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DEVELOPMENT OF SMART DUSTBIN BY USING APPS

Jamil Abedalrahim Jamil Alsayaydeh[1,2], Adam Wong Yoon Khang[1,3], Win Adiyansyah Indra[1,3], Vadym Shkarupylo[4] and Jayananthinii Jayasundar[1]
[1]Fakulti Teknologi Kejuruteraan Elektrik dan Elektronik, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, Durian Tunggal, Melaka, Malaysia
[2]Center for Advanced Computing Technology, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, Durian Tunggal, Melaka, Malaysia
[3]Center for Telecommunication Research and Innovation, Universiti Teknikal Malaysia Melaka, Hang Tuah Jaya, Durian Tunggal, Melaka, Malaysia
[4]Department of Computer Systems and Networks, National University of Life and Environmental Sciences of Ukraine, Heroyiv Oborony str., Kyiv, Ukraine
E-Mail: jamil@utem.edu.my

ABSTRACT

This paper entitled Development of Smart Dustbin by Using Apps. Arduino as a controller between ultrasonic sensors, buzzer, led, fan and WiFi Module. This system implemented so that cleaning department management or cleaners can be aware with the overflow of rubbish of a dustbin at certain place. It is very useful in daily life and important for all level of people either young, old, disable people or anyone who using the dustbin to throw rubbish. This is a very important system to be implemented mainly at the indoor buildings such as supermarket. The project started to work when there is a people coming near to the dustbin to throw rubbish where it will be detected by the ultrasonic sensor and motor will be open the cover of the dustbin. The level of rubbish inside can be seen through the Blynk Apps. Once the level of rubbish reached a certain level a reminder notification will be send to the cleaning department to give a warning that dustbin going to be full. Another notification will be send once the level of rubbish reached maximum level to take immediate action to collect the rubbish through the Bylnk Apps and buzzer started to give beep sound.

Keywords: camera-ready, WiFi module, blynk Apps, smart, technology, control, arduino, GSM module, internet of things.

INTRODUCTION

In this era, most of the people prefer to shop at the supermarket. This is because as there are a lot of choices of goods from the household things until the raw things. As there are many people keep on visiting the supermarket, there also a lot of rubbish started to be generated. Hence, this lead to the dustbin cannot cope with the rubbish and sometimes the dustbins are overflow. This type of situation not only happens at the supermarket but at the most of the places. This problem happens due to the cleaning department not very sensitive to this matter of the dustbin full of rubbish and also overflow. The dustbins which are full and overflow not collected on time by the cleaning department. Therefore, to overcome this matter here come the idea of develop a smart dustbin by using Apps. Whenever the dustbin is full, an alert notification is sent to the cleaning department for quickly pick up the rubbish. Development of Smart Dustbin by using Apps is a high performance programmable smart dustbin using Apps. Apps is a system which it combines the knowledge in the field of telecommunications and computing. This smart dustbin started to work once a person nears the dustbin. The ultrasonic sensor used to detect the person when they come near to the dustbin. Then, the dustbin will be automatically open. People no need to use their hands or leg to open the cover of the dustbin to throw the rubbish. When the dustbin is going to be full then a reminder notification will be sent to cleaning department. Once the dustbin with rubbish reach a maximum level buzzer will give a beep sound and at the same time it will sent an alert notification through a communication link which is Blynk Apps to the cleaning department.

WASTE MANAGEMENT

In this modern together with super advanced technology day and the fast development in the human population, the waste problem has become one of the worst environmental problems in many of the countries. The reason of this problem occurs is due to the way of controlling waste collection and management in the country where the waste is not managed efficiently and effectively. Wastes are created from different types of sources where it could cause the environmental pollution. It also can give a risk to the health. Lack of proper management solutions is one of the big difficulties in managing the landfill for the liable party. Therefore, to get more information of the collection and management of the waste there are some interviews and site visits which were conducted. It was conducted by the company which are responsible for the waste management [1].

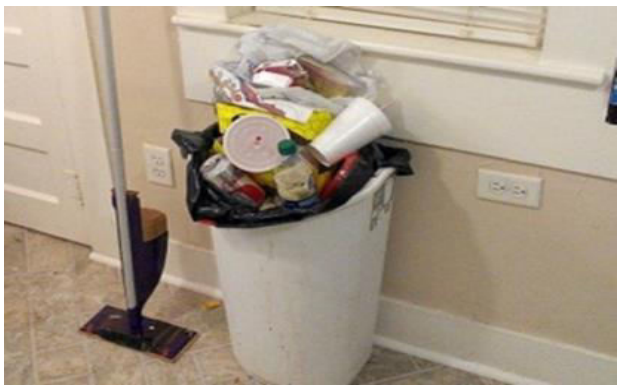

Figure-1. The waste not managed efficiently and effectively.

The Figure-1 above demonstrates the real situation of the reason that is faced by the authorities in this country. One of the factors that make situation like this happen is that the cleaning management or authorities does not get information about the current situation whether the dustbin is full of rubbish or not. Actually, the authorities of the cleaning department have their own regular schedules on the picking up the rubbish and on for the each of collection bins which when it is full or not, the cleaner have to wait for the appointed day to collect the rubbish. The system that they use is not relevant as this will generate problems when there are big events or functions where at that time the amount of rubbish will be loaded rapidly. So, the rubbish that were gathered produce bad smells and it may cause to the destruction of other general cause harm to public health.

IOT BASED SMART GARBAGE AND WASTE COLLECTION BIN

Navghane, S. S. et.al proposed A IOT Based Smart Garbage and Waste Collection Bin, briefly tells that this is regarding a trash bin which it is connected with a microcontroller. This microcontroller has a system based on the IR wireless and also central system. Central system used as show the status of trash by web browser of a mobile with of a page html using WI-FI. Thus in html page the latest out is refreshed. This project depends on the working of the Wi-Fi module; essential for its implementation. Combination of sensors of weight and IR sensor give the amount of weight and the separate level. The different level of junks can be known by using the IR sensor. While when the trash achieved a level that crossed a limit, here weight sensor will be activated so that it can send its output. More information about the microcontroller (ARM LPC2148) and the controller passes the information to transmitter which is the Wi-Fi module. This combines the microcontroller with 32 kB, 64 kB and 512 kB of embedded high speed flash memory. For the recipient part a mobile phone with the Wi-Fi switch must be connected. In the mobile phone with web program can know the current information regarding the garbage bins [2] [3].

Monika K A et.al proposed A Smart Dustbin based on IoT in which the smart bin was built on a platform which was based on Arduino Uno board which was interfaced with a GSM modem and an ultrasonic sensor. This sensor was placed on the top of the bin. A threshold level was set as 10cm. As the garbage reaches the level of threshold, the sensor triggers the GSM modem which alerts the associated authority till the garbage in the bin is emptied. At the end, a conclusion was made that various issues like affordability, maintenance and durability were addressed when these smart bins were designed. It also contributed towards a hygienic and clean environment in the process of building a smart city [4].

Chakole, S. *et al* proposed a Real Time Smart City Garbage Collection and Monitoring System Using GSM and GPS, it tells about a project that is created by using Embedded System for the efficient collection of junks. It is a project that is with a coordinated system of GPS and GSM. The GPS stands for Global Positioning System while the GSM stands for Global System for Mobile Communication. Sensors are located at the garbage bins which common at the open environment. Once, junks reached to an expected level of the sensor, the AT89S52 Controller will receive a signal. The signal then passed for an immediate action to truck driver of garbage collection which the dustbin is completely full. By using GSM system, it will send message from the AT89S52 once the bin is fully filled. The function of AT89S52 is to utilize between sensor and GSM system [5].

SMART DUSTBIN

This venture Smart Dustbin is about another design used in the city rubbish dustbins where suggest the center of board for quick collecting of rubbish. This dustbin is additionally intended to pack the rubbish periodically therefore keeping the unnecessary involving of dustbin's space by light weighted yet space possessing trash particles like wipes, and so on. A leaf switch is squeezed by the rubbish when it achieves a specific level and an Arduino Uno is customized such that when the junk achieves this specific level, intimation is given to the central hub in the form of glowing of LED [6].

Chaware, S. et.al proposed an integrated system of Wi-Fi modem, IoT, GSM, Ultrasonic Sensor is introduced for efficient and economic garbage collection. The developed system provides improved database for garbage collection time and waste amount at each location. He analyzed the solutions currently available for the implementation of IoT. By implementing this project, then will avoid over flowing of garbage from the container in residential area which is previously either loaded manually or with the help of loaders in traditional trucks. It can automatically monitor the garbage level & send the information to collection truck. The technologies which are used in the proposed system are good enough to ensure the practical and perfect for solid garbage collection process monitoring and management for green environment [7].

Garbage Management is a big issue for everyone to need action across it immediately. Lokhande, P. et.al proposed a system that able to observe the different type garbage is thrown into dustbin by using sensors. When dustbin is full or overflowed then ultrasonic sensor is

detected the level garbage in dustbin or some wet garbage is thrown into dustbin is detected by the Moisture sensor or some unpleasant smell as well as toxic gases are generated then gas sensor is give the information. This sensors output is given to the Micro-controller. In this system there are two technologies are used like Zigbee and Global system for Mobile communication (GSM). These two technologies are used for wirelessly data transmission over long distance. PIC controller is used to send the Message to cleaning authority who clean the dustbin by using GSM. It is a real time system; the dustbin status is shown on PC by using GUI. This type of system is used in college campus, offices and many places where it is suitable [8].

Table-1. The similarities and differences on past and current research.

Journal	Similarities	Differences
The IoT Based Smart Garbage and Waste Collection Bin	- use WIFI as the communication system	-use different microcontroller -use IR sensor
Smart Dustbin	-use Arduino	-does not use any sensors and communication system
Smart Dustbin-An Efficient Garbage Monitoring System	-use Arduino	- use GSM as communication system
Smart Garbage Monitoring System using Internet of Things (IOT)	-Arduino UNO as the microcontroller	-two different way of communication system which is GSM and WI-FI
Smart Bin Implementation for Smart Cities	- use only one sensor	-use different types of microcontroller - the communication system is GSM system
Garbage Collection Management System	- use ultrasonic sensor	-use different types of microcontroller - use GSM system as communication system
The Real Time Smart City Garbage Collection and Monitoring System Using GSM and GPS	-use same sensor	- use different types of microcontroller -use GSM system as communication system

GLOBAL SYSTEM FOR MOBILE COMMUNICATION (GSM)

The global system for mobile communication modem able to acknowledged any of the GSM that organizes administrators SIM card. It also can simply act as a mobile phone that has an own kind of mobile number. One of the advantages of using this modem is that can utilize the RS232 port to communicate and embedded applications created. Exchange of information, control of SMS and remote control are the applications that can be use GSM. There are 2 ways that the modem can be associated whether with PC serial port 13 or any of the microcontroller via MAX232. This modem can be used for sending and receive short message. Besides that, can be used to make and receive voice calls. GPRS mode to interface with a web and can do some applications for information logging or control also can be utilized.

GSM module characteristics:

- Effectiveness of improved range
- International roaming
- Can work with integrated services digital network (ISDN)
- Able to support new services
- Manage SIM phonebook
- Fixed dialling number (FDN)
- Alarm management with real time clock
- Speech with high quality
- Phone calls more secure which uses encryption
- Text message (SMS)

Figure-2. GSM module.

Buzzer

Buzzer is one of the devices that normally used in electronic device, vehicles, household things, alarm devices, timers and others. It produces a discernable tone when powered. There are two types of buzzer which are piezo and magnetic. Buzzer is ordinarily utilized as a part of home automation undertaking, for example, home alarm and real industry. It gives a security to the home. In this project, buzzer used for sounds a "beep" when the rubbish becomes full.

Table-2. Comparison between Piezo and Magnetic buzzer.

Piezo Buzzer	Characteristic	Magnetic Buzzer
< 30mA	Current consumption	30mA-100Ma
3V-250V	Operating voltage	1V-16V
High	Sound level	Low
High	Resonant frequency	Low
Large	Foot print	Small
Cheap	Price	Expensive

Microcontroller

A little computer or single board of an independent system with peripherals, memory and a processor is a microcontroller. It can be utilized as an embedded framework. Besides that, microcontrollers are intended for installed applications, as opposed to the microchips utilized as a part of computers or other broadly useful applications comprising of different discrete chips. Most programmable microcontrollers that are utilized today installed in other buyer items or hardware. The items are including telephones, peripherals, cars and household items for PC system. Then, microcontrollers are devoted to an undertaking and compile a particular program. In ROM (read-only memory) the program is stored. Microcontrollers are frequently low-control devices. Moreover, microcontroller ordered by a few parameters that are bits, packaging type, RAM size, speed, flash size, supply voltage and the number of input and output lines.

Arduino

An Arduino can know as an open source for the PC equipment and the programming organizations. It also used in project and user group which plans and fabricates the single-board microcontrollers. Microcontroller units for building advanced gadgets or intelligent items able to detect and to limit the objects in the physical and computerized world. The Arduino Uno is one of the microcontroller boards. It comprises of input/output pins where 6 of them can be utilized as PWM outputs, a power jack, 6 of analog inputs, USB connection, 16 MHz crystal oscillator, ICSP header, and also reset button. Arduino available with everything that expected can help the microcontroller. It is just need to associate to a PC by using USB link or can power it with an AC-to-DC connector or alternative way which is battery to begin. The difference of Uno from every single going before board in where it does not utilize the FTDI USB to-serial driver chip it includes the Atmega16U2 (Atmega8U2 up to form R2) modified as a USB-to-serial converter. For the version 2 of Arduino Uno has a resistor pulling the 8U2 HWB line to ground, making it simpler to put into DFU mode while for the third form, 1.0 pinout (SDA and SLC) are included. Besides that, the third form of Arduino Uno has the more grounded circuit and the 8U2 was supplanted by the 16U2.

ANDROID BASED SMARTPHONE: CLASSIFICATION AND SELECTION

The project's smartphone operating system (OS) is one of the first required elements of choices for this project development and An-droid based phones can be the best model to select from. Such a choice can be because of Android becoming particularly popular everywhere today; including its acceptance and ranked (2017) the first by Google for having Linux Kernel. Upon agreement with Android developers, the Google Android OS got specific name for each major of the Android OS version in alphabetical order with Android 1.0 the earliest and then 1.1 versions, both respectively born in September 2008 and February 2009. However, the first Google based Android (Cupcake /Android 1.5) was released in April 2009; and since then Google has started naming every An-droid new version. Beyond Cupcake, other versions have been gradually named: Donut (1.6) and Éclair (2.0 & 2.1) in 2009, Froyo (2.2 to 2.2.3) and Gingerbread (2.3 to 2.3.7) in 2010, Honeycumb (3.0 to 3.2.6) and Ice Cream Sandwich (4.0 to 4.9.4) in 2011..., Nougat (7.0 to 7.1.2) and Creo (8.0) respectively in 2016 and 2017.

Arduino is an important component for home remote control systems project for being the main component of all involved systems that commands and manages all other components participation to the operation of the whole remote control system. For, the interface inside the smartphone can make communicate with the appliances through the capability of the Arduino that use the Bluetooth module's connectivity. The selection of a model from the different Arduino types is also important to assure that it can fit with the required behaviors from the command inputs as analyzed and decided in advance to the project start. Here are some basic details about Android based hand-phones that can be in home control systems.

- Arduino Yun is a board that is used when designing connected devices or generally for the Internet of Things (IOT) projects. It combines the power of Linux with the ease of use with Arduino systems.
- The connection from Arduino: Ethernet and Wi-Fi support, a USB-A port, micro-SD card slot, 20 digital input and output pins, with 3 reset buttons included on the Arduino board [9]. It is a microcontroller board based on the ATmega32u4 and the Atheros AR9331, which is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture [10]. And it also distinguishes itself from other Arduino

boards in that it can communicate with the Linux distribution on board, offering a powerful networked computer with the ease of Arduino.

- The Arduino Mega is a microcontroller board based on the ATmega1280. It has 54 digital input/output pins, 16 analogue inputs, 4 UARTs a reset button, etc.; [11], and its power source is selected automatically [11].
- Arduino Uno possesses (Figure-1) a microcontroller as the brain, which is ATmega328 IC. It consists of six analogue inputs and also 14 digital input/output, a USB connection, an external power supply, a power LED, and a reset button; etc. It is also known as the first in the series of USB based Arduino boards; and based on Android 1.0 (the Arduino software /IDE) it has become the reference model for the Arduino platform (e.g. Figure-1). Arduino Uno is viewed also by others as suitable model for beginners.

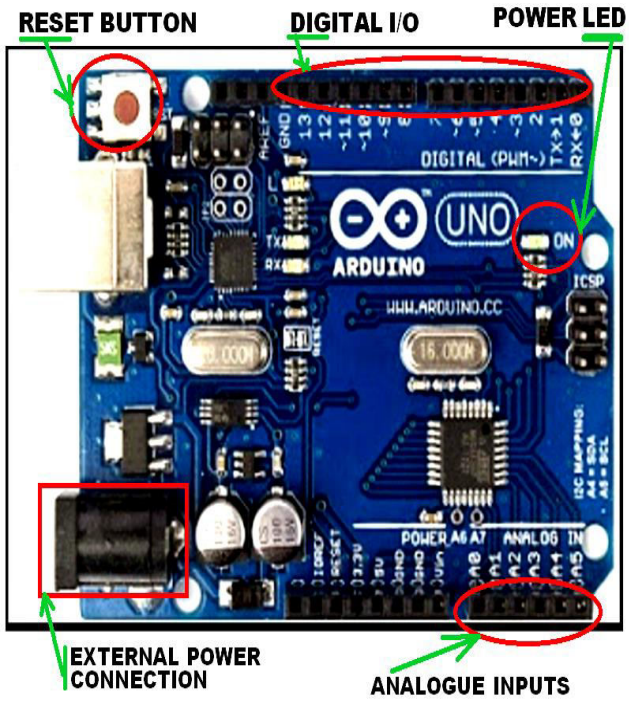

Figure-3. Arduino Uno components board layout (E.g. Arduino-Uno-VS-ESP8266) [12].

PIC16F877A MICROCONTROLLER

In industry, PIC 16F877A microcontroller isn't an uncommon microcontroller for user. This PIC are generally utilized as a part of any small scale venture, security and safety devices, remote sensors, home automation and in numerous modern instruments in computerized electronic circuit. Other than that, the coding is simple compose and straightforwardness lead the user can use many as could be expected under the circumstances that need it. The coding of this microcontroller additionally easy and understand by user. It has 40 pins all together and comprises of 33 pins for input and output. Additionally, this microcontroller likewise low cost and adaptable and it move toward becoming user's favorite. PIC16F877A finds its applications in a huge number of devices. It is used in remote sensors, security and safety devices, home automation and in many industrial instruments. An EEPROM is also featured in it which makes it possible to store some of the information permanently like transmitter codes and receiver frequencies and some other related data. The cost of this controller is low and its handling is also easy. Its flexible and can be used in areas where microcontrollers have never been used before.

PROJECT METHODOLOGY

Project design

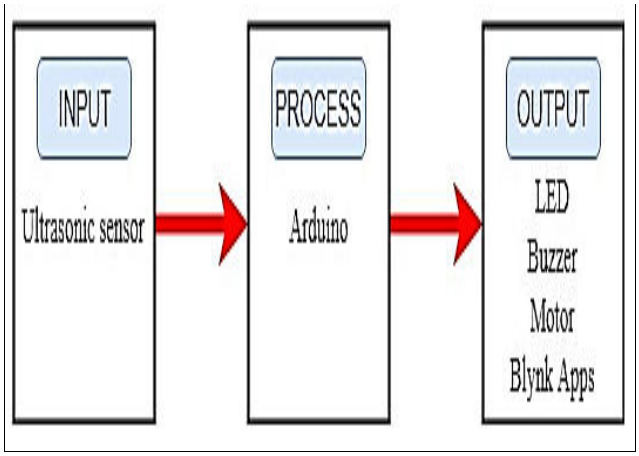

Figure-4. Smart dustbin project's input, output and process.

Block diagram of project

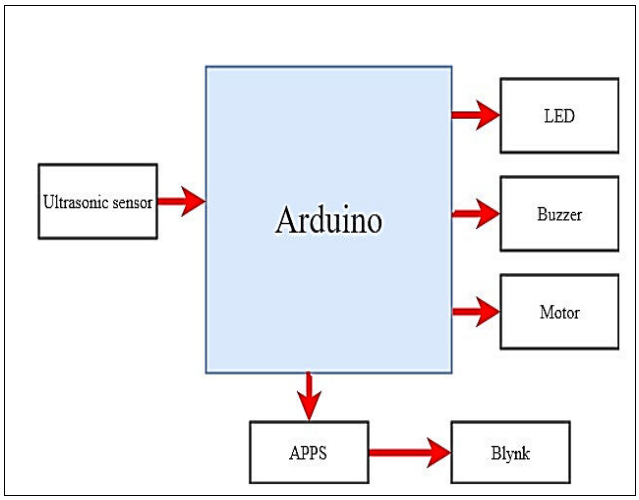

Figure-5. The block diagram of smart dustbin by using Apps system.

Flowchart of process flow

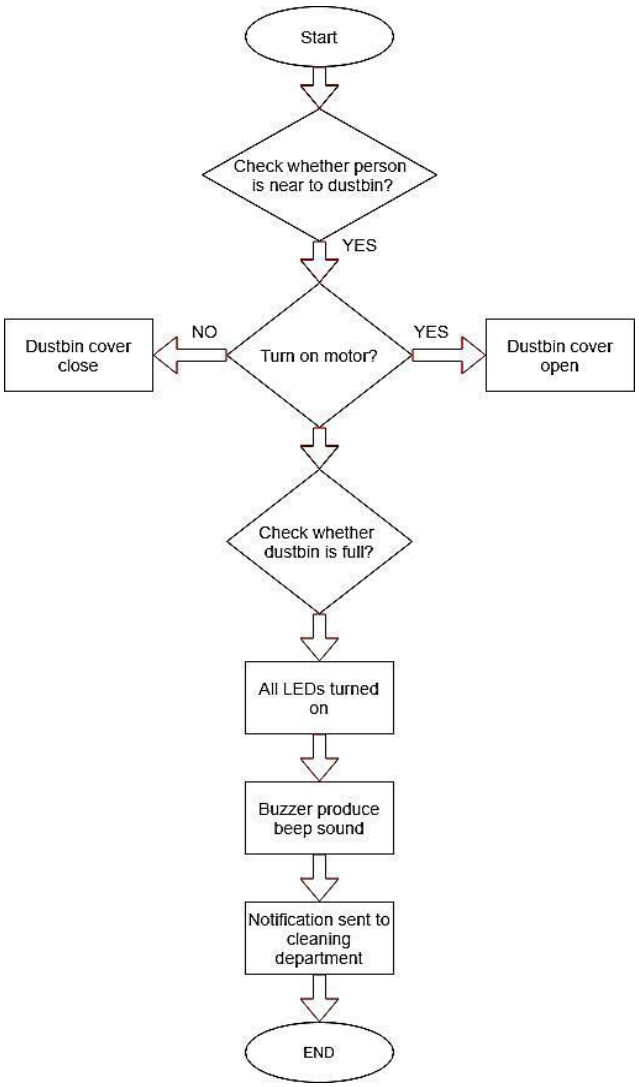

Figure-6. Flow Chart of Project System.

RESULTS AND DISCUSSIONS

The system has been tried to show the working process on the project of smart dustbin by using Apps system which is Blynk where it has already been projected. The application in this project to work as interface and Arduino to work together with function to give and control the commands given by the android application able to be done with the combination of software application and hardware component which had been used in this project. The application which used is able to send reminder and alert notification to the cleaning department.

FINAL RESULT OF HARDWARE AND BLYNK APPS

Performance analysis

For verification on the functionality correctness of the developed product, a series of testing operation took place as the final step of the project work. The tests showed successful results for the different appliances when switched ON and OFF using the apps that has been developed. Some of the functionality testing details are given in pictures by next paragraphs.

Figure-7. All LED's turned on when rubbish reached maximum level.

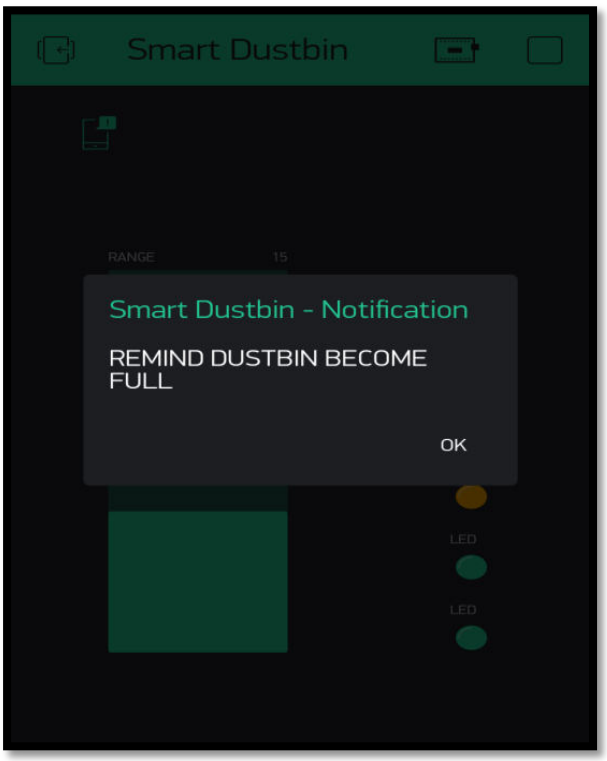

Figure-8. Reminder notification in Blynk Apps.

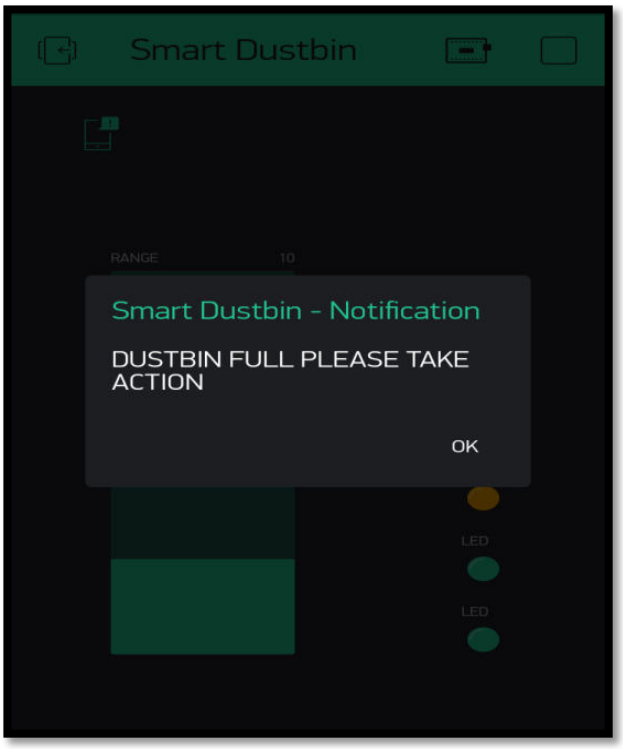

Figure-9. Alert notification dustbin is full in Blynk Apps.

Analysis on Wi-Fi module with Blynk Apps

The time that had been taken for the ESP8266 Wi-Fi Module to response with Blynk Apps has been analyzed from 10 different distance ranges. Each of the distance ranges was analyzed three times and the average time taken was calculated. From this we able to get average time taken for the each different distance ranges. Each distance has different average time taken for the ESP8266 Wi-Fi Module to response. The average of time taken to response for each distance has been show in the table as below.

Table-3. Analysis on Wi-Fi module with Blynk Apps.

Range of distance (m)	Average time taken to response between ESP8266 and Blynk Apps (s)
10	1.16
20	1.26
30	1.40
40	1.46
50	1.63
60	1.66
70	1.73
80	1.83
90	1.86
100	-

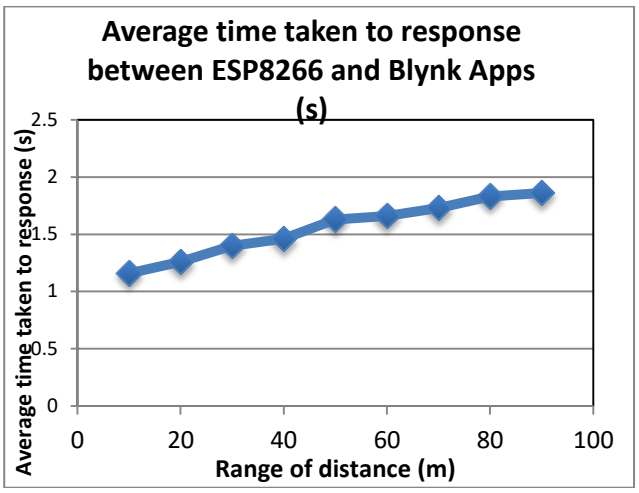

Figure-10. Graph of average time taken to response between ESP8266 and Blynk Apps (s).

Analysis of ultrasonic sensor reading

The table and graph below shows the analysis of ultrasonic sensor readings comparison between the sensor value and actual distance value. The actual readings were measured by using measuring tape. The ranges of reading of the ultrasonic sensor are between 10m until 40m. The readings difference between the sensor reading and actual reading are almost same actual reading. The difference is only 1cm.

Table-4. Analysis on Wi-Fi module with Blynk Apps.

Sensor Reading (cm)	Actual Reading (cm)
10	9
15	15
20	19
25	26
35	36
40	39

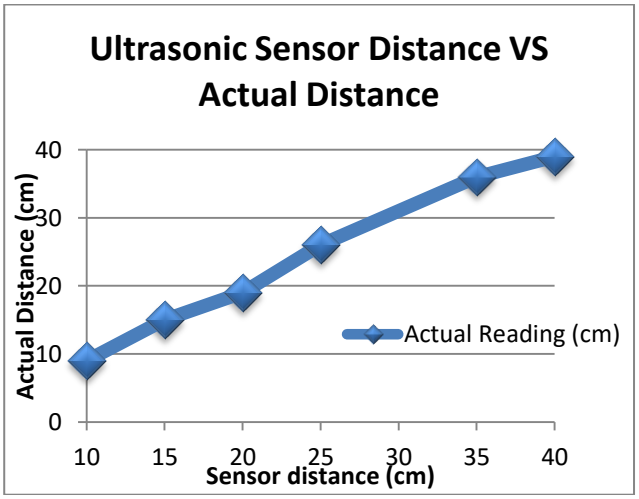

Figure-11. Graph of ultrasonic sensor distance with actual distance.

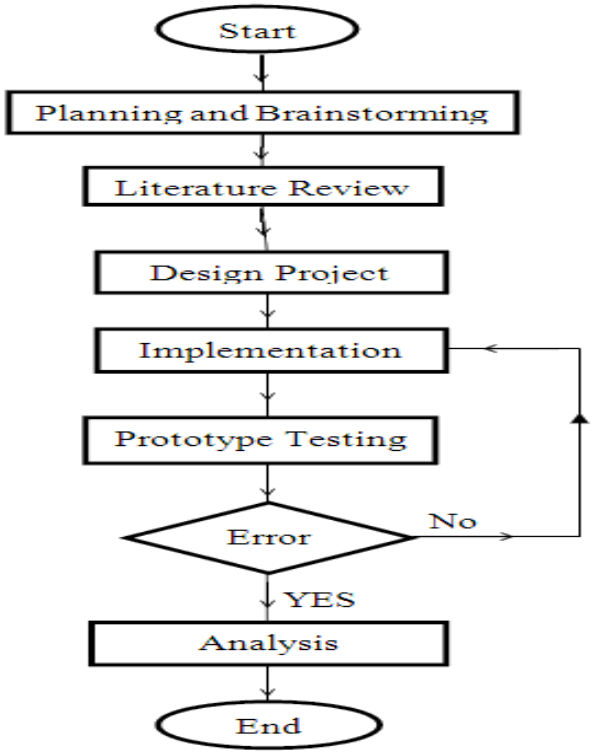

Figure-12. Project design simplified flowchart.

The overall steeps for the project realization stages can be summarized into six sequences (Figure-12), namely: planning/ideas brain-storming, literature review; project design, prototype implementation; modeled solutions testing and validation.

Basically the work under each goes this way:

- The preparation includes planning what project to be developed.
- The reviews to finding more details about the project component, function and etc.,
- The design is to produce the project layout and related work to its appearance;
- The prototype is done using the material selected based on the characteristics that are correlated to each other;
- The assembled prototype is implemented according to the design model (e.g. plan/diagram and dimensioning. fit);
- Finally, the prototype testing upon execution allows seeing what can be the first performance result. This is repeated as many as possible to ensure all potential errors are resolved. Lastly, when the resolved problems are analyzed, the details can be written to make sure that the project functions well.

CONCLUSIONS

The project's objectives for controlling Smart Dustbin by using Apps have been successfully developed. Particularly to the case of this journal article, most of the relevant details to the general theory of design and implementation have been also introduced throughout this article. These attempts include various technical details from the theory to practical realization of this category of Smart Dustbin by using Apps.

As to the testing and result analysis, the system able to be as an observing system where it will send reminder and alert notifications to the cleaning department when the ultrasonic sensor calculates the level of the rubbish in the dustbin by using Blynk Apps. The Blynk Apps will be in online mode when the hardware or the dustbin is able to use by anyone to throw rubbish. The Blynk Apps received the data from the dustbin when people throw rubbish into the dustbin. It will send data starts from the dustbin in the empty condition until the rubbish in the dustbin reached a maximum level where it can be identified by sensor. The color of LED's changing proportionally with the level of rubbish in the dustbin. Next, the system can send data from one location to another location. It has been tested by using different ranges of distance such as 10m, 20m, 30m until the distance is 100m. The data sent from one location to another location with the different response of time from the Wi-Fi Module with the Blynk Apps. The time taken to response does not have much difference.

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