



Smart Recycle Bin

Nur Amira Elyanie Sarman¹, Nur Amirah Abdul Razak¹, Nur Izni Fatin Abdul Rahman¹, Sharifah Saon^{1*}, and Abd Kadir Mahamad¹

¹Faculty of Electrical and Electronic Engineering,
Universiti Tun Hussein Onn Malaysia, Parit Raja, 86400, MALAYSIA

*sharifa@uthm.edu.my

1. Introduction

Recycling is the process of converting waste materials into new materials and objects [1]. Recycle is very important because it is an alternative to conventional waste disposal that can save material and help lower greenhouse gas emissions. Thus, it can give profits to everyone either directly or indirectly. Waste management is an important requirement for ecologically sustainable development in many countries. Efficient sorting of waste is a major issue in today's society. In Europe, currently use 16 tonnes of material per person per year, of which 6 tonnes become waste [2]. The consumer society in Europe has led to an ever increasing production of waste although recycling may seem like a modern concept introduced with the environmental movement of the 1970s, it's actually been around for thousands of years. Recycling is the reprocessing of materials into new products. Nowadays, most of people not throwing the recycle trash in the correct bin according to their type and these phenomena make the workers need to separate again the recycle trash before the process of disposal.

This project focusing to sort aluminum, plastic and paper material into their respective bin. This is to overcome the problem of people not throwing the recycle trash in the correct bin according to their type. These phenomena make the workers need to separate again the recycle trash before the process of disposal. By using inductive proximity sensor, photo electric sensor and ultrasonic sensor, type of trash's material which are aluminum, plastic and paper can be track accordingly. Each recycle bin is designed with a specific shape opener for recycle trash. Once the materials is detected, the servo motor operated to close the opener of the bin. While, ultrasonic sensor uses as a detector that placed inside the top of the recycle bin to detect the level of the recycle trash in the recycle bin, and a notification is submitted to the corporation's office by applying the concept of Internet of Thing (IoT), using Blynk, thus employee notify it and able to take further action.

Automatic smart recycle bin can encourage people to recycle in the right recycle bin and developing the culture of recycling in our society. By do the proper recycling, we also consuming and increasing the level of environmental awareness in society.

Today, technology become more advanced and sensor is one of the medium that can be used to improve and ease daily life. Sensor is widely used in industries, facilities, and others. People always want to do something that they can put little effort on it. Therefore, everything in life uses in 'automatic mode'

by using variety kind of sensors. In this project Blynk as IoT platform is uses, as a system that have the ability to transfer over a network without requiring human-to-human or human-to-computer interaction, thus expecting to ease the human work.

Recycling plays an important role in the economy by ensuring waste is re-used and reduced. Recycling also saves communities money in waste handling, landfill production, and incineration costs associated with burning garbage because waste is being recycled and reused rather than put into the landfills. By buying recycled products and packaging we can create an economic incentive for recyclable materials to be collected, recycled, and manufacture into new products. This creates a closed loop system that reduces the costs of recycling [3].

2. Methodology

The development of a system specificity for aluminium, paper and plastic recycle bin. Both paper and plastic recycle bin, work with ultrasonic sensor that detect the distance between the recycle material and bin opener, as shown in Figure 1. Figure 2 shows the flow chart of the development paper and plastic recycle bin, with the Duration as an input distance and calculated as $\text{Distance} = (\text{Duration}/2)/29.1$, where 29.1 is used to convert the distance in centimeter and this value is varies for others measurement unit. For $\text{Distance} < 5$, the serial monitor in Arduino IDE display "The distance is less then 5" which mean there object detected infront of the ultrasonic sensor of the recycle bin. Then the serial monitor also print the calculated distance in centimeter and the servo motor start to turn to 180° to open the entrance of the recycle bin for 5s and then back to the original position (0°). If the $\text{Distance} > 5$, the serial monitor print "the distance is more than 5" which mean that distance is when there is nothing infront of the ultrasonic that want to enter the recycle bin and the servo motor remain at 0° . Then the loop for this system is continue.

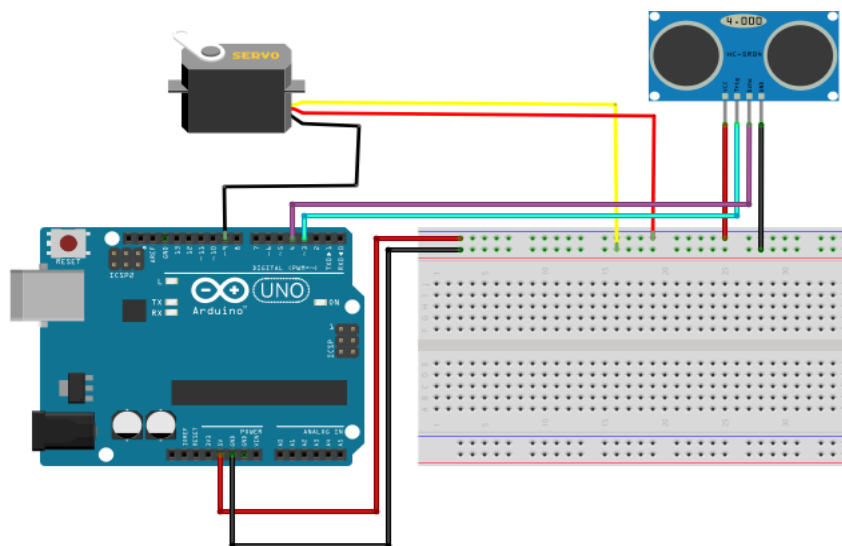


Figure 1: Circuit for paper and plastic recycle bin

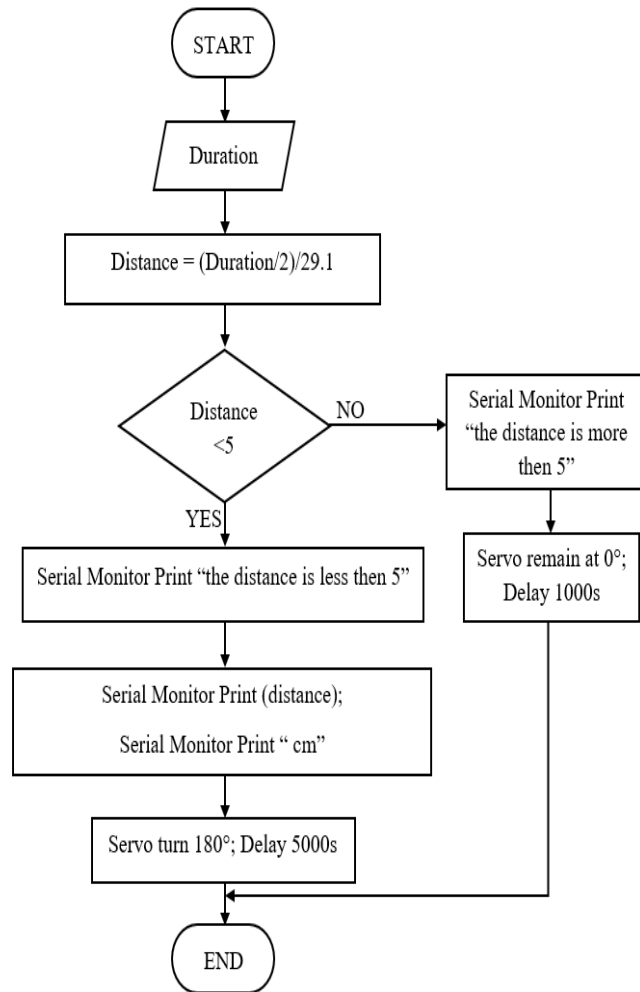


Figure 2: Flow chart for paper and plastic recycle bin

For aluminium recycle bin, inductive proximity sensor is used to detect aluminium can. Figure 3 shows the flow chart of the development of aluminium bin, with reading as an input for the system and being calculated using formula of $\text{Metal} = \text{Reading} * 100 / 1024$ to know either there is any aluminium sensed, and the circuit is shown as in Figure 4. If the reading is > 500 , the serial monitor prints "Metal Detected" as aluminium can is sensed. Thus the servo motor rotates 180° to open the opener of the bin for 5s before turning back to initial position (0°). If the reading < 500 , the serial monitor prints "Metal Not Detected" as the inductive sensor does not sense any aluminium. The servo motor remains at initial condition.

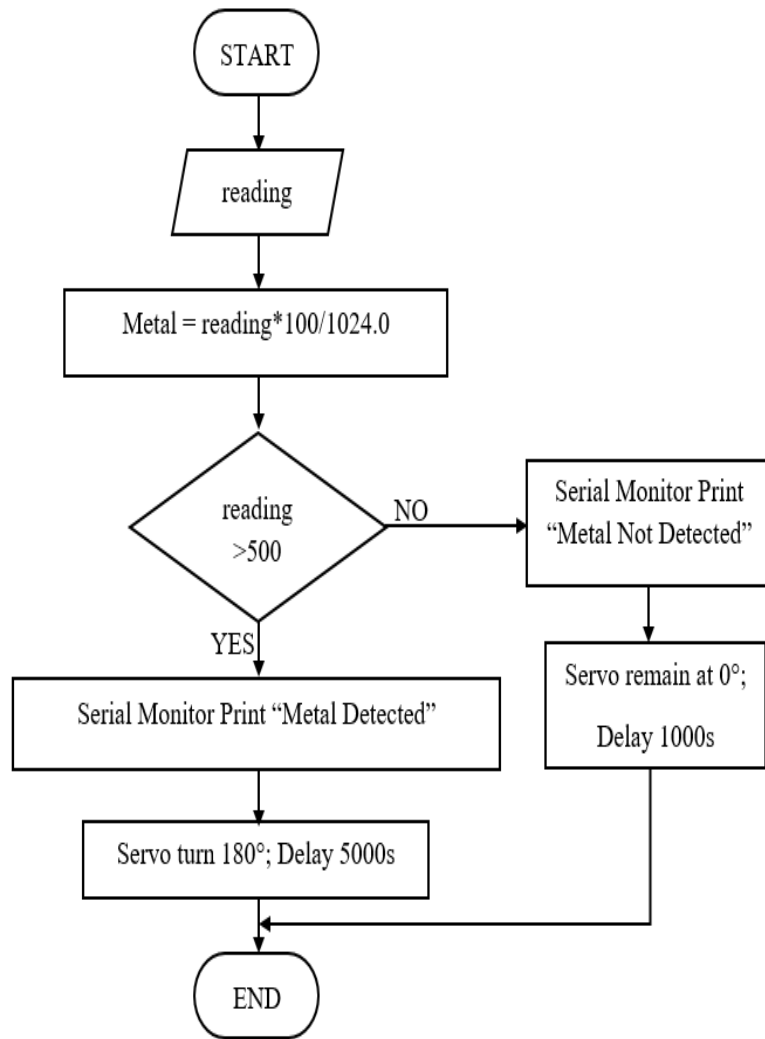


Figure 3: Flow chart for aluminium recycle bin

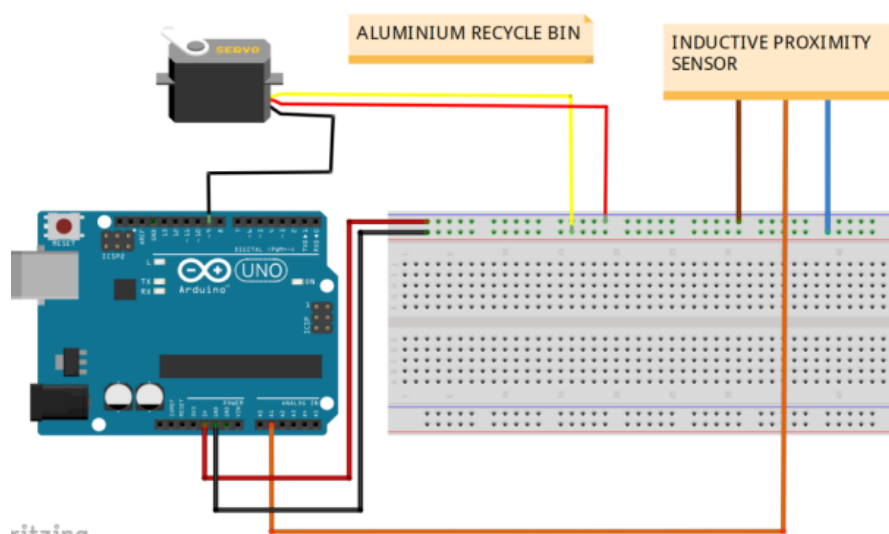


Figure 4: Circuit for aluminium recycle bin

Detection of level of recycle material in bin is conducted by installation of level detection circuit using Arduino ESP8266 NodeMCU Lua WIFI and Blynk apps as shown in Figure 5. Based on Figure 6, szInComing_Data is an input of the system which is the level of the recycle material inside the recycle bin. If the recycle bin is empty, the Blynk display the percentage level of fullness of the recycle bin, once the percentage reach 100%, Blynk send a notification "It is Over Flow!" to the user (worker or janitor) to collect the recycle materials.

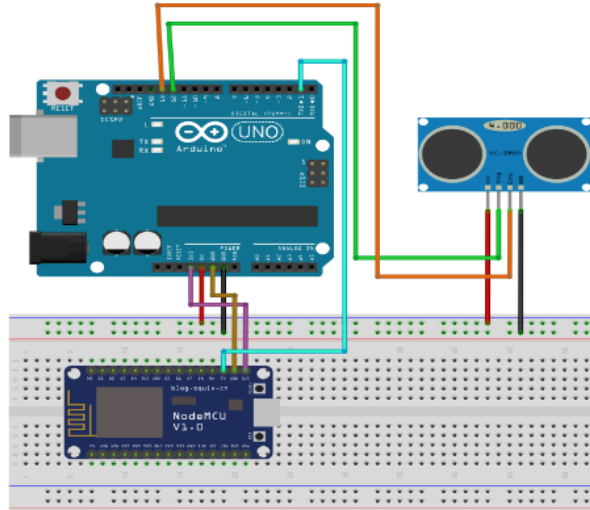


Figure 5: Circuit for FULL - EMPTY recycle bin detection

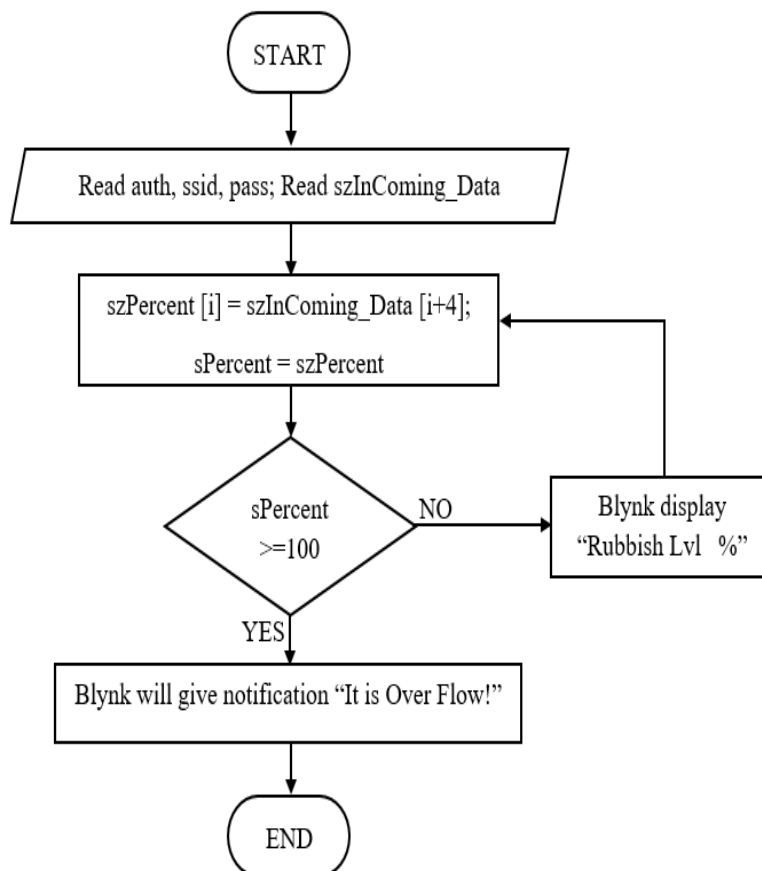


Figure 6: Flow chart for FULL - EMPTY recycle bin detector

3. Results

Figure 7 show the prototype of recycle bin for paper and plastic, respectively, that occupied with ultrasonic sensor that functional to detect the present of paper material, and specific shape of bin opener that controlled by servo motor. The servo motor functional once the sensor sense the material and the barrier of the recycle bin's cover is open. The aluminum recycle bin is occupied with inductive proximity sensor. Once sensor successfully detect the present of aluminum, then servo motor functional to open the opener on the top of recycle bin. For this recycle bin, the cover of recycle bin with circle shape to indicate the shape of aluminium can. The recycle bin for aluminum and plastic is shown in Figure 7 (c).



Figure 7: Prototype of (a) paper recycle bin; (b) plastic recycle bin and; (c) aluminium can recycle bin

For the notification system, Arduino ESP8266 NodeMCU Lua WIFI is used to connect with internet and link with Blynk. Ultrasonic sensor is used to detect the distance of the recycle trash in the recycle bin. Once the percentage of recycle trash in the recycle bin reach to 100%, the Blynk send notification to respective authority and "It is Over Flow" is displayed, as shown in Figure 8.

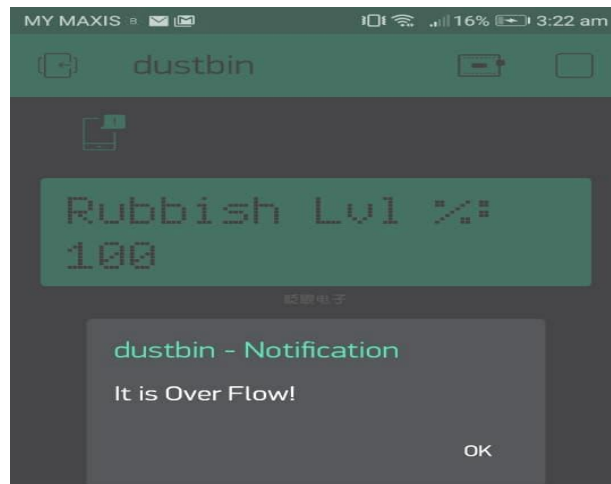


Figure 8: The notification from Blynk

Figure 9 shows the circuit connection to the Blynk that has been attached to the bin for the functional prototype. Figure 10, 11, and 12 show the full circuit connection for paper, aluminium and plastic bin.

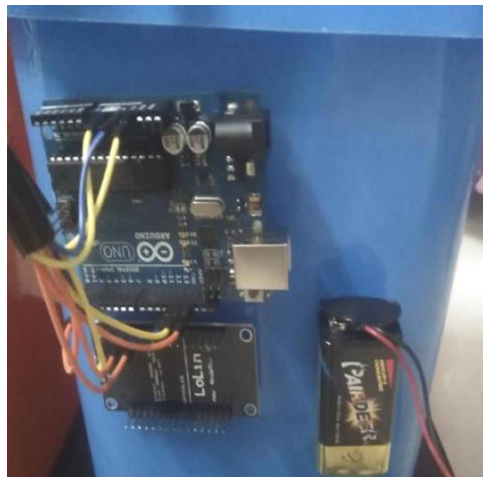


Figure 9: Circuit connection to Blynk



Figure 10: Circuit of ultrasonic sensor and servo motor for paper recycle bin



Figure 11: Circuit of inductive proximity sensor and servo motor for aluminium recycle bin



Figure 12: Circuit of ultrasonic sensor and servo motor for plastic recycle bin

4. Conclusion

As a conclusion, this project is successfully achieve the project objective. With an efficient of recycling system, expecting that non-renewable resources is secure, and at the same time it able to increasing the production from recyclables. This lead to the result in energy and space saving for waste disposal.

This product has a market value and potential to be marketable worldwide by attract people to practice the recycle method and can overcome the problem of lack of landfill in their countries. It is recommended to uses photoelectric sensor for plastic detection to improve the detection of plastic trash. On the other hand QR/Barcode as an another alternative to separate the trash according to the type of material.

References

- [1] Wikipedia (2018). *Recycling*. [online] Available at: <https://en.wikipedia.org/wiki/Recycling> [Access Date: 25 March 2018]
- [2] European commission (2012). *The EUs approach to waste management*. [online] Available at: <http://ec.europa.eu/environment/waste/index.htm> [Access Date : 26 March 2018]
- [3] Yann Glouche, Paul Couderc (2013). *A Smart Waste Management with Self-Describing objects*. Leister, Wolfgang and Jeung, Hoyoung and Koskelainen, Petri. The Second International Conference on Smart Systems, Devices and Technologies (SMART'13), Rome, Italy. <hal-00924270>
- [4] Rinkesh (2009), *Conserve Energy Future. Advantages and Disadvantages of Recycling*. [online] Available at: <https://www.conserve-energy-future.com/advantages-and-disadvantages-of-recycling.php> [Access Date: 26 March 2018]
- [5] Renewable Resources Coalition (2016). *The Benefits of Recycling*. [online] Available at: <https://www.renewableresourcescoalition.org/recycling-benefits/> [Access Date: 27 March 2018]
- [6] Techtronicity. (2017, August 5). *SG90 controlling servo motor with smartphone using Blynk app*. [Video file]. <https://www.youtube.com/watch?v=4zbGkqEK70k> [Access Date: 20 April 2018]