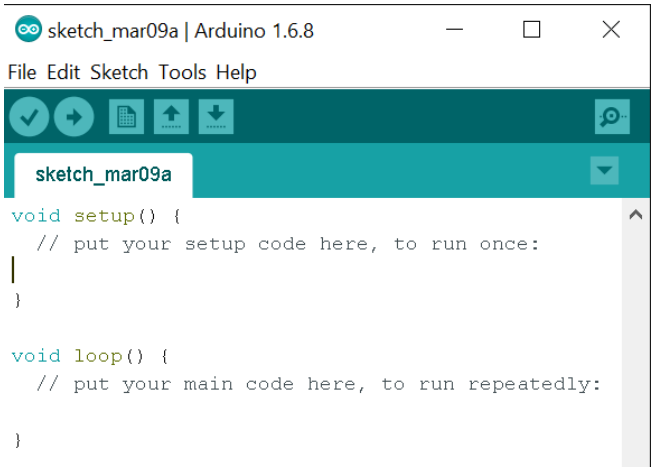

Figure 3-9 Arduino IDE

Arduino IDE [6] is the software that is used to develop and upload the code to the Cytron Uno. Arduino IDE can runs on Windows , Mac OS X and Linux. There are some built in libraries which provide some basic functionalities.

3.3 Design

During the design phase , the author draft a sketch of the circuit diagram to connect all the hardware components together.

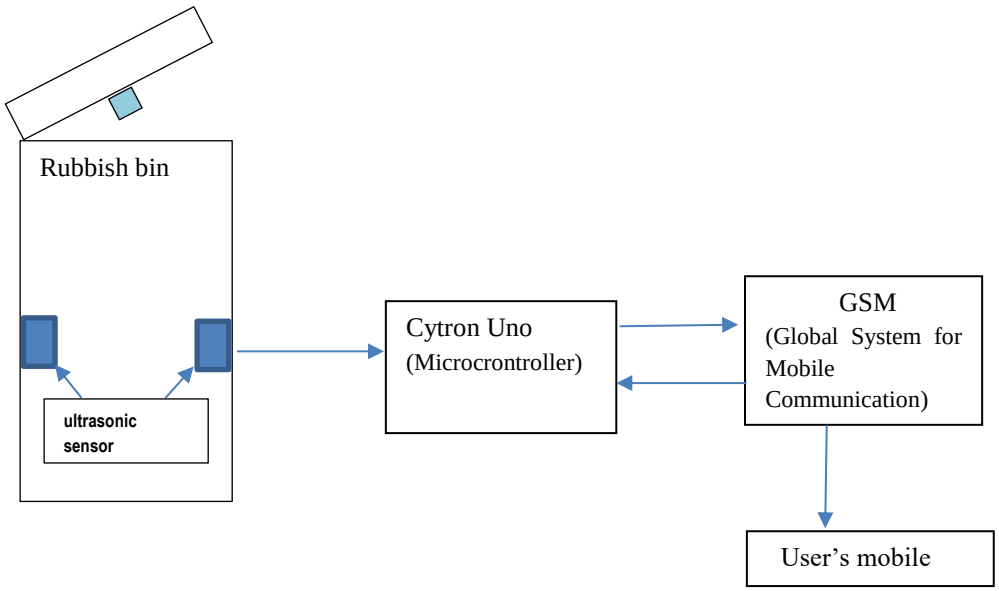

Figure 3-10 Block diagram of smart rubbish bin system

3.3.1 Final Prototype Circuit

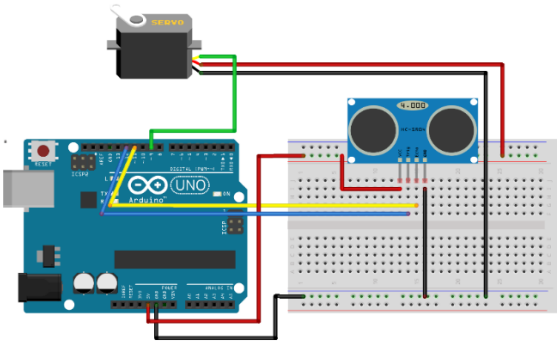

Figure 3-11 Final Prototype Circuit (Cytron Uno, Ultrasonic sensor , Servo motor)

Sensor	Arduino
VCC	5V
GND	GND
TRIG	PIN 8
ECHO	PIN 9

Servo	Arduino
TRIG	PIN 11
ECHO	PIN 10
GND	GND
VCC	5V

Sensor	Arduino
VCC	5V
GND	GND
TRIG	PIN 8
ECHO	PIN 9

GSM	ARDUINO
RX	10
TX	11
VCC	5V
GND	GND

Figure 3-12 Final Prototype Circuit (Cytron Uno , GSM module , Ultrasonic sensor)

The Figure 3-11 and 3-12 shows how each devices pin are connected together .As for the layout of the circuit, it can be seen in “Work Done” (Figure 4-5).

3.3.2 Final Prototype Flowchart

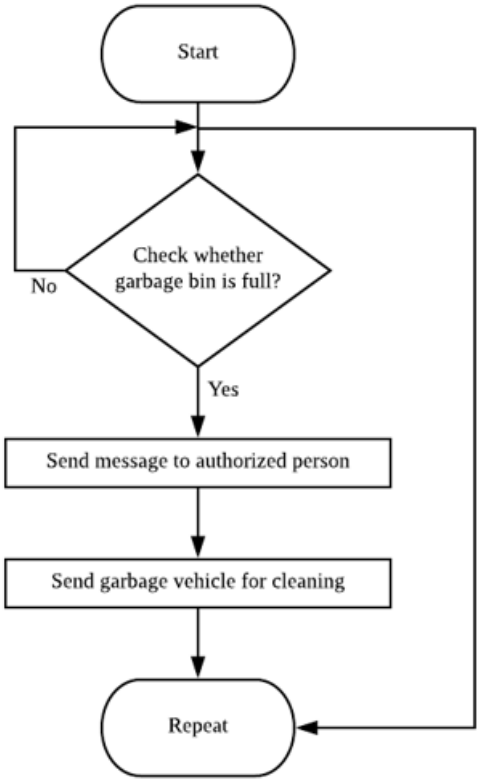

Figure 3-13 Final Prototype Flowchart

3.4 Implementation

During Implementation phase, the author will assemble all the parts that had gathered from the analysis phase. First the author will connect the hardware components such as ultrasonic sensor and GSM to the Cytron Uno according to the sketched circuit diagram from the design phase.In this phase, all the hardware components were coded using Arduino IDE and testing on the code is carried out. Sensors were placed at the right place to make sure the system function properly.

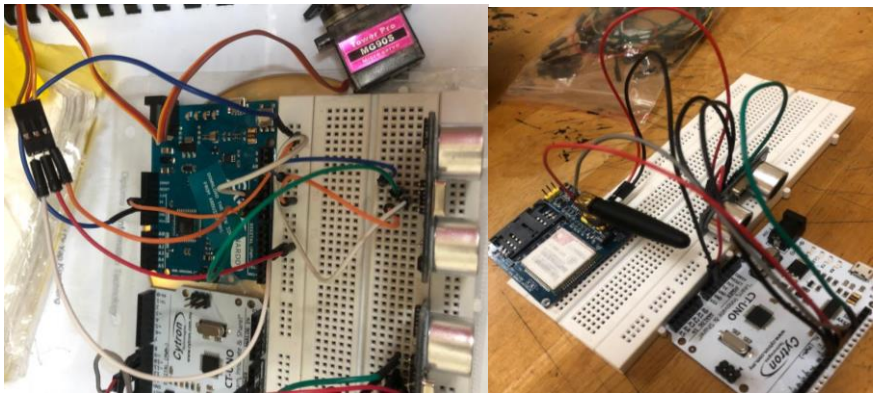

Figure 3-14 Assemble devices according to Final Prototype Circuit

3.5 Testing

Next, Testing phase, which is the most important phase in the development cycle.

The system is built according to the plan but it might occur some problems that need to be modified .Activities such as debugging errors in coding ,check the sensitivity of the sensors and the connectivity of GSM module need to be carried out continuously to make sure the system function properly .When the user place the hand in front of the lid in the range of 20cm , the lid will open automatically and close when the hand is move away ,this means that the system is function in a correct way. When the garbage reached the threshold level , greater or equal to 90% of the bin , it will triggers the GSM module to send a SMS to notify the user that the bin is fully filled.

Besides , the author would ask supervisor and friends to test the system and give some suggestion and comment .The author would proceed to modify the prototype based on the comments that the author received and repeat the design and implementing phase if necessary.After all phase have been gone through , a complete Smart Rubbish Bin System is done. A final report including all the documentation is produced and a presentation about the system is conducted.

4 Work Done

Smart Rubbish Bin System was develop to detect the level of garbage in the bin and notify the user through SMS if the bin is full. Furthermore , author had added a new function to open and close the lid automatically when user pass the hands in front of the bin.

4.1 Final Prototype Codes

Arduino IDE was used to code the project. Figure 4-1 and Figure 4-2 will show the segment of codes for opening and closing of the lid. Figure 4-3 and Figure 4-4 shows the segment of codes for detecting the level of the garbage in the bin

Measure the distance between object and ultrasonic sensor

```
void loop()
{
  long duration, inches, cm;
  Serial.begin(9600);
  digitalWrite(pingTrig, LOW);
  delayMicroseconds(2);
  digitalWrite(pingTrig, HIGH);
  delayMicroseconds(10);
  digitalWrite(pingTrig, LOW);

  duration = pulseIn(pingEcho, HIGH);

  cm = duration / 29 / 2;
```

Figure 4-1 Measure the distance between object and ultrasonic sensor

In the loop ,to make sure the Trig pin is clear ,the author set the Trig pin on a LOW state for 2 microseconds. Then , for generating the ultra sound wave , the Trig pin is on HIGH state for 10 microseconds.
pulseIn() function read the travel time and assign the value into the variable “duration”.
This function has two parameters , one is the name of the Echo pin and the second one is either HIGH or LOW.
HIGH means that the pulseIn() function will wait for the pin to go HIGH caused by the bounced sound wave and it will start timing , then it will wait for the pin to go LOW when the sound wave end which will stop the timing. The function will return the length of pulse in microseconds.

Open and close the lid of the bin

```
  if(cm <=20){
    myservo.write(180);
    delay(100);
  }else{
    myservo.write(0);
  }
  Serial.print(cm);
Serial.println("cm");
  delay(2000);
}
```

Figure 4-2 Open and close the lid of the bin

Figure 4-2 shows a segment of codes that performs its function to open and close the lid of the bin. If the distance is less than or equal to 20cm , the servo motor will rotate 180 degree (open the lid)or else it will just remain its current position.

Detect the level of the garbage in the bin

The author consider the height of the bin is 20cm and store the value in 'max' variable.
The level of the garbage in the bin is calculated by using the formula 'diff=max – distance' where 'diff' variable will indicate how much the bin is left to fill and is converted into percentage.

```
if (perc>=90 && flag==0)
{
Serial.println("Garbage Bin is FULL.");
// Call the Function of Send SMS.
SendMessage(); // Send Message Function

}
```

Figure 4-3 Detect the level of garbage in the bin

Figure 4-3 shows the segment of codes that will invoke the sendMessage() function. The 'flag' variable is used as a switch to control the scenario or piece of logic to perform. The 'flag' variable is set as 0 initially .
When the percentage is greater or equal to 90 and the flag is 0 , SendMessage() function is invoked. It is the function used to send SMS. The flag will become 1 in order to execute this function once .If not , this function will continue to execute and the user will keep receiving SMS continuously as long as the garbage level is maintain at level 90 or above.

Send message to notify the user

```
void SendMessage()
{
 Serial.println("Your Garbage Bin is Full.");
  flag=1;
delay(10000);
mySerial.println("AT+CMGF=1"); //Sets the GSM Module in Text Mode
delay(1000); // Delay of 1000 milli seconds or 1 second
mySerial.println("AT+CMGS=\"+60137273153\"\r"); //
delay(1000);
mySerial.println("Your Garbage Bin is Full."); // TheSMS textto send
delay(100);
mySerial.println((char)26); // ASCII code of CTRL+Z
delay(1000);

}
```

Figure 4-4 Send message to notify the user

AT command “AT+CMGF=1” sets the GSM module to text mode. Then the message will be send to the phone number stated in AT command “AT+CMGS=\” .
The end of SMS content is identified with CTRL+Z symbol and the ASCII value of this is 26. mySerial.println((char)26) send a char(26) to GSM module to indicate the end of the message content.

4.2 Final Prototype Layout

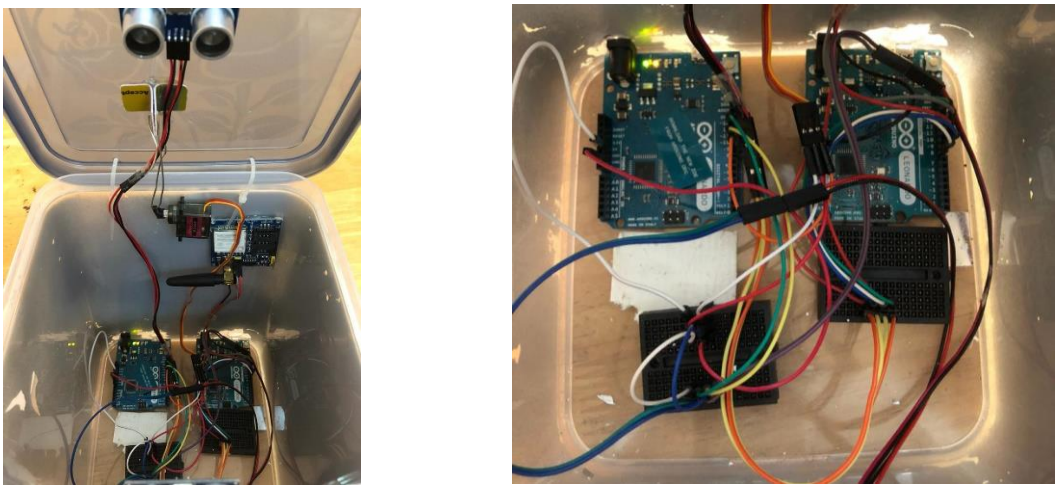

Figure 4-5 Final Prototype Layout

The figure above shows the final prototype layout. It is connected according to the circuit diagram which is shown in “Methodology (Figure 3-11 & 3-12)”. The author upload the codes into the Cytron Uno and proceed with some brief testing with the connection between the devices to ensure the circuit functioning properly.

4.3 Final Prototype Outcome

Figure 4-6 Model –Front

Figure 4-7 Model –Back

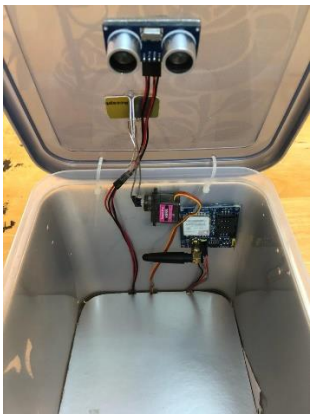

Figure 4-8 Model –Inner

Once all the hardware components and codes are functioning properly, the author placed all the hardware into the bin.

The bin that the author used is a 15cm*15cm*20cm bin in this project. The author drilled two holes to fit the ultrasonic sensor at the side of the bin which is use to open the lid when hand is passed in front of it. Besides , in order to power up the Cytron Uno and GSM module , two holes were drilled at the bottom of the bin. Another ultrasonic sensor is fit on top of the lid to detect the level of the garbage. The servo motor is attached to the wall of the bin and a metal paper clip is used as a connection shaft which is connected to the hinge.

4.4 Challenges

Figure 4-9 Wi-Fi Module (ESP 8266)

The main problem that the author faced was implementing the Wi-Fi module (ESP8266). In the proposal , author had planned to use the Wi-Fi module as the communication module. Author had tried several time to connect the Wi-Fi module to the Cytron Uno but always failed to do so. After doing some research, author found out that the operating voltage of Wi-Fi module is only 3.3V but the Cytron Uno and other components operates at 5V.A step down voltage divider is needed to step down the voltage that the Cytron Uno had supplied. At the same time , author found out that GSM module is a better option compared to Wi-Fi module as a communication module .This is because GSM module is able to send SMS and does not need to connect to Wi-Fi to operate . This is more suitable for the Smart Rubbish Bin System as rubbish bin are normally placed in outdoor where there is no Wi-Fi connection.

5 Results and Discussion

The final prototype of this project was able to perform its function and was also able to meet the aim and objectives that was proposed in the proposal . The Smart Rubbish Bin System is able to detect the level of the garbage bin and notify the user when the garbage bin is full. The author was motivated to further improve the project by implementing a new function.
The addition function in this project is when the user pass the hand in front of the sensor ,the lid will open automatically and close when the user move the hand away.
So the final outcome of the project was more than expected compared to what was proposed. The new function improved the overall user-friendliness of the system as the user not need to touch the lid of the bin which is unhygienic.
However, not every project is perfect ,there are still many ways it can be improved. One of the weakness of this project is that there is only one method to notify the user which is through SMS . If the rubbish bin is placed in an area with a bad signal , the user might not be able to receive the message.

Nevertheless, the result of the project are satisfied and function according to what the author had planned.
It was able to meet the expectations that were proposed in the proposal and the author even further improved the project by adding a more user-friendly function.

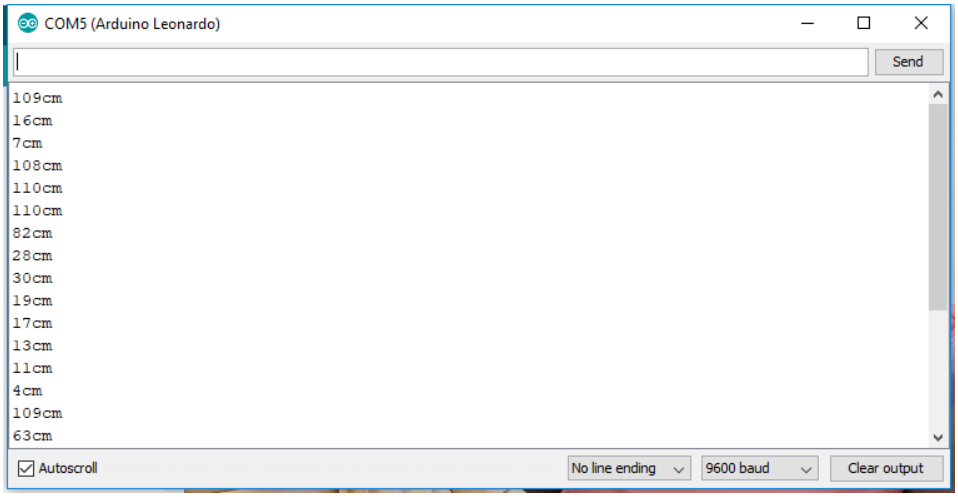

Figure 5-1 Serial monitor for open and close of the lid

Figure 5-2 When user passes the hand in front of sensor in the range of 20cm

Figure 5-3 When user passes the hand of sensor above the range of 20cm

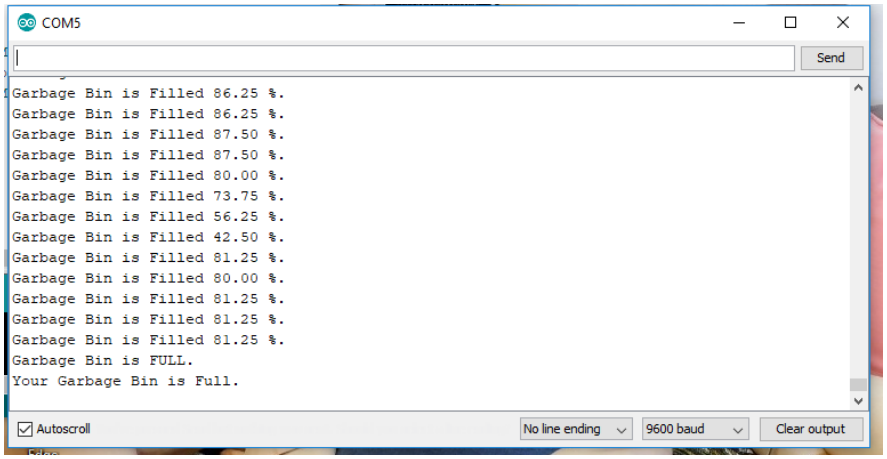

Figure 5-4 Serial monitor for detecting the level of garbage

Figure 5-5 Bin full Alert Message

When the ultrasonic sensor on top of the lid has detected the garbage level exceed its threshold value, the GSM module has successfully send an alert message to notify the user to clean up the bin. It takes about 4-5 seconds to send a message to the user.

6 Conclusion and Future Works

6.1 Conclusion

In conclusion, the final prototype of the Smart Rubbish Bin System has achieved the aim and objectives of this project. The implementation of Smart Rubbish Bin using ultrasonic sensor , Cytron Uno microcontroller and GSM module was able to improve the efficiency of the waste management process that results in minimize the logistic resources and time. Smart Rubbish Bin assures the cleaning of garbage bins , as soon as the garbage level reaches its threshold value thus solve the problem of overflowing garbage bins. This reduces the total number of trips of garbage collection vehicle and hence reduces the overall expenditure associated with the garbage collection. Furthermore , this project will solve the problem of people throwing the garbage outside the bin because he/she does not want to dirty their hands to open the lid of the bin by implementing the automatic open and close lid.

6.2 Future Works

The scope for the future work is this system can be implemented with GPS (Global Positioning System) which will track the location of the rubbish bin and define the best route for the garbage vehicles. Besides , it would be better for the user to get the real time information by creating an web application to show the level of garbage inside the bin.

7 References

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Appendix

8.1 Appendix A – Supervisor Meeting Record

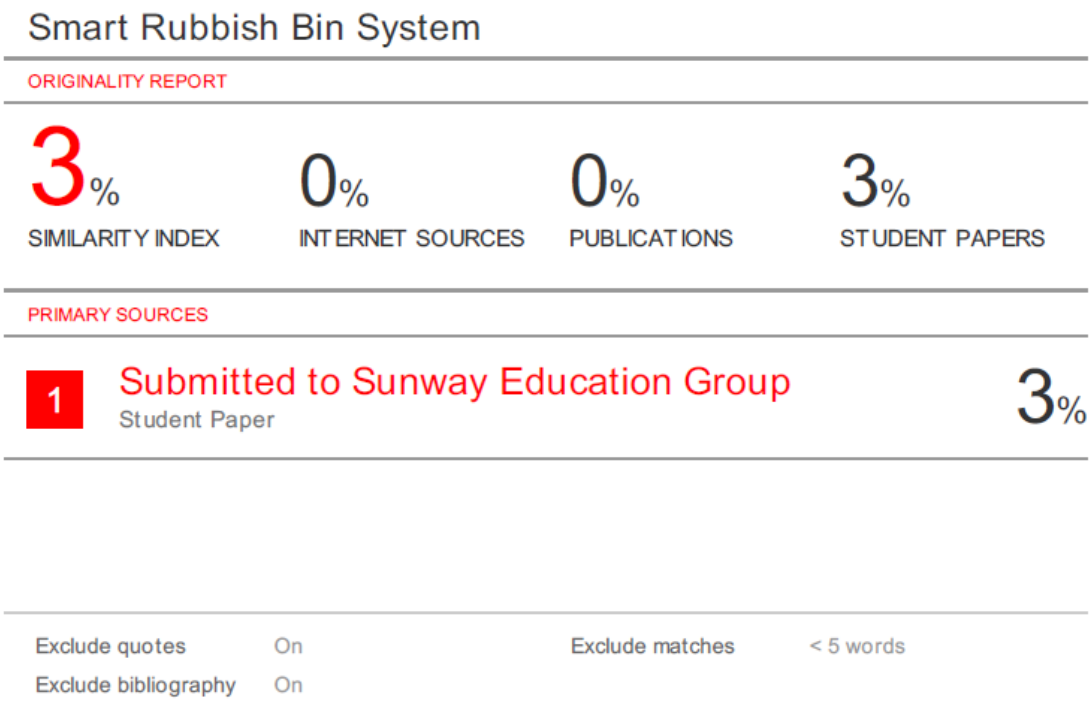
8.2 Appendix B –Codes

```
#include <Servo.h>
Servo myservo;

#define pingTrig 11
#define pingEcho 10


void setup()
{

  pinMode(pingTrig, OUTPUT);
  pinMode(pingEcho, INPUT);
  myservo.attach(9);
}

void loop()
{
  long duration, inches, cm;
  Serial.begin(9600);
  digitalWrite(pingTrig, LOW);
  delayMicroseconds(2);
  digitalWrite(pingTrig, HIGH);
  delayMicroseconds(10);
  digitalWrite(pingTrig, LOW);

  duration = pulseIn(pingEcho, HIGH);

    cm = duration / 29 / 2;

    if(cm <=20){
      myservo.write(180);
      delay(100);
    }else{
      myservo.write(0);
    }
    Serial.print(cm);
  Serial.println("cm");
    delay(2000);
  }
```

```
#include <SoftwareSerial.h>
SoftwareSerial mySerial(10,11);
#define trigPin 9
#define echoPin 8
int flag=0;
float perc;
void setup()
{
mySerial.begin(9600); // Setting the baud rate of GSM Module
Serial.begin (9600);
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
delay(500);
}

void loop()
{
long duration, distance;
int max = 80; // Let consider as Height of the Garbage Bin is = 80 cm.
float diff, perc;
digitalWrite(trigPin, LOW);
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);
duration = pulseIn(echoPin, HIGH);
distance = (duration/2) / 29.1;
diff = max - distance; // 'diff' variable tells u that, how much the Garbage Bin is Left to fill.
perc = (diff/max)*100; // 'perc' var


if (perc<90)
{
Serial.print("Garbage Bin is Filled ");
Serial.print(perc);
Serial.println(" %."); // These 3 Lines are print, that how much the Garbage Bin is Filled..

}


if (perc>=90 && flag==0)
{
Serial.println("Garbage Bin is FULL."); // When the Garbage Bin is filled more than 90%,
                                        then this Error Message will Displayed.
// Call the Function of Send SMS.
SendMessage(); // Send Message Function Call.

}
```

```
if(perc<90 && flag==1)
{
Serial.print("Garbage Bin ");
Serial.print(perc);
Serial.println(" %.");
flag=0;
}
delay(500);
}
void SendMessage()
{
 Serial.println("Your Garbage Bin is Full.");
  flag=1;
delay(10000);
mySerial.println("AT+CMGF=1"); //Sets the GSM Module in Text Mode
delay(1000); // Delay of 1000 milli seconds or 1 second
mySerial.println("AT+CMGS=\"+60137273153\"\r"); // Replace x with mobile number
delay(1000);
mySerial.println("Your Garbage Bin is Full."); // The SMS text you want to send
delay(100);
mySerial.println((char)26); // ASCII code of CTRL+Z
delay(1000);

}
```

8.3 Appendix C – Turnitin Originality Report



Smart Rubbish Bin System

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