Premier University

Computer Science and Engineering

Report On

”Smart Dustbin Using Arduino”

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Abstract

In this recent world, urbanization has increased tremendously. At the same phase, there is increasing amount of waste production.Waste management has been a crucial issue to be considered. In this report, smart bin is built on a microcontroller based platform Arduino - Uno board, which is interfaced with Ultrasonic sensor. It will stop overflowing of dustbins along roadsides and localities as smart Dustbins are managed in real time.Smart bins efficiently manage waste, preventing foul odors, insects and diseases, promoting a clean environment on a large scale.The goal of this project is to keep our environment clean and eco-friendly.

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1 INTRODUCTION

1.1 Idea

In the era of rapid technological advancements, the intersection of innovation and everyday conveniences has led to the development of smart solutions aimed at enhancing various aspects of our lives. One such application is the integration of smart technologies into waste management systems, offering an intelligent approach to handling and moni toring discarded materials. This project focuses on the design and implementation of a Smart Dustbin, a novel system that leverages Arduino-based automation to streamline waste disposal processes. The primary objective of this project is to create a smart dustbin system that can autonomously monitor the fill level of the bin and actuate the lid accordingly. By utilizing an ultrasonic sensor for distance measurement, an Arduino microcontroller for processing data, and a micro-servo motor for lid control, the smart dustbin aims to optimize waste management processes. This not only contributes to a cleaner and more organized environment but also presents opportunities for resource optimization and improved operational efficiency.

A dustbin is a large container with a lid which people put their rubbish in and which is usually kept outside their house.Dustbin(or garbage bins,trash cans,whatever you can call them)are small plastic(or metal) containers that are used to store trash(or waste) on a temporary basis. They are often used in homes,offices,streets,park etc.To collect the waste.In some places,littering is a serious offence and hence public waste container are the only way to dispose small waste.usually, it is a common practice to use separate bins for collecting wet or dry,recyclable or non-recyclable waste. In existing method the ULTRASONIC SENSOR and SERVO MOTOR is used. Automatic lid opening and closing method is used in smart dustbin and microcontroller programming is done in the system. A simple but useful project called smart dustbin using arduino is designed and developed here.Using this project,the lid of the dustbin stays closed,so that waste is not exposed(to avoid flies and mosquitos) and when one want’s to dispose any waste,it will automatically open the lid.

1.2 Scope

Arduino-based smart dustbins offer a promising solution to enhance waste management practices by automating waste collection and monitoring, optimizing bin usage, and ensuring timely disposal to minimize overflow and littering. These systems integrate

sensors to monitor environmental parameters like air quality, temperature, and humidity, providing valuable data for environmental studies and pollution control. By promoting hygienic waste disposal practices, smart dustbins contribute to public health enhancement, reducing the spread of diseases caused by improper waste disposal. Additionally, they play a crucial role in resource optimization by optimizing waste collection routes and schedules based on real-time data, thereby minimizing fuel consumption, reducing operational costs, and maximizing efficiency. Moreover, projects involving Arduino-based smart dustbins drive innovation and technological integration in waste management systems, fostering the adoption of technology in the public sector and contributing to the advancement of sustainable development goals.

1.3 Importance

The project is important in various way.Here are :

1) Smart dustbins enable efficient waste collection, ensuring timely disposal and preventing overflow, which can lead to littering and environmental pollution.
2) With sensors and connectivity, smart dustbins provide real-time data.
3) smart dustbins can help reduce operational costs for waste management authorities.
4) Proper waste management contributes to environmental protection by reducing pollution and preserving natural resources.
5) Implementing smart dustbins fosters innovation and the adoption of technology in traditional waste management systems, leading to more sustainable practices.

2 IMPLEMENTATION

2.1 List of equipment

A. **HC-SR04 Ultrasonic Sensor:** The Ultrasonic Sensor HC-SR04 is one of the most commonly used distance measuring sensors and works extremely well with arduino. The time its take the sound wave to be sent, hit the object and return back to the sensor is measured.

B. **Arduino UNO :** Arduino is an open source computer hardware and software com pany, project, and user community that designs and manufactures single board . The ultrasonic sensor module uses any two digital pins on the Arduino for Trig and Echo.

C. **Connecting Wire:** For the connection of the Ultrasonic sensor to the Arduino mi crocontroller by using the jumper wire. A jump wire is an electrical wire or group of them in a cable with a connector or pin at each other.

D. **SG90 Micro Servo Motor:** The SG90 micro servo motor is a versatile and widely used component in hobbyist projects, robotics, and various electronic applications. Known for its small size and affordability, the SG90 offers precise control over angular movement, making it ideal for tasks such as steering mechanisms, robotic arms, and other applica tions requiring controlled rotational motion.

E. **9V Power Supply:** A 9V power supply is a common and versatile source of electrical power for a variety of electronic devices and components. It is widely used in applications such as small electronics projects, battery-operated devices, and low-power circuits. The 9V battery, a compact and portable option, is convenient for providing reliable energy in situations where a compact form factor is essential.

2.2 Circuit Diagram

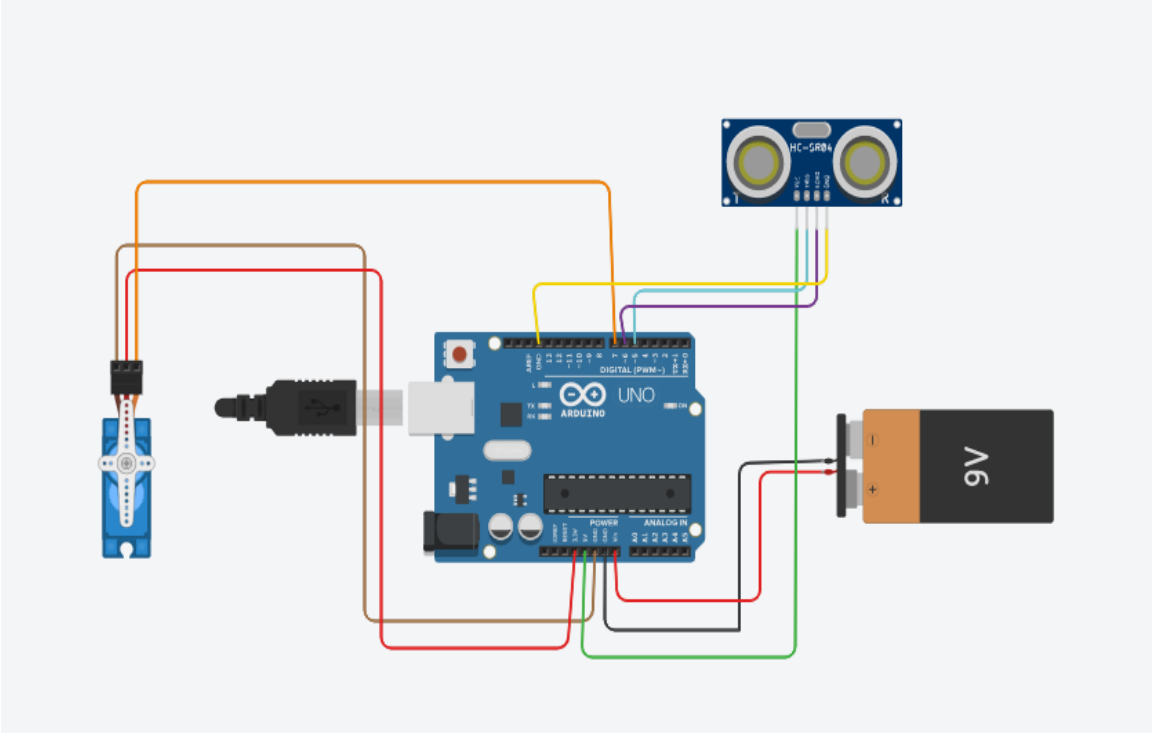

Figure 1 : Circuit Diagram of Smart Dustbin

After connecting all components to the Arduino nano first upload the code by connecting the USB cable to the Arduino nano and a pc . First compile the code then upload it using Arduino IDE.When system is powered ON, Arduino keeps checking for any things that come near the sensor at give range using the ultrasonic sensor. When Ultrasonic sensor(HC-SR04) detect any object Arduino determines if it has to give command to servo motor to open the lid or not. If the threshold value is less than that of given during coding then lid will open or else it will not open.Lid will open for few seconds which is given in the code and then it will automatically close.

2.3 Flowchart

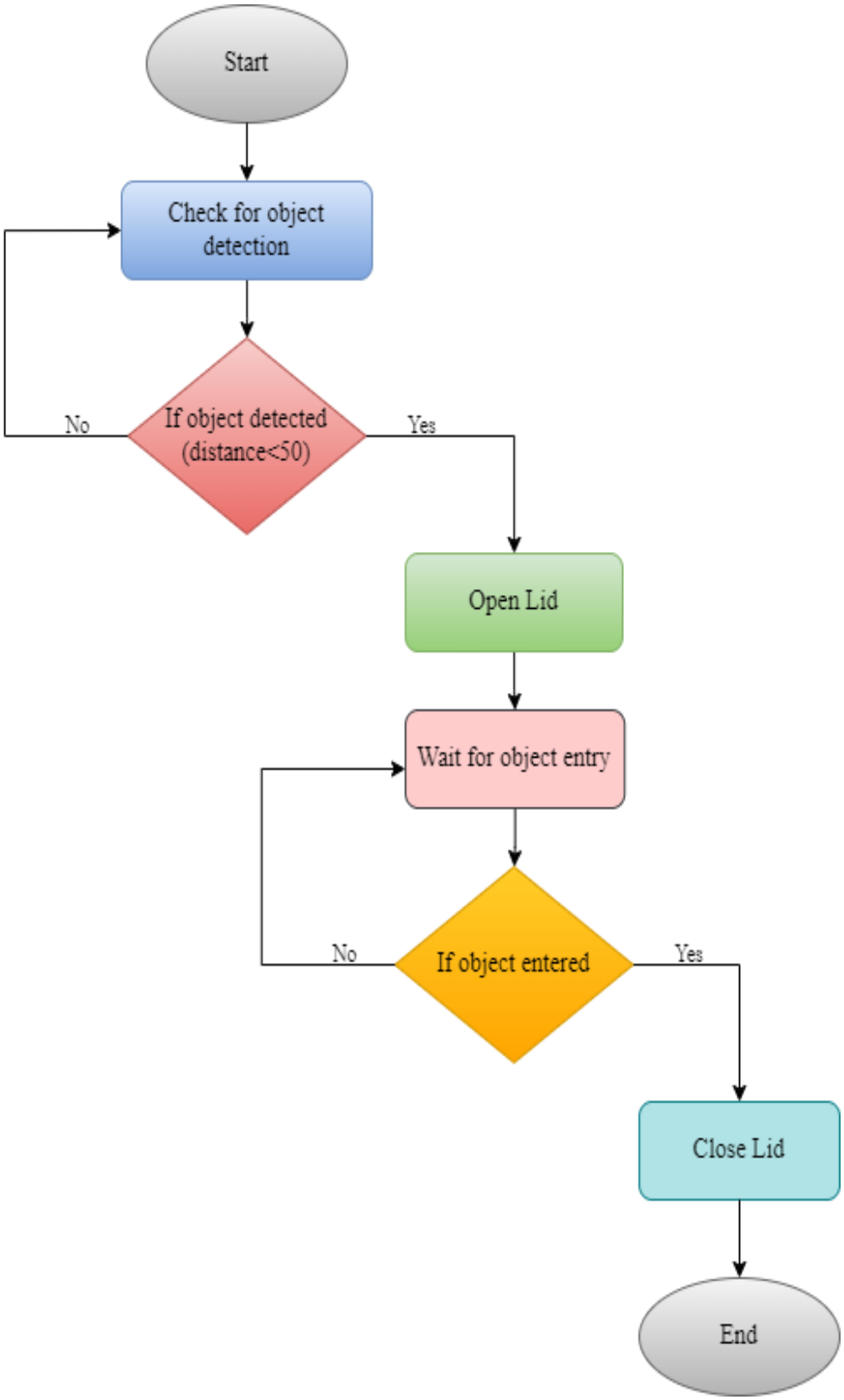

Figure 2 : Flowchart of smart dustbin

3 TESTING & ANALYSIS

Testing and analysis are crucial phases in the development of the smart dustbin project. The primary objectives of testing are to validate the proper functioning of the smart dustbin components, assess its performance under various conditions, and ensure its reliability for practical use.Testing was conducted in a controlled environment to simulate real-world scenarios.Here are some test cases with outcomes:

Test case description	Test case notation	Expected outcome	Testcase Status
Trigger the dustbin's sensor multiple times within a short period.	T1	The lid should open promptly upon detecting trash and close smoothly after a brief delay once the trash is removed. The mechanism should operate reliably without jamming or sticking.	Pass
Expose the smart dustbin to different environmental conditions	T2	The dustbin should maintain reliable operation under varying environmental factors, without degradation in performance or sensor accuracy.	Pass
Introduce non-trash items (e.g., small objects, pets) near the dustbin sensor.	T3	The dustbin should avoid false lid activations caused by non-trash items, minimizing disruptions and conserving power.	Fail

		The system should accurately distinguish between legitimate trash disposal events and other objects.	
Invite users to interact with the smart dustbin and provide feedback on usability.	T4	Users should find the dustbin intuitive to use, with clear feedback mechanisms	Pass

Table 1 : Testcase scenario

Upon analysis of the test cases, it is evident that the smart dustbin project successfully demonstrated reliable lid opening/closing mechanisms, environmental robustness, and effective avoidance of false lid activations caused by non-trash items. However, a notable issue arose during the false positive/negative testing scenario, where the system occasionally failed to recognize legitimate trash or falsely triggered lid activations in response to non-trash items. This discrepancy indicates a potential flaw in the system's trash detection algorithm or sensor calibration, leading to user frustration and a reduction in overall usability. Addressing this issue will be crucial to ensuring consistent and accurate performance, thereby enhancing user satisfaction and the practicality of the smart dustbin project. Further investigation and refinement of the trash detection mechanism are recommended to mitigate these issues and optimize system reliability.

4 CONCLUSION & FUTURE ENHANCEMENT

In conclusion, the Smart Dustbin project has successfully demonstrated an efficient and automated waste management system. Through the integration of an Arduino micro controller, ultrasonic sensor, and micro-servo motor, the project addresses the need for a responsive and hands-free dustbin solution. Using this project, the lid of the dustbin stays closed, so that waste is not exposed (to avoid flies and mosquitos) and when we want to dispose any waste, it will automatically open the lid. This project came in comfortable which a worthy elucidation for maintaining green environment.

Future enhancements for a smart dustbin using Arduino include smart sorting, capacity monitoring, energy efficiency, remote monitoring, data analytics, odor control, user interaction improvements, integration with smart cities, safety features, and community engagement initiatives. Smart dustbins are now the needs of Smart buildings. Smart dustbin is a new idea of implementation which makes a normal dustbin smart.There is a great scope for the modifications of the Smart Dustbin in the future. The system can be improved by adding new functionalities. Dumping of the waste was manual in Smart dustbin this can be automated by fixing a robot arm.

5 REFERENCES

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