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Garbage Box (G-Box) Designing and Monitoring

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Abstract

This paper describes a G-Box, a garbage box that can be monitored using mobile phone. The G-Box is designed to attract, to stimulate, to educate, and to train the kids to throw the garbage in the correct place, so that the clean environment can be achieved. The system of the garbage box in this research is designed in two parts, i.e. G-Box (Garbage Box) and P-Box (Prize Box). The G-Box and P-Box can communicate using Bluetooth. When the kids have thrown the garbage in the G-Box, the G-Box will give the notification trough MP3 player by saying "Thank you very much, please get your candy in the P-Box". The G-Box also sends the signal to the P-Box to throw away the candy from the P-Box as the prize for the kids that have thrown away the garbage in the correct place (in this case, the G-Box).

Keywords: Garbage, Monitoring, Android, Bluetooth.

1. Introduction

Garbage becomes a serious problem not only in Indonesia, but also throughout the world. The increase in the population results in the increase of human activities, which in turn can also cause an increase in the volume of Garbage. According to Daniel [1], the amount of waste which are some of the by-products produced from urban lifestyles, are growing faster than the rate of urbanization growth. Sixteen years ago there were 2.9 billion urban residents who produced around 0.64 kg of solid waste per person per day (0.68 billion tons per year). In 2012, this number has increased to around 3 billion people which produces 1.2 kg of waste per person per day (1.3 billion tons per year). In the year 2025, it is likely that it will increase to 4.3 billion urban population which produces around 1.42 kg/capita/day of municipal solid waste (2.2 billion tons per year) [1].

Many problems can be caused by garbage if they are not handled properly and correctly. One of the most common examples is that the garbage can cause flooding. It is because of the littering can clog the waterway so that they cannot flow to the water infiltration area.

In addition, littering can disrupt the environment ecosystem, especially inorganic garbage that cannot be easily decomposed naturally by the bacteria. In general, this type of garbage need a very long time for being decomposed, therefore it can pollute the soil and the surrounding environment.

In other case, garbage can also cause unpleasant odors that often disturb the community, especially for those who live in areas not far from the Final Disposal Site. The unpleasant odor caused by this garbage can certainly disrupt human health. Meanwhile, from data of The World Health Organization [2], it is known that the need for clean air for humans is 10-20 m^3 per day. Therefore, the problem of garbage is very important to overcome. In developing countries, such as Japan, America, France [3], Thailland [4], waste is a problem that has always been the main topic. A lot of effort is being made to overcome the waste problem, starting from providing early education to children regarding the importance of disposing of garbage in their right place [5], sorting waste [6], doing waste management [7], developing IoT [8], [9], [10].

Throwing garbage not in their proper place basically is due to someone habit that was brought from childhood. In Indonesia, especially in areas with low educational levels, children are less aware of the importance of removing and managing waste. Therefore, this problem should be paid attention more. In the current digitalization era, smart educational games, such as waste sorting can be one of the teaching media in instilling the culture of throwing garbage in their place. However, unfortunately the game is only a simulation and many negative impacts can occurred.

Based on the background described above, in this study, an innovation was proposed to increase public awareness and concern about garbage. A G-Box connected with android is proposed for attracting, stimulating, educating and training the kids to develop good habit of throwing the garbage in its proper place. The android can be used to monitor the

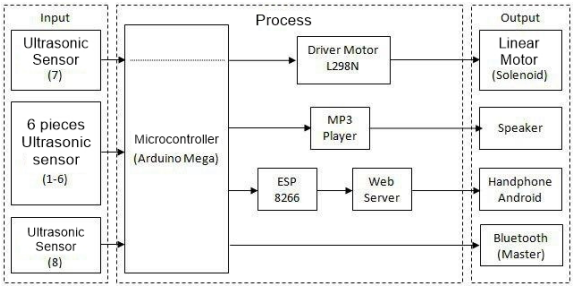
quantity of the garbage and also the prize. In this research, the candies were used as the prize. The G-Box and P-Box can communicate each other using Bluetooth.

2. G-Box Design

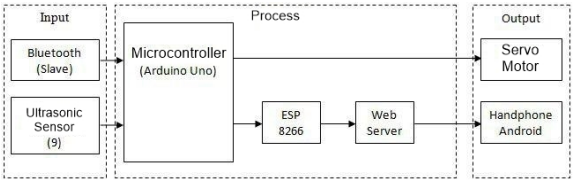
The G-Box system in this research consists of 2 parts, i.e. i) The garbage box (G-Box); ii) The prize box (P-Box). The block diagrams of the G-Box and P-Box are shown in **Figure 1**. The G-Box is equipped with 8 ultrasonic sensors that have different function. The Ultrasonic Sensor (7) in the design construction serves to provide a direct signal for the linear motor (solenoid) that has function to open and close the G-Box cover automatically. Ultrasonic sensors (1), (2), (3), (4), (5) and (6) have function to determine whether there are objects enter to the G-Box or not. If there sensors detect objects, they will send signals to microcontrollers 1 (Arduino Mega 2560), then this microcontroller will send a signal to activate DF Player (MP3). DF Player will give notification sound that informed that the prize can be obtained in the P-Box.

The communication between G-Box and P-Box will take place when ultrasonic sensors (1) - (6) have detected the objects that enter the G-Box. The microcontroller 1 will send data to the microcontroller 2 (Arduino Uno) to activate the servomotor to issue the prize of chocolate candy from the P-box. The G-Box will always be connected to the P-box via a Bluetooth connection.

ESP 8266 has function to connect the G-Box and P-box to the Android. The android will display a notification whether the G-Box is full as signal data obtained from the ultrasonic sensor (8) and whether the P-Box is empty as a result of detection from an ultrasonic sensor (9).



(a)



(b)

Figure 1. Block Diagram

The mechanical designs of G-Box and P-Box are shown in **Figure 2**. **Figure 2 (a)** is the front side of the G-Box, while **Figure 2 (b)** is the back-side of G-Box. **Figure 3 (c)** is the right side of the P-Box, while **Figure 3 (d)** is the front side of the P-box

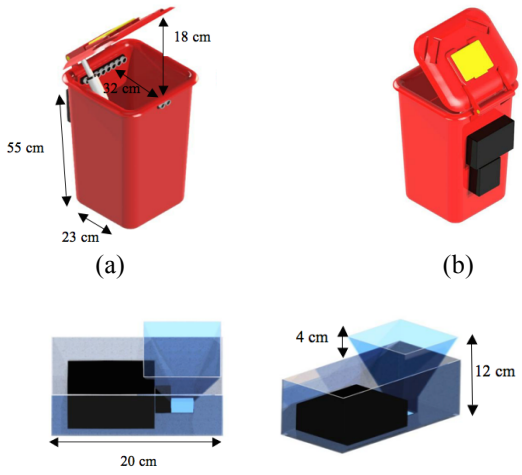


Figure 2. Mechanical design of the G-Box and P-Box

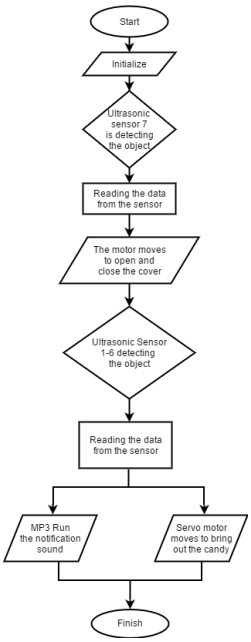


Figure 3. Flowchart of G-Box System

The flowchart of the software designs of the G-Box is shown in **Figure 3**. The flowchart is started from initialization, then, the ultrasonic sensor (7) in The G-Box will read the objects near it. If the objects are detected, then the driver motor L298N will move the linear motor (solenoid) to open the cover of the G-Box. When the cover has been opened and if there is garbage object that is detected by ultrasonic sensors (1) – (6), then, the Ardunio in

the G-Box will process the data from the sensors and continue to send the data to the P-Box trough the Bluetooth communication and to the MP3 player to run the notification sound that they can get the prize (candy) in the P-Box.

Figure 4 is the program code of the G-Box. When garbage was detected, The G-Box bluetooth will send data "1" to the P-Box bluetooth. The data will appear in the serial monitor of Arduino IDE software in the form of number "1". When the communication between the Bluetooth devices has been successful, there will be a notification number "1" and "garbage is detected".

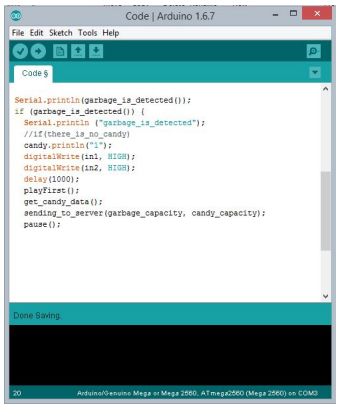


Figure 4. Program code of G-Box

Figure 5 is the Program Code of the P-Box. When the Bluetooth in the P-Box obtained the data "1" from the G-Box, the servo motor in the P-Box will move to throw away the candy.

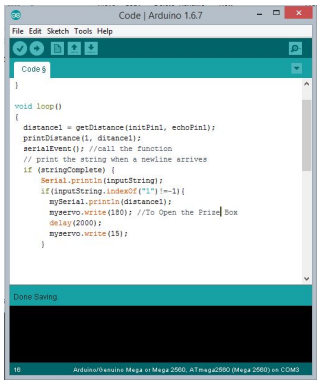


Figure 5. Program Code of P-Box

3. Experimental Result

In the experiment shown in **Table 1**, the ultrasonics sensors were tested to know whether they can work well or not. Some objects such as: i) Paper (a piece of paper, crumble paper, drinking box); ii) Plastics (drinking bottle, food wrapping, candy wrapping); iii) cans (drinking can) are exposed to the G-Box sensors. The ultrasonic sensor (7) worked well by detecting every objects that got closer to the G-Box. The ultrasonic sensors (1) – (6) also function well by detecting the garbage objects closed to them. However, those ultasonic sensors could not detect the wrapping candy garbage. It was due to the size of the garbage was too small. One of the examples of monitoring display can be seen in **Figure 6**.

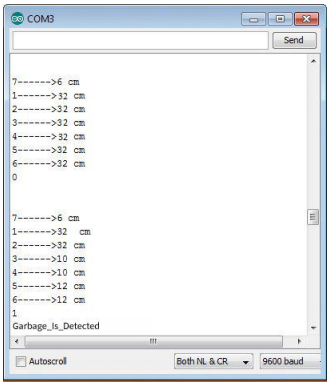
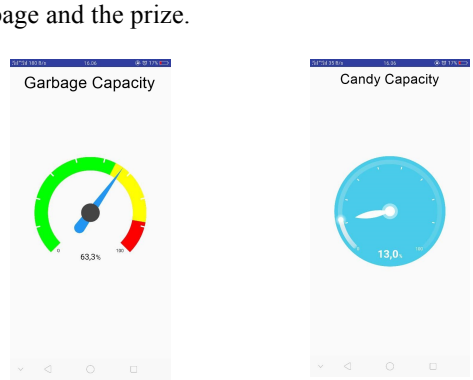


Figure 6. The monitoring display

The communication between the G-Box and the T-Box experiment is shown in **Table 2**. The data sent from the G-Box by the Bluetooth HC-05 module will be received by the P-Box via the HC-05 bluetooth module receiver. Bluetooth in G-Box will be connected as a bluetooth master and bluetooth in the P-Box as bluetooth slave. A virtual communication port on a computer was used to see the process of sending data to the both of bluetooths. Before being used, this Communication (COM) virtual must be set with the port on the computer, so that no errors occur. In **Table 2**, when the candy wrapping was inroduced, the Bluetooth of G-Box and P-Box need a long time to communicate each other, the status of that devices were"pairing" that means that they cannot verify the objects. The maximum distance of Bluetooth communication between G-Box and P-box were measured by conditioning the G-Box not in static condition. Therefore, the distance was so small (between only 10 cm – 33 cm).

The android Monitoring display can be seen in **Figure 7**. It can monitor the condition of both the garbage and the prize.



(a) **(b)**

Figure 7. Android Monitoring Display

Tabel 1: Ultrasonic Sensors, Servo Motor and Speaker Tests

Material	Samples	Ultrasonic sensor	Servo Motor	Speaker
Paper	A piece of Paper	ON	ON	ON
	Crumble Paper	ON	ON	ON
	Drinking Box	ON	ON	ON
Plastic	Drinking Bottle	ON	ON	ON
	Food Wrapping	ON	ON	ON
	Candy Wrapping	OFF	OFF	OFF
Can	Can Bottle	ON	ON	ON

Table 2: Bluetooth communication between G-Box and P-Box

Material	Bluetooth Communication distance (cm) in different distance (cm) of Ultrasonic Sensors						Transmitted Bluetooth Logic	Received Bluetooth Logic	Servo Motor
	1	2	3	4	5	6			
A piece of paper	32	32	10	10	12	12	1	1	ON
Crumble Paper	32	12	12	32	32	32	1	1	ON
Drinking Box	32	32	12	32	32	32	1	1	ON
Plastic Bottle	32	10	32	32	32	32	1	1	ON
Food Wrapping	33	32	32	18	18	32	1	1	ON
Candy Wrapping	-	-	-	-	-	-	Pairing	Pairing	OFF

4. Conclusion

The G-Box and P-Box work well. The outside sensors of the G-Box (distance sensor) could detect everyone who got closer to it and gave information to the controller, in which gave command to the final control (pneumatic motor) to open the G-Box's cover. It is also the same with all of the garbage sensors inside the G-Box. They could detect the garbage objects that got closer to them well, except the candy wrapping. It was due to the size of the wrapping was too small. Besides that, the G-Box can also communicate well with the P-Box in establishing the Garbage box system. The P-Box also did it task correctly. In addition, the capacity of the garbage and the candy in this research can also be monitored well using the android.

5. Future Works

In the future, this research will focus on monitoring the garbage using the Garbage Robot (G-Bot) that can move from one place to another place. The proposed G-Bot in the future research has capability to; i). navigate to the target position; ii). choose which command that it should execute first; iii) monitor the temperature and air quality around the GT-Bot. The Iot will also be implemented to that G-Bot in order to support the smart city.

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