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Smart Dustbin with Segregation and GSM Module System

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Abstract: The project's goal is to help garbage collectors while also beautifying the environment. It does not require a large amount of manpower to gather the trash. Money will be saved significantly since they will not have to be paid. Society will become more harmonious because of the clean environment, and these garbage collectors will be cleaner while performing their duties. The purpose of this research is to prototype a smart dustbin with a segregation system using Arduino as the microcontroller. Sensors such as an infrared sensor, a moisture sensor, and an inductive proximity sensor are used to complete this smart dustbin. Moisture sensors and inductive proximity sensors are used to segregate different types of waste, while infrared sensors are used to detect users. Ultrasonic and GSM SIM900A modules are the most important components in the notify system. Smart dustbins with a notification system allow the management to reduce costs because they can easily manage the schedule of collecting the waste according to the notification sent by the smart dustbin. Because all of the systems are automated, human power can be reduced as well. With the limitation of using a power adapter as the supply, future researchers can prototype smart dustbins using a solar panel or battery. In conclusion, this smart dustbin has great potential for the development of smart cities and Industry 4.0.

Keywords: Arduino, Segregation, Waste, Sensor, Monitoring

1. Introduction

Most people across the world are unconcerned about garbage. They expect garbage collectors to step in. As a result, waste separation ideas for trash cans are rather inventive[1]. The project's goal is to help garbage collectors while also beautifying the environment. The recycling may then be accomplished with ease. Furthermore, most individuals are aware that trash management takes longer and involves many participants [2].

As a result, they will require a substantial amount of money to recompense them. Furthermore, the most common sort of waste disposal is an unanticipated need that is placed at landfill sites, harming all

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living creatures[3]. Certain industrial processes will become more organized because of the waste management plan[4]. The benefit of undertaking this project is that it does not require a large amount of manpower to gather the trash. As a result, money will be saved significantly since they will not have to be paid. That is the aspect on which this project is based[5].

Next, we will make it easier for garbage collectors to accomplish their jobs when collecting garbage in public places. As a result, society will become more harmonious because of the clean environment, and these garbage collectors will be cleaner while performing their duties[3]. This is excellent since it reduces their chances of contracting sickness[6]. Furthermore, it decreases the danger of injury and manpower for those who attempt to recycle this garbage. Finally, waste segregation materials will be simplified because of this product[7].

1.1 Objective

This study aims to overcome numerous of problems cause by waste. The objectives are as follow:

- To design a prototype of smart dustbin embedded with Arduino Mega, ultrasonic sensor, moisture sensor, servo motor, GSM SIM900A module inductive proximity sensor and infrared sensor.
- To notify the garbage collecting authority about the garbage level of dustbin
- To simplify the work of garbage separation to avoid time and money waste

1.2 Scope of Study

Arduino Mega will be used as a microcontroller. The waste will primarily segregate into metal waste, wet waste, and dry waste. Three different colours of LED's are used to indicate the types of waste while another two colours of LED's are used to indicate the bin in a standby mode or in processing mode. Proximity sensor is used to detect metal waste while moisture sensor is used to detect dry or wet waste. An infrared sensor is used to detect humans and servo motor is used to open the lid of the bin. Servo motor also used to segregate the waste. An ultrasonic sensor is used to detect the fullness of the dustbin. A microcontroller will control GSM module to send alert SMS to a phone number as a notification to collect the full trash bin[8].

2. Methodology

Figure 1 shows the methodology flow chart of this study

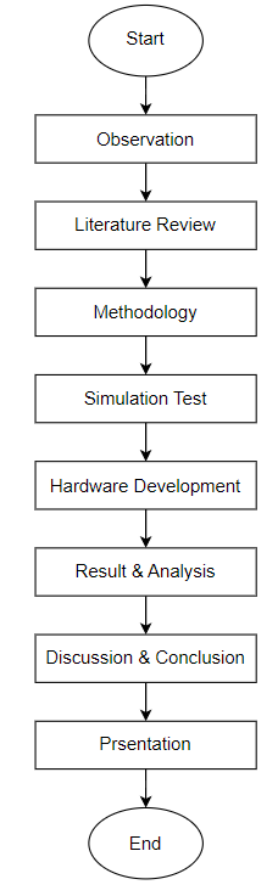

Figure 1: Methodology flowchart of this study

2.1 Block Diagram

The system block diagram for this project is shown in Figure 2.

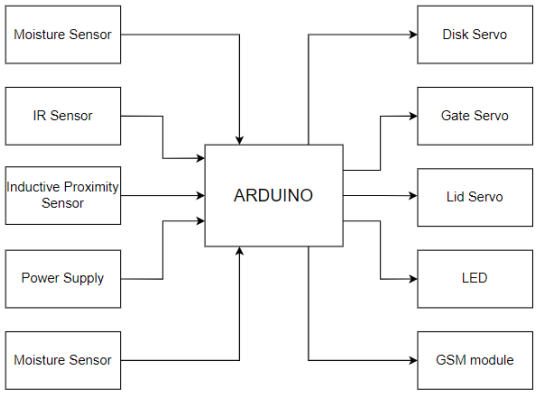

Figure 2: Block Diagram of System

The block diagram depicts the project's progress. First, electricity must be supplied to the Arduino. This is because they require electricity for electronic equipment to work and the project to proceed. In this project, solar power is used to power the system. The Arduino will then be powered on and ready to use. The infrared (IR) sensor will then detect an object within the distance set in the code. When the IR sensor detects an object, the servo motor will run to open the lid of the dustbin and close after a delayed time. Inductive proximity sensors and moisture sensors are used to detect whether the

waste is dry, wet, or metal waste. The sensor will send the sensor to Arduino, and then Arduino will send instructions to the disc servo motor for the next process. Lastly, if the ultrasonic sensor detects that the waste is almost full, it will activate the GSM module to send a notification for the collection of the waste.

2.2 System Flowchart

The system flowchart for this project is shown in Figure 3.

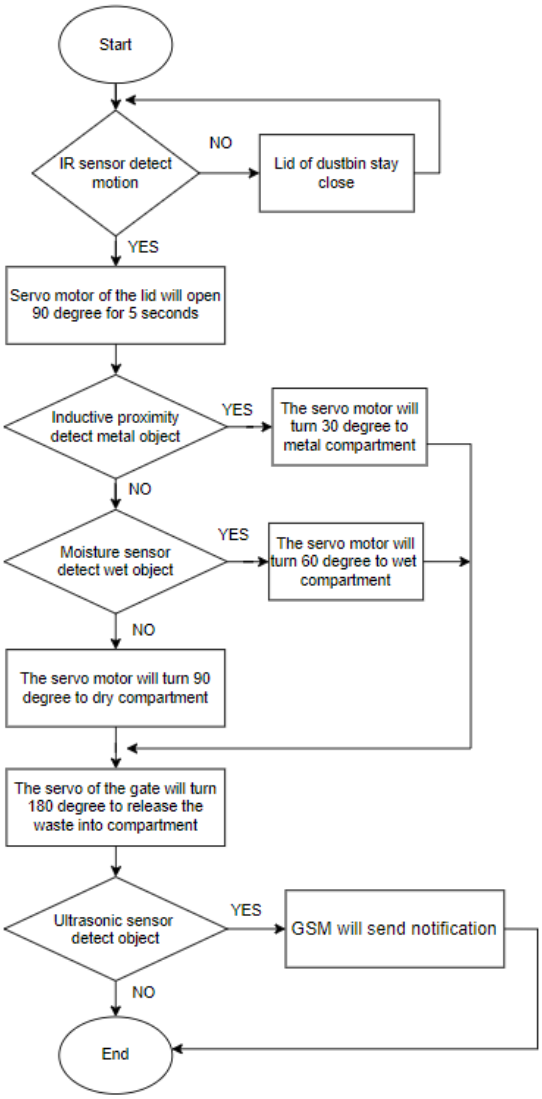

Figure 3: System Flowchart

The flowchart shows how the project flows when the system is running. Firstly, the IR sensor will detect motion or an object within the setup distance and open the lid of the dustbin[9]. The lid will close automatically after some time, according to the timer set. If the IR did not detect any object or motion, the lid would stay closed. Then, the inductive proximity sensor will detect whether the waste is metal waste or not[10]. If the waste is metal, the disc servo will turn 30 degrees, and the waste will be released into the metal compartment. If the waste is not made of metal, the moisture sensor will detect whether it is wet or dry. Wet waste will trigger the servo motor to rotate 60 degrees, and the waste will be released into the wet compartment. Dry waste will trigger the servo motor to turn the servo motor 90 degrees. After that, ultrasonic will start to measure the waste inside each compartment, and if ultrasonic

detects the waste is almost full, it will trigger the GSM module to send a notification for collection purposes[11].

2.3 Layout Design

Figure 4 show the design for the prototype of smart dustbin.

Figure 4: Layout Design

3. Results and Discussion

3.1 Assembly Components of Smart Dustbin

The assembly of components of smart dustbin is shown in Figure 5. Based on the diagram, all pin for VCC and GND are connected to 5v pin and GND pin of Arduino board respectively.

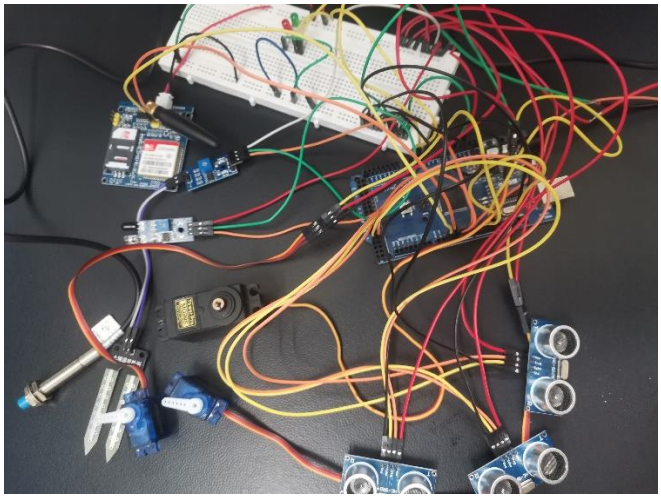

Figure 5: Schematic Diagram

3.2 Function of Component in the System

Each component and its function are shown and described in Table 1.

Table 1: Function of Components

Components	Functions
Infrared sensor	• To detect human and send data to micro servo to open the lid of the dustbin
Moisture sensor	• To detect wet waste
Inductive proximity sensor	• To detect metal waste
Micro servo motor	• To open the lid of the dustbin for input of waste b • To open the gate after the type of the waste is identified
Servo motor	• To switch the compartment, depend on the type of the waste
Ultrasonic sensor	• Using soundwave to measure the level of the waste material in the dustbin
Arduino Uno	• Act as a central processing unit to carry out all the process • To receive input data from sensor and send data to output sensor
Led	• Red led to indicate the dustbin is in processing mode • Green led to indicate the dustbin is on standby for use
GSM Module	• To notify the authorities when receive data from ultrasonic when level of waste is full

3.3 Analysis

Smart dustbin was thoroughly tested using different items that are usually disposed off on a regular basis. To test the effectiveness segregation of wet wastes, different wet waste was used. It was observed that the system was activated only after the waste was kept on the tray. Following a two second delay period, the waste thrown by the user was correctly segregated into the wet compartment.

Similarly, the dry waste segregation test condition was implemented using paper, candy wrappers, cardboard and packaging of drinks. It was observed that the bin was activated only after the waste was placed on the tray. After a delay of two seconds, the dry waste was accurately disposed off in the dry waste compartment.

Figure 6: The Segregated Waste

Upon filling the compartment to 90% of their capacity, it was observed that the ultrasonic sensor detected the sub bins as almost full. At this stage, an SMS was sent to the authorities through the GSM module informing them that the bins need to be cleared as soon as possible.

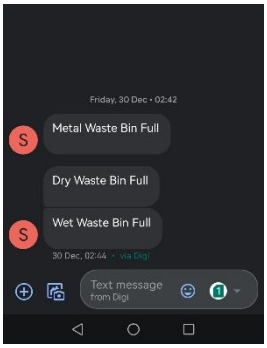

Figure 7: SMS alert sent to authorities

4. Conclusion

The first objective in this project is to design a prototype of a smart trash can embedded with an Arduino Mega, an ultrasonic sensor, LEDs, a GSM SIM900A module, a moisture sensor, a servo motor, and an infrared sensor. This objective has been achieved because a prototype of a smart trash can have been designed and built. Next, the second objective is to notify the garbage collecting authorities about the garbage level in the dustbin. This objective has been achieved by implementing the notify system built by using an ultrasonic sensor to measure the level of waste and a GSM SIM900A module to send notifications to the authorities. The system brings advantages to the authorities in that they can perfectly manage the time spent collecting garbage and reduce the cost of management. The last objective for this project is to simplify recycling work. This objective has been achieved because this project has a segregator system, which will separate the garbage in the dustbin. So, it will simplify the recycling work, which is part of segregating garbage. This project also does not require people to manage it because it is an automatic machine that only requires a technician when there is a problem. The worker just collects the garbage when it is full. To conclude, all the objectives have been achieved successfully.

In conclusion, the fact that all the sensors can accurately identify trash demonstrates that we are heading in the right direction. In the dump, the circuit has been constructed and installed. It is safe to say that the trash can is full at this point. Once this garbage can is removed, we are certain that there will be a reduction in the amount of waste that has collected on wasteland, that the streets will become cleaner, and that there will be a reduction in the amount of carbon dioxide emissions. There is information that must be researched and located to determine how an actuator and sensor are controlled, as well as how software may be designed for future implementation. This information is necessary since there is something that needs to be implemented. We will have successfully completed this project as soon as we have figured out how the actuator and the sensor function. In the future, we will be able to go on with the implementation of this project once we have collected all the data from the simulation testing as well as the hardware testing.

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