

## Weight Monitoring Waste Bin Based on Internet of Things (IOT)

Nor Akmal Ahmad<sup>1</sup> and Mohd Hakimi Zohari<sup>1, \*</sup>

<sup>1</sup>Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia, 84600, Pagoh, Johor, MALAYSIA

\*Corresponding Author Designation

DOI: <https://doi.org/10.30880/peat.2020.01.01.037>

Received 1 September 2020; 9 November 2020; Available online 02 Month 2020

**Abstract:** At present, one of the challenges in most cities are cleanness of the environment regarding the garbage management. In order to avoid overload of the garbage and improve the cleanliness, Weight Monitoring Waste Bin Based on IOT is designed. In the proposed system, the weight of the garbage is detected with the help of weight sensor HX711 and sent to the user for garbage collection through Blynk Application. Ultrasonic sensor is used to detect the people coming closely to the garbage bin with trash while the bin is at full status and block adding of any more garbage to the bin by notification. The peripheral sensors used are interfaced through the Arduino microcontroller. Moreover, LED will change the colour with three condition where red, green and orange. This will capably help to monitor the garbage collection to make the environment smart, clean and safe.

**Keywords:** Weight Monitoring, Waste Bin, Weight Sensor, Ultrasonic Sensor, Blynk.

### 1. Introduction

In the modernization era, there are a lot of flats and apartments that have been built in the quick development area such as cities. This is due to extraordinary housing difficulties which have been extremely risen as a result of migration from villages to town where found the works. In Malaysia, there are numerous issues faced by the residents of the flats. The main issue are domestic solid waste disposal, where it cause air pollutions [1]. Dissimilar landed houses, the waste disposal bins are shared among all residents which live in the same building where live in flats. Therefore, the bins incline to be filled very fast [2].

In consequence, disorganized and ineffective disposal waste management may affect the bins that are full with garbage. Furthermore littering from residents will cause the garbage piles to be speckled outside the bins. Therefore, there will be a question of sanitary as those garbage piles may become the root cause of illness and diseases like dengue, diarrhoea, and cholera. [3] The main objective of the project is to monitor the dustbin by developing weight monitoring waste bin system. The weight monitoring system implements Internet of Things (IoT) to gain realtime information regarding the trash weight and condition on the bin. Then, second objective is to develop a lid bin open and close with

automatically using ultrasonic sensor. Third is to notify waste administrator when level of garbage reaching full condition by using current technology. Lastly, to evaluate the temperature and humidity in bin on the Blynk Application

### 1.1 Internet of Things

In order to keep the city in hygienic condition has been always continuing task which needs energies of people working on ground level emptying the garbage bins whenever they are full. In order to make the city become clean, IOT garbage monitoring with weight sensing project is an innovative step towards making this process more smooth and effective.

Next, the Internet of Things (IoT) has been implemented in our nation the previous couple of years. The Internet of Things defines as ever rising network of fleshly objects that feature an IP address for internet connectivity. It also known as communication that ensues between these objects and other Internet-enabled strategies and organisms.

By using IoT, it gives an IP address can be made as a piece of implanting them with electronic equipment. For example, sensors, application programming and systems administration cloud. In Weight Monitoring Waste Bin Based on IoT project, IoT are used to send notification to consumer when garbage are full or overload. In nutshell, with the execution of the IoT innovation is proposed to address the poor waste management issue influencing our nation [4].

### 1.2 Arduino Uno as a Microcontroller

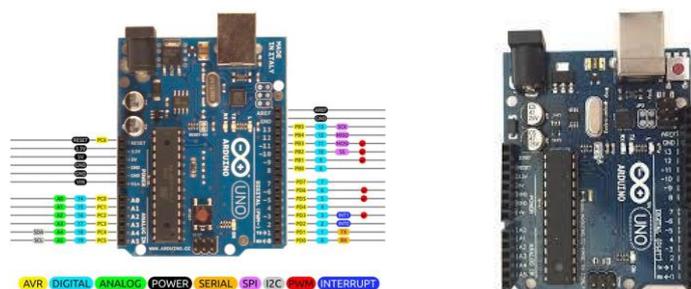
Arduino Uno R3 with is a microcontroller board based on the ATmega328P and it a main controller to control Weight Monitoring Bin Base on Iot. Arrduino Uno contains 14 digital input/output pins where first 6 pin can be used as output of PWM. For this project connection of pin Arduino where pin 4 connected with third port of gas sensor, port 8 was connected with port J pulse on servo motor. For pin 8 it connect with port echo of ultrasonic sensor and port trigger for pin 10. Other 6 pin is analog inputs where pin A0 connected with port 4 of gas sensor. 6 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. An Arduino is easy connect it to computer with a USB cable or power it with an AC-to-DC adapter or battery.

## 2. Components and Methods

### 2.1 Components

#### 2.1.1 Processing Unit

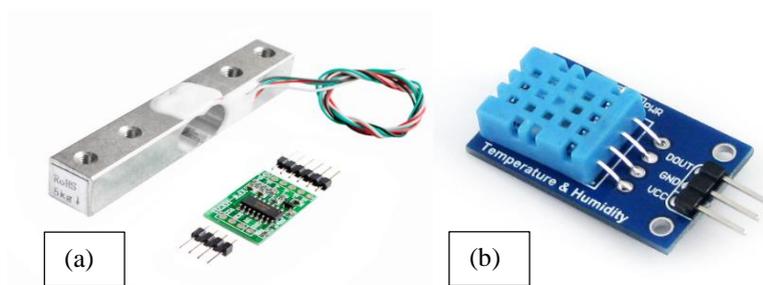
In developing an embedded system, microcontroller plays a very important role which is to control the function of the devices and the system itself. Arduino Uno is used as the main processing unit in this project because it has an enough pin for Input/Output [5-6]. This Microcontroller will receive input from input component such weight sensor, ultrasonic sensor and humidity and temperature sensor. According to Arduino Company, this Microcontroller board based on the ATmega328P and it has 14 digital Input/output which is 6 pin of it can be used as Pulse Width Modulation (PWM) outputs. This microcontroller also powered by using USB port that connected to AC or DC power supply



**Figure 1: Microcontroller board**

2.1.2 Input Unit & Output Unit

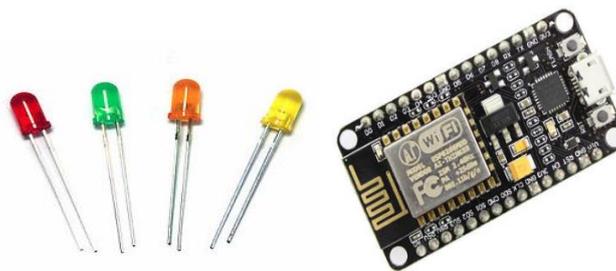
Input unit known as a component that can trigger the entire system with giving a signal to the Microcontroller. For implementation of this project, using a sensor as an input component such as HX 711, DHT 11 and Ultrasonic sensor to trigger the system [7]. ESP 8266 module Wi-Fi also used in this project where it function as an input. Then, for the output unit unit play an important role to give a feedback to system. As for this project, servo motor and Light Emitting Diode (LED) is one of the output units which will light on if it receives a signal from Microcontroller.



**Figure 2 : (a) Weight sensor; (b) Temperature and Humidity Sensor**



**Figure 3: (a) Ultrasonic sensor; (b) Servo Moto**



**Figure 4: (a) LED; (b) Wi-Fi module**

2.1.3 Display Unit

Display unit is one of the important components in this project which is it providing a good communication between human and the device system. With this display unit, human will be easier to understand how the system works. Display unit also display the input from the Weight sensor through Wi-Fi Module. When garbage are overweight, HX711 detected and send the notification to the user via on Blynk Application. By that, LED also will show red colour and on the smart phone it show that garbage are 100 % load.



**Figure 8: Show the garbage in the dustbin are 50 % of weight**

#### 2.1.4 Software

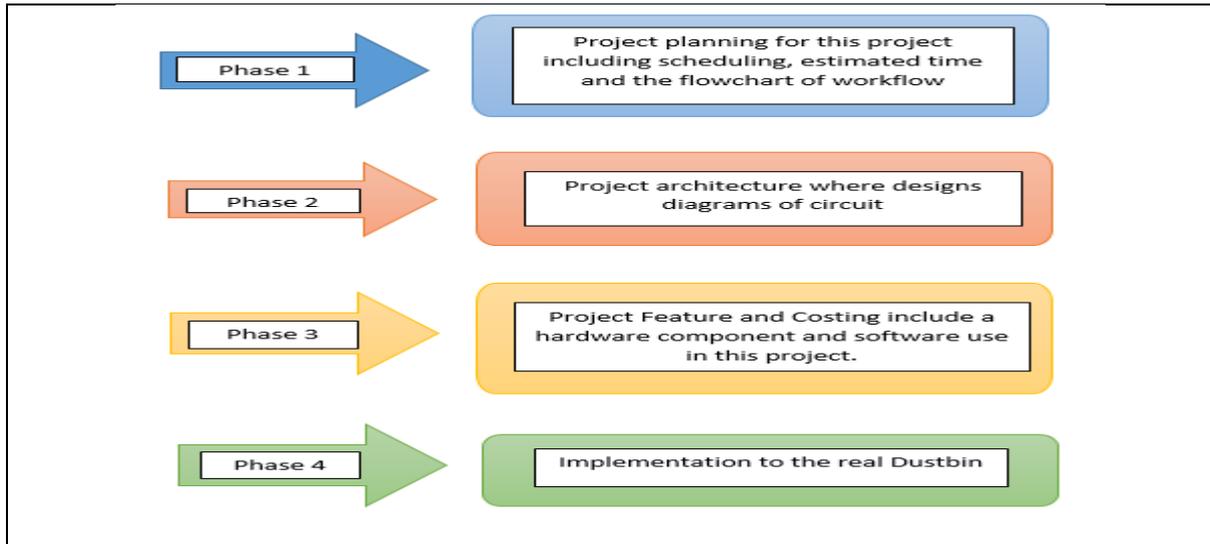
As this project device is using Arduino Uno as the main processing unit, Arduino IDE software is needed to write program code for the whole project which is compatible to compile and upload the code to the Arduino Uno. Other than Arduino IDE software, Proteus software also used for simulation of this project. Hex file from the Arduino IDE is used to run the program in Proteus and Fritzing software is used to design [8] the circuit diagram for this project.



**Figure 9: Arduino IDE and Fritzing software logo**

#### 2.2 Methods

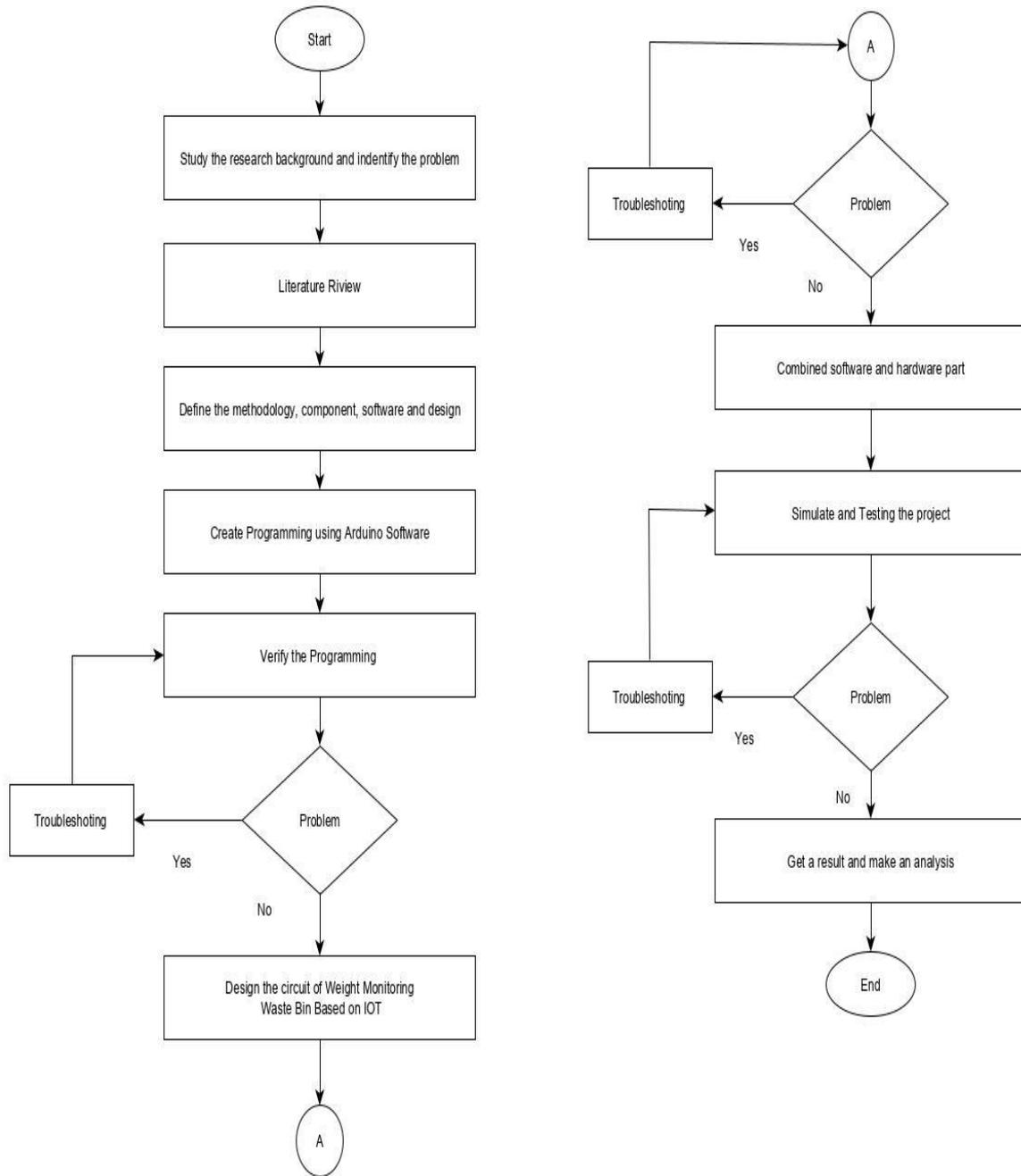
The methodology purposed is to provide detail about this project such as the design of the project and the software and hardware used in this project. It also discussed about important to guide student to implementation the greatest explanation. This section is be responsible for implementation of the software development for Weight Monitoring bin based on IoT. The topic will discuss four phases which are Project Planning, Project Architecture, and Project Features and Costing and Implementation to real Dustbin.



**Figure 10: Overall Project Methodology**

### 2.1 Development of Project Planning

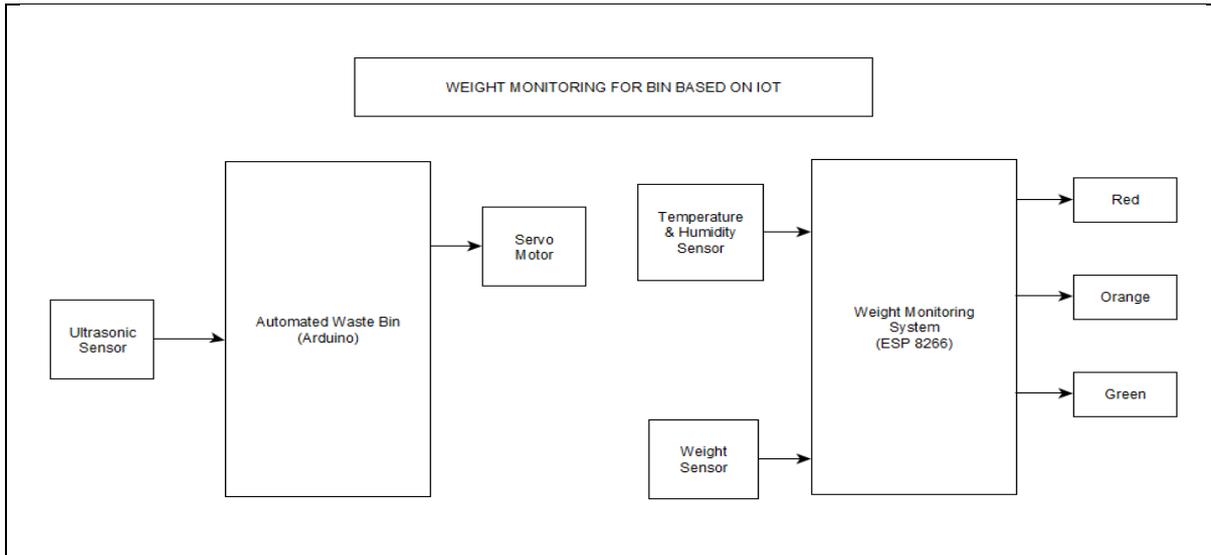
Phase 1 is development of Project Planning in implementation the Weight Monitoring Bin Based on IoT. The most important to accomplish the project effectively and successfully are planning the whole project and scheduling it for each elements about this project. This project planning provides a flowchart that represent the workflow and process of the project. Then, project schedule is more detailed about the list of tasks which is it needed to be accomplished to prevent the process of work.



**Figure 11: Flowchart of project planning**

## 2.2 Development of Project Architecture

In phase 2, it would be briefly explained and illustrate the full block diagram of project. Thus, for represent a system layout and structure that involved in the project by using a block diagram. The overall block diagram is shown in Figure 11 illustrates separated block diagram used in Weight Monitoring for Waste Bin Based on IoT. Then, block diagrams were designed to show the preliminary plan and the system layout for each part of the operating system in this project.



**Figure 12: The overall block diagram of Weight Monitoring for Bin Based on IoT.**

The left part of block diagram for Arduino controller, which are using the Arduino Uno as a controller to interface of software and hardware component. Then, Arduino Uno is received input data from ultrasonic sensor which is to detect the movement from human when opening the lid dustbin. The range that ultrasonic sensor can detect are 12 cm only. When garbage was reach its heavy such as full with liquid, Weight Sensor will give notification the output to user via Blynk application on the smart phone. The right part are block diagram for ESP 8266 WIFI module. Function of this system is to get information from sensor, which temperature and humidity sensor that will send a signal to Wi-Fi module that connected with Arduino Uno then it will send the data through an output. The ESP8266 also used to send information to web notification such as Blynk. Besides, when garbage was reach its heavy such as full with liquid, weight sensor will give notification to user. The LED are used to monitor the level or garbage and implemented based on colour which when its red is full, orange show it 50 % and green is empty. Weight sensor will give notification the output to user via Blynk application on the smart phone.

2.3 Development of Project Features and Costing

**Table 1: Total Costing of project**

Parts	Total
Component	RM 197.82
Miscellaneous	RM 25.76
Dustbin	RM 24.50
Total	RM 248.08

2.4 Programming Development Method

Satisfactory to correctly develop the programming structure and the preliminary step is used the flowchart to assemble the procedure. The flow are required operation function of each part of this project. Before create a coding, the first step is sketch a flowchart. Flowchart is important to solve the solution with the systematic procedure. By using these programming technique, it capable to display the flow of process and the instruction for program coding to solve the problems.

### 2.4.1 Flow Chart for Automatic Waste Bin System

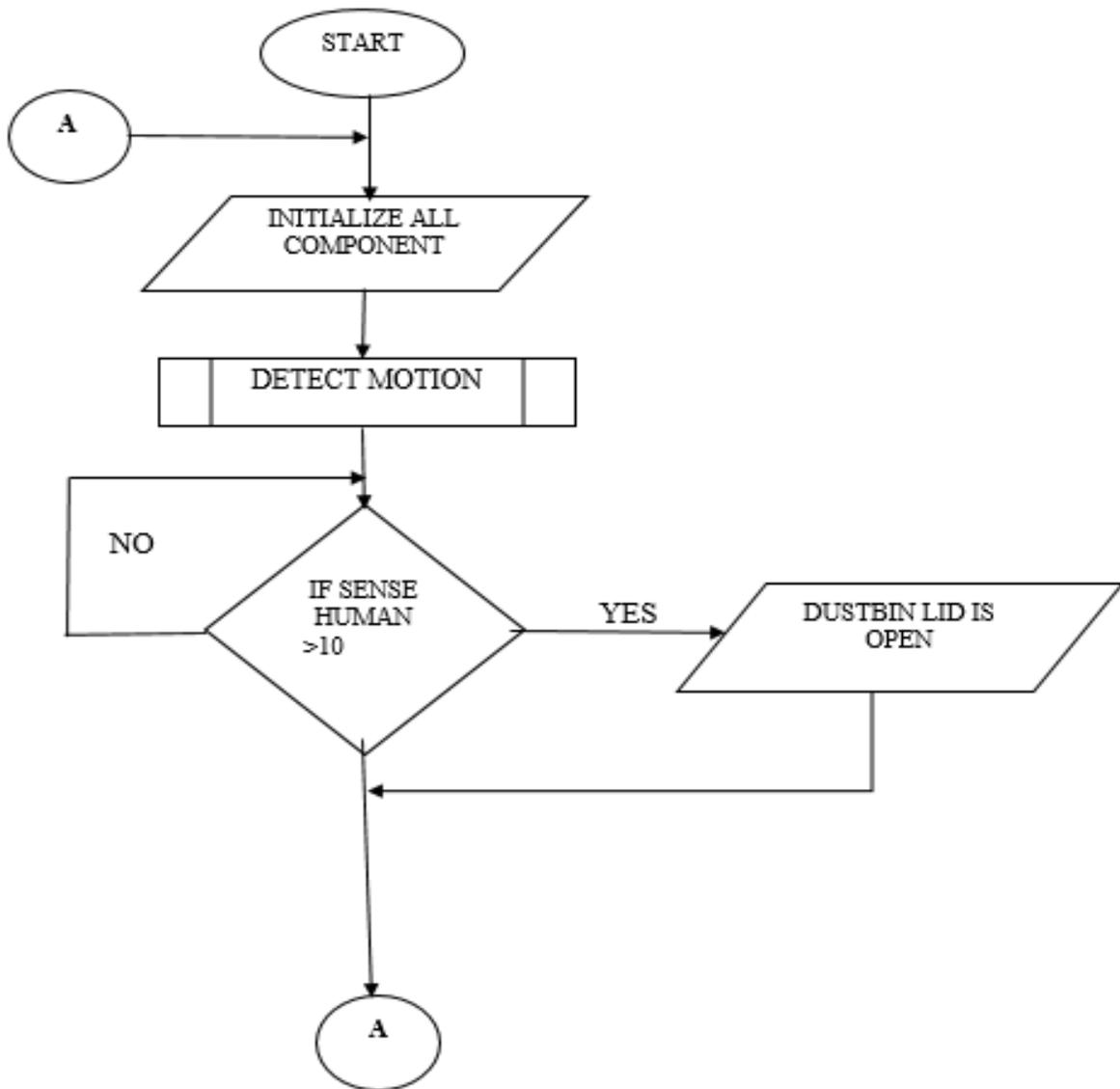


Figure 13 : Flowchart of Automatic Waste Bin System

2.4.2 Flow Chart for Weight Monitoring for Bin Based on IoT

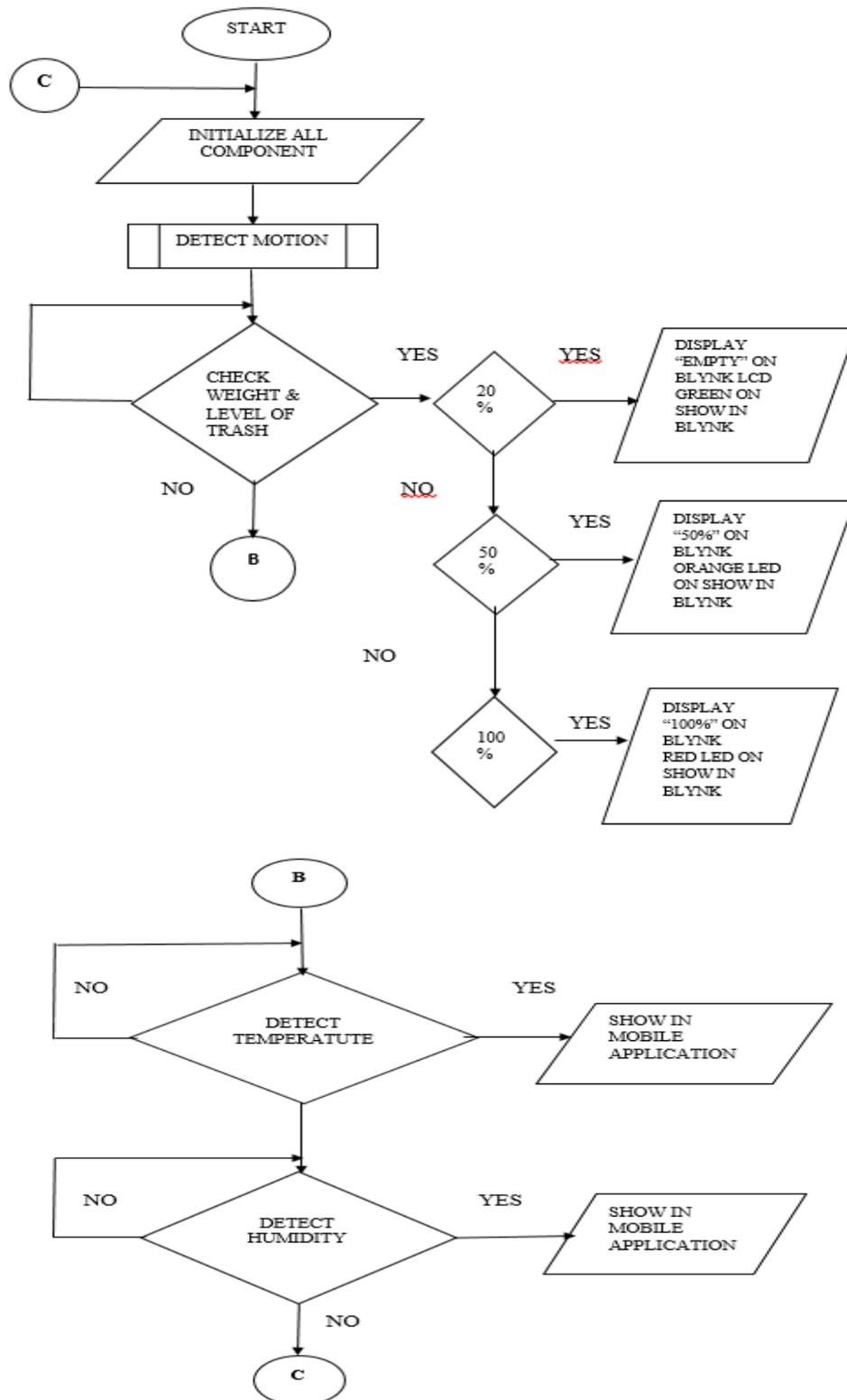


Figure 14: Flowchart of Weight Monitoring for Bin Based on IoT

3. Results and Discussion

This section discussed and analysed all the result of Weight Monitoring Waste Bin Based on IoT. Then, will define all performance, problem that faced and also the strength of the project.

### 3.1 Performance of Weight Monitoring Waste Bin Based on IoT system.

The main system in Weight Monitoring Waste Bin Based on Iot are weight sensor (HX711) can detect any weight of garbage. Limit of weight sensor can measure the weight is 5 kg and give a notification to user when garbage are reach 50 % and 100 %. This system also connected with the DHT 11 where it shows the temperature and humidity in the bin. . In this experiment, 3 months needed to observe the weight of rubbish where start from 8am until 8 pm. The surveillance for testing the sensor on the project, 3 different place are selected which is corridor, office and in house. Time was set between 8 am until 8 pm to get more data. Table 2 shows the condition of garbage in dustbin Table 3 shows the performance of sensor HX711 and DHT 11

**Table 2: Condition of garbage in dustbin.**

Condition of garbage	Colour of Led
 <p>Empty condition</p>	 <p>Orange LED</p>
 <p>Moderate condition</p>	 <p>GreenLED</p>
 <p>Full condition</p>	 <p>Red LED</p>

**Table 3: Performance of sensor HX711 and DHT 11**

Place	Time	Weight percentage	Temperature	Humidity	Colour of LED	Level of trash
Corridor/ Balcony	8 a.m – 12 a.m	0 % - 15 %	29.0 °C	80 %	Orange	Little
	12p.m –4 p.m	15 % - 50 %	36.0 °C	63 %	Green	Moderate
	4 p.m –8 p.m	50 % -100 %	32.8 °C – 38.0 °C	71 % - 82 %	Red	Full
In office	8 a.m – 12 a.m	0 % - 15 %	27.1 °C	48 %	Orange	Little
	12p.m –4 p.m	50 % -100 %	33.0 °C – 38.0 °C	63 % - 74 %	Red	Full
	4 p.m –8 p.m	15 % - 50 %	34.0 °C	79 %	Green	Moderate
In House	8 a.m – 12 a.m	50 % -100 %	28.0 °C – 32.3 °C	66 % - 76 %	Red	Full
	12p.m –4 p.m	0 % - 15 %	31.0 °C – 36.0 °C	38 %	Orange	Little
	4 p.m –8 p.m	15 % - 50 %	34.7 °C	59 %	Green	Moderate

As result shown, garbage reach 100 % of weight when peak hours where the time is between 4 pm until 8 pm at corridor place. LED turn on to red colour that show garbage was full and user need to take it out from dustbin. The range of temperature are 32.8 °C until 38 0 °C and the humidity are 71% to 80 %. For the second place where in the office, the level or garbage are little and LED turn on yellow. On the Blynk apps shown the temperature was 21.7 °C and humidity are 48 %. This is because on that morning was rainy so it cause effect to the temperature. Third place is in the house where on 12 pm until 4 pm, the weight garbage shown 0 % because user just clean up the dustbin so dustbin was empty without any garbage. But around 2 pm the weight of garbage reach 15 % because people throw the garbage in the dustbin and LED turn on into orange. The temperature on that time are 34.8 °C and the humidity was detected is 38 %. Overall of the result, it may be different based on situation and environment where the dustbin placed. The power that can load in this project are 5 V where using PC or power bank to connect the circuit. Meanwhile, it can save an energy and easy to carry out to everywhere.

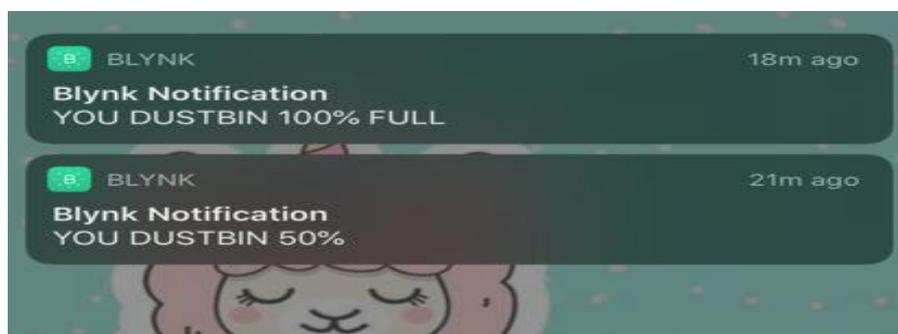
**Figure 15: Blynk notification appears on smartphone with 100 % weight of rubbish.**

Figure 15 shows a notification obtained by users via Blynk Application. Users get all the results through on the apps. In the system, weight of rubbish above to 50 % until 100 % will notify the user that rubbish was full or not. In this apps also show the humidity and temperature of garbage. Percentage

of humidity and temperature changing based on type of rubbish and the situation in dustbin. Type of rubbish was affected to temperature because DHT 11 are very sensitive with heat.

#### 4. Conclusion

This project were accomplished all the objectives where the main goal is to develop the system by implementing IoT. It gain the real-time information regarding the trash weight and condition on the bin. This project also work with implementation of Arduino Uno R3, weight sensor, ultrasonic sensor, temperature and humidity sensor, servo motor, LED, and Wi-Fi Module ESP8266. The combination of software and hardware provides this project are successful with smoothly. Using Blynk application, user always can determine the level or garbage in the dustbin. This system guarantees the clean-up of dustbins quickly when the garbage level extents its maximum. If the dustbin is not cleaned in specific time, it can cause the area will smelly. This system also aids to avoid the false information and effect to reduce the exploitation in the general management system. This project can decreases the total of trips of garbage collection vehicle. During current issue in the world about COVID19, this project were designed to make our environment are always hygiene and keep clean. In future, condenses the complete expenses concomitant with the garbage assembly. It initially aids to preserve sanitation in the public in this country.

#### Acknowledgement

The authors would like to thank the Faculty of Engineering Technology, Universiti Tun Hussein Onn Malaysia for its support.

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