Intelligent Smart Dustbin (i-SMARTBiN)

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Abstract

Technology play a central role in nearly all aspects of our lives. Technology is also used as an approach to educate the next generation about the importance of the environment. The i-SMARTBiN is a cost-effective design of an intelligent waste container. Normally the trash bin that is on the market is manually operated either using the feet or hands to open the lid thus it will be challenging for children to dispose of trash. This project's goals are to discipline and educate children to instil in them a sense of responsibility and the value of cleanliness, as well as to facilitate their growth and education. The i-SMARTBiN design is based on Arduino Nano board and an ultrasonic sensor to monitor the container's level of fill. The main concept behind the i-SMARTBiN is object detection. A similar methodology is implemented here, where the Ultrasonic sensor is placed on top of the dustbin's lid. When the ultrasonic sensor detects an object resembling a human hand, it will trigger the Arduino to open the i-lid SMARTBIN's using the servo. The infrared sensor (IR Sensor) in the i-SMARTBiN used to detect the dustbin when its full, the green LED will ON and the servo will open the smart dustbin lid, but the i-SMARTBiN lid will not open by the servo when its full, and the red LED will on. The i-SMARTBIN encourages children to throw garbage at the right place. Using i-SMARTBIN, the lid of the dustbin stays closed, so that waste is not exposed (to avoid flies and mosquitos) and when to dispose any waste, the lid will automatically open. The i-SMARTBiN automatic system is an innovation creation that can be used by all levels of society.

Keywords: i-SMARTBiN, intelligent, educate

1.0 Introduction

Dustbin is a small plastic container or some of it made from metal box that are used to store trash on a temporary basis. They are often used in home, park, office, street and many other place to collect the waste. In some places, littering is a serious offence and hence public waste containers are the only way to dispose small waste. It is a common practice to use separate bins for collecting wet or dry, recycled or non-recycled waste (Rajapandian et al., 2019). In this project, we have designed a simple system called Arduino Based Smart Dustbin with IOT Notifications using ultrasonic sensor and servo motor, where the lid of the dustbin automatically opened when it detect human hand clap or foot tap. As we all know, smart dustbins are not something new that we hear about nowadays because they have already been created. However, according to our studies, smart dustbins only use led as

notifications, which means that if the dustbin is about to fill up, it will show a red led and a green led if it is still empty. So, it is hard and not helpful for a few peoples who are disable such as colour-blind people. By that, we have improvised our project where the dustbin has a led display to show the level of the dustbin. It also will not open when it full so it also help people that have a bad habit by still throwing trash even when the dustbin is already full. This bin is a vast usage in offices, homes and in certain area for garbage management. The main objective of the research project is to design and build of hardware for i-SMARTBiN by implementing a build-in wireless which attached to the microcontroller coupled with the ultrasonic sensor to monitor the level of dustbin. The system should be able to acknowledge the status of dustbin either full or empty.

2.0   Literature Review

Several solutions for waste management equipped with IoT facilities have been proposed and invented in the literature to help solid waste management authorities improve the quality of service delivery. Researchers designed a solid management system uses WSN integrating two different wireless technologies. Waspmote has been used as sensor node. The mote encompasses ATmega1281 microcontroller with built-in accelerometer sensor. Multiple type of sensors such as level, weight, humidity and temperature sensors applied at the sensor node using mart Metering v2.0 board (Hannan et al., 2015). All data read from sensor node are transmitted to receiver segment by going through Zigbee and GPRS communications using Meshlium as a middle gateway. Receiver segment stored all collected data in database and displayed it using a developed web application. Thus, solid waste bin and its real time status can be monitor by using the developed automated system.

Smart Waste Management System [SWMS] manipulates geospatial technology and intelligence sensor such as ultrasonic sensor via IoT technology for reliable Smart City and M2M solution (Omar et al., 2016). A pilot study is conducted by locating the SWMS at districts of Sepang and Kuala Langat and limited to apartment and condominium. SWMS application as a tool for local authority to monitor waste collection operator to ensure waste collection services is deliver per contract by the service provider. Application of geographic information system [GIS] also done by as a decision support tool for planning waste management. The proposed system attempts to provide solution of problems like proper allocation and relocation of waste bin, check for unsuitability and proximity convenience to the users and future suggestions (Thompson et al., 2013)

Another work provides a Smart Garbage Monitoring System specifically to apartment, condominium or flat type residency that has trash chute (Yusof, N., Jidin, A. Z., & Rahim Mohd, 2017). This proof of concept system uses ultrasonic to measure the waste level and Arduino Uno as microcontroller (Malaysian Institute of Road Safety Research, 2007). Ultrasonic sensor will continuously measure the waste level and notify the residence and garbage collector regarding the waste status. This system send notification 15 through SMS to collector whenever waste bin is almost or already full. Indicator can

be put at each level of the resident to alert the residencies to minimize or stop dispose waste.

Some researches exploit the power of RFID as a way to improve and enhance the waste management efficiency especially in monitoring the waste collection activities. It also may reduce the workload of truck driver in recording the collection process and the surrounding area. Not only that, scattered waste around the dustbin also monitored using IR sensor to maintain the cleanliness and hygiene of city (Yusof et al., 2018).

3.0 Methodology

Among the components of this project's preparation are the following:
i.   Process of designing circuit.
ii.   Process of making Printed Circuit Boards.
iii.   Process of designing model.

For designing this project circuit diagram and running a test simulation, we are using Proteus Design Suite 8 software. The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. Schematic capture in the Proteus Design Suite is used for both the simulation of designs and as the design phase of a PCB layout project. It is therefore a core component and is included with all product configurations. The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analogue and digital electronics connected to it. Figure 1 and 2 shows the block diagram and layout design of i-SMARTBiN. The proposed system must assure the cleaning of the dustbins when the garbage level reaches its maximum and sends the status to the cleaning management. The ultrasonic sensor will detect when the dustbin is empty, the green LED will on and the servo will open the smart dustbin lid. The i-SMARTBiN lid will not open by the servo when it's full, and the red LED will on. Figure 3 illustrate the schematic diagram of the proposed system. The process flowchart of the i-SMARTBiN is presented in figure 4.
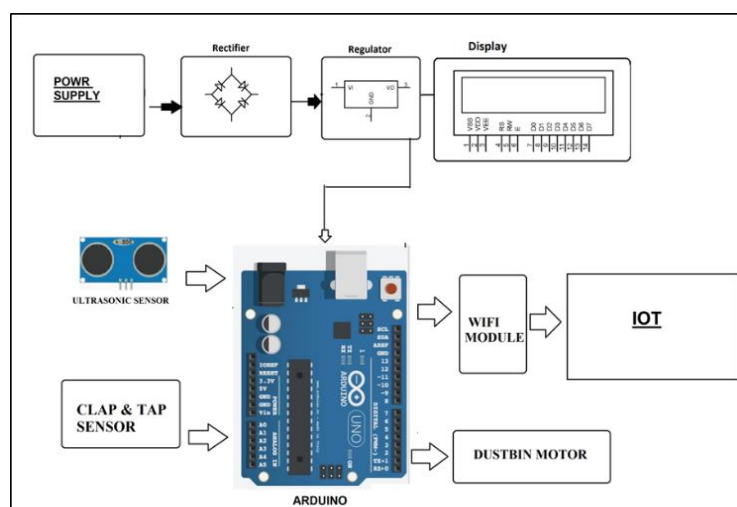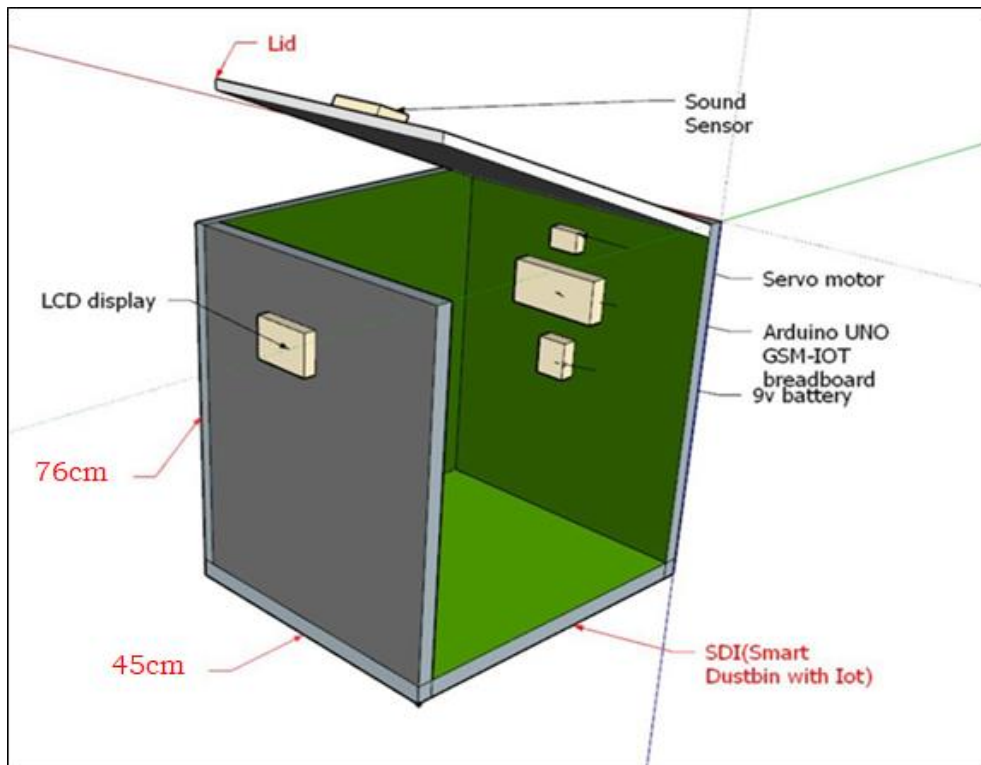

Figure 1: Block diagram of i-SMARTBiN
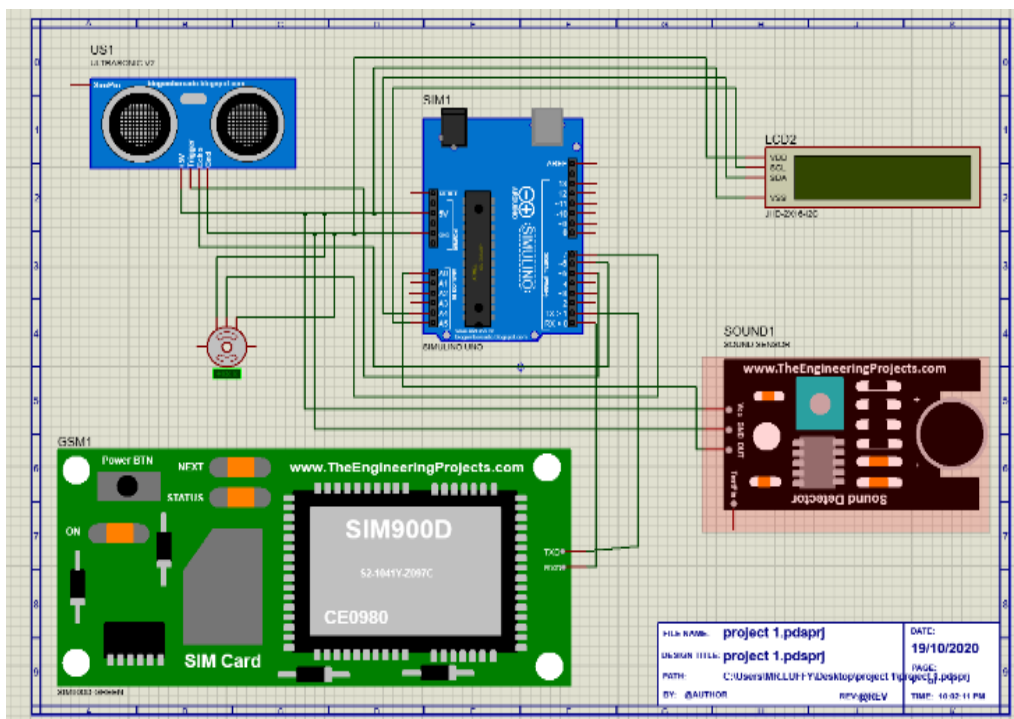
Figure 2: The layout design of i-SMARTBiN

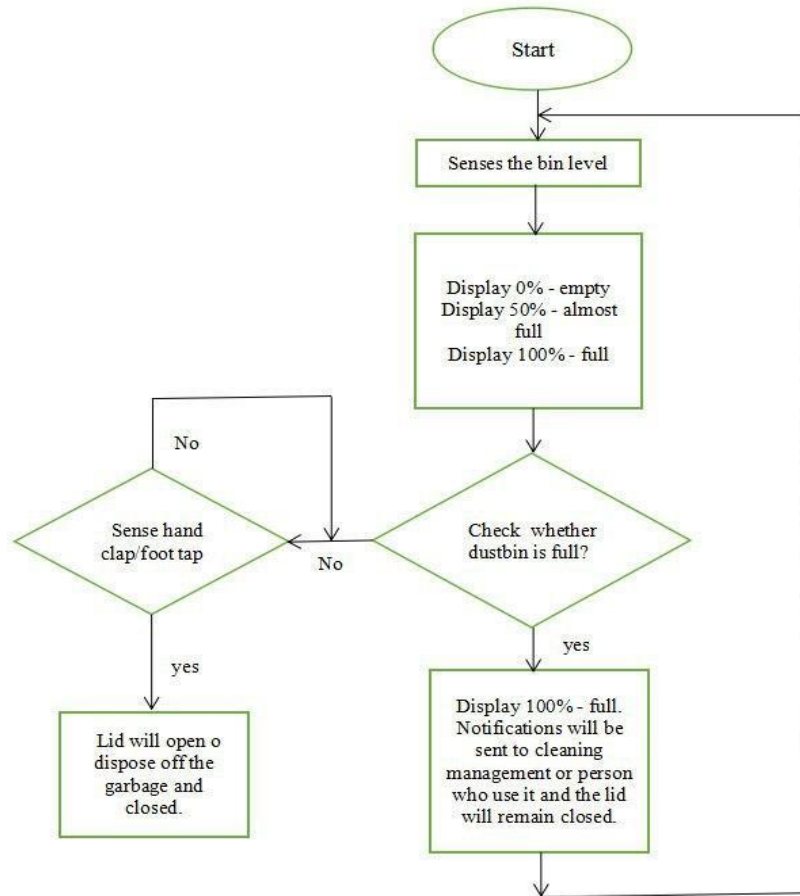**Figure 3:** The schematic diagram of i-SMARTBiN

Figure 4: Flowchart of the i-SMARTBiN

4.0   Results and discussion

Figure 5 displayed the prototype of the proposed hardware of i-SMARTBiN.
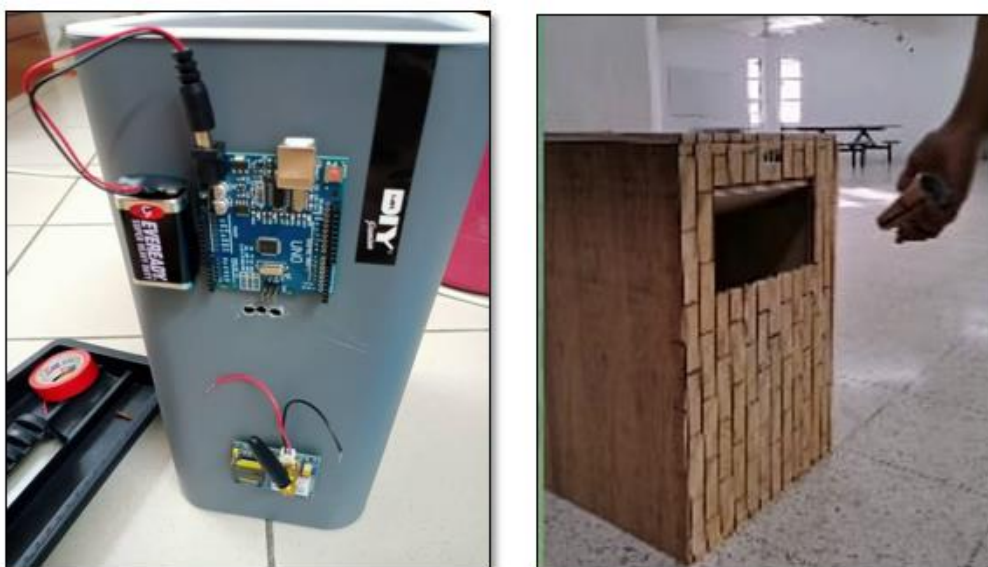

Figure 5: Prototype of i-SMARTBiN

Based on the result, i-SMARTBiN is the implementation of smart garbage management system using IR sensor, microcontroller and GSM module. This system ensures that trash cans are emptied as soon as their maximum capacity is reached and notifies cleaning management (S. Sharma & S. Singh, 2018). Effective solid waste management is guaranteed by the proposed model. This reduces the total number of trips of garbage collection vehicle and hence reduces the overall expenditure associated with the garbage collection. The effectiveness lies in the fact that the real time monitoring of solid waste management helps in timely removal of garbage and prevention of any harmful waste from harming the environment. It ultimately contributes to maintaining the cleanliness of the society's environment. Therefore, the smart garbage management system makes the garbage collection more efficient. Local authority can use this type of system and monitor the waste collection status in real-time and based on the recorded information that send by GSM module. With this system, they able to measure their operational performance, and predict future operation requirements.

5.0   Conclusion

As a conclusion, i-SMARTBiN has successfully achieved the objective of this project. i-SMARTBiN help and improve a quality of life to keep hygiene, healthier and simpler. i-SMARTBiN make an evolutionary shift toward cleanliness. i-SMARTBiN cans outperform ordinary garbage cans due to the combination of sophisticated waste monitoring and technology. It is outfitted with smart devices such as infrared sensors and GSM module. When the ultrasonic sensor detects an object resembling a human hand, it will trigger the Arduino to open the i-lid SMARTBIN's. The infrared sensor in the i-SMARTBiN will detect the dustbin when it's empty, the green LED will ON and the smart dustbin lid will open. But if the i-SMARTBiN it's full, the lid will not open and the red LED will on. The i-SMARTBIN encourages children to throw garbage at the right place. Using i-SMARTBIN, the lid of the dustbin stays closed, so that waste is not exposed and when to dispose any waste, the lid will automatically open. It will benefit social health and cleanliness. This i-SMARTBIN will bring about some improvements in terms of hygiene as well as technology.

References

Hannan, M. A., Abdulla Al Mamun, M., Hussain, A., Basri, H., & Begum, R. A. (2015). A review on technologies and their usage in solid waste monitoring and management systems: Issues and challenges. *Waste Management, 43, 509–523.*

Malaysian Institute of Road Safety Research. (2007). *General Road Accident Data in Malaysia (1997 – 2014)*. Retrieved 21 10, 2016, from Malaysian Institute of Road Safety Research: https://www.miros.gov.my/1/page.php?id=17

Omar, M. F., Termizi, A. A. A., Zainal, D., Wahap, N. A., Ismail, N. M., & Ahmad, N. (2016). Implementation of spatial smart waste management

system in Malaysia. *IOP Conference Series: Earth and Environmental Science, 37, 012059.*

Rajapandian, B., Madhanamohan, K., Tamilselvi, T., & Prithiga, R. (2019). Smart dustbin. *International Journal of Engineering and Advanced Technology (IJEAT), 8*(6), 4790-4795.

Thompson, A. F., Afolayan, A. H., & Ibidunmoye, E. O. (2013). Application of geographic information system to solid waste management. *Pan African International Conference on Information Science, Computing and Telecommunications (PACT).*

Yusof, N., Jidin, A. Z., & Rahim Mohd, M. I. (2017). Smart Garbage Monitoring System for Waste Management. *MATEC Web of Conferences, 97, 01098.*

Yusof, N. M., Zulkifli, M. F., Yusof, M., & Azman, A. A. (2018). Smart waste bin with real-time monitoring system. *International Journal of Engineering & Technology, 7*(2.29), 725-729.