Smart Waste Management System

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1. Introduction

In a world increasingly focused on sustainability and efficiency, the management of waste has emerged as a critical concern. Conventional waste disposal techniques not only prove ineffective but also pose significant harm to the environment. To address these challenges, we propose the development and implementation of a Smart Waste Management System, centered around an innovative waste bin solution.

Through innovative features, our waste management solution aims to revolutionize waste handling, providing a sustainable and efficient answer to the challenges of modern-day waste disposal.

2. Background and Context

Traditional waste management methods often lack efficiency, leading to environmental pollution, health hazards, and resource wastage. With the rise of urbanization and population growth, the need for effective waste management solutions has become increasingly pressing.

Hence, various IOT research has been carried out over the years to address the problem. The development of an innovative Automatic Waste Management and Segregation Systems utilizing IoT technology are proposed [1][2] Their research demonstrates the successful deployment of IoT-enabled sensors for efficient segregation of dry and wet waste. The integration of Machine Learning to separate waste into more categories is also researched upon [3]. Inadequate waste management not only poses environmental threats but also engenders public health concerns. Proposals for on-spot automatic waste segregation units in smart cities underscore the urgency of addressing these issues [4].

By automating the waste management processes, these systems offer promising avenues for promoting sustainable waste management practices and improving urban living conditions. However, further research and implementation efforts are warranted to realize the full benefits of these technological innovations and foster widespread adoption across diverse urban landscapes including Sri Lanka. Hence, we believe our motive is beneficial and timely, to support humans in repetitive tasks like waste segregation and waste management at a cost effective rate.

3. Objectives

The proposed system aims to optimize waste collection, sorting, processing, and disposal processes using technology. Some major objectives are:

● Minimize unnecessary time spent in waste collection trips by indicating the fill-level and weight of the waste collected as real-time data.

- Increase the recovery and recycling rates of valuable materials from waste streams through effective sorting and separation processes.Hence reuse, recycling, and recovery of resources is promoted.
- The weight of valuable materials like metals can be obtained real time to send to recycling centers.
- Cleanliness and hygiene near waste collection centers is encouraged using this approach. Overflowing of waste levels in dustbins is prevented and the unpleasant odor, pests, and other nuisances associated with waste handling are mitigated.

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4. Project Scope

This project aims to develop an affordable and user-friendly solution for waste segregation and management in domestic settings. The proposed model will feature enhanced sensing capabilities to accurately identify and segregate different types of waste materials. However, one limitation of the system is that only one type of waste material can be deposited into the bin at a time. Additionally, there may be a slight delay between the addition of waste materials due to the sensing process. Furthermore, the size of the bin restricts the acceptance of large materials. It's important to note that after segregation, the user will manually decide the next steps based on the fill level indicator.
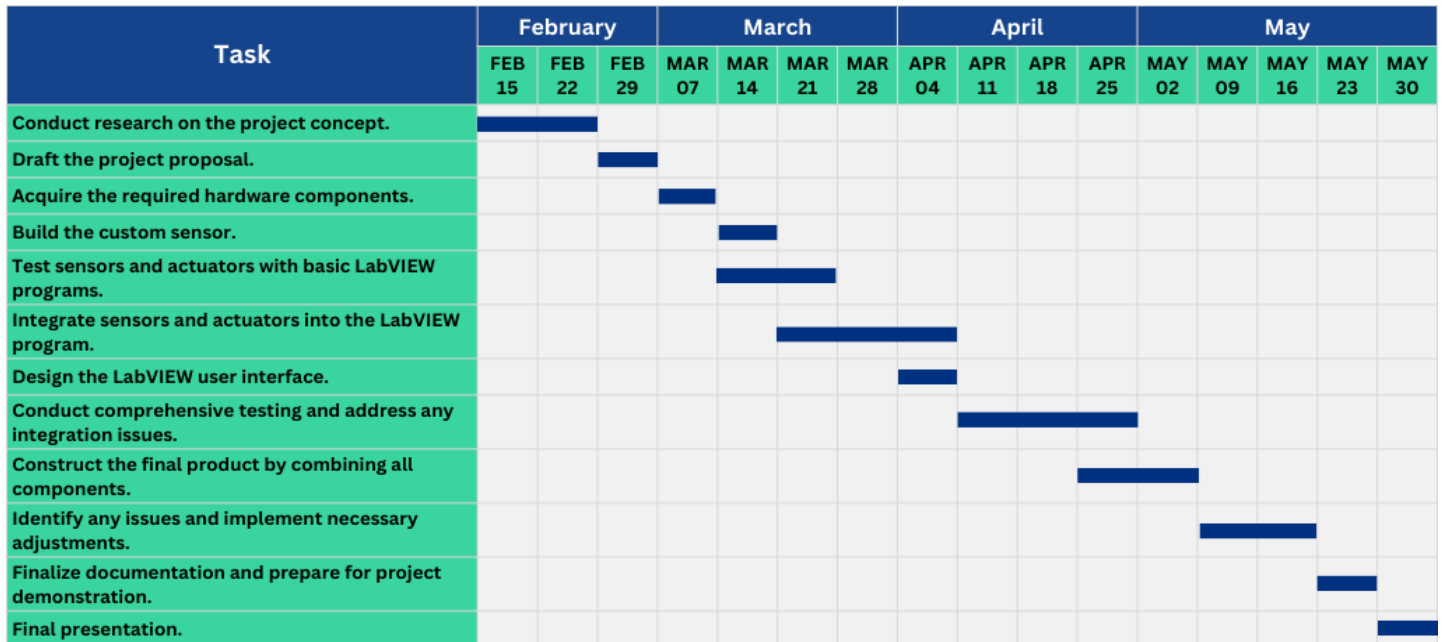
5. Methodology

The methodology we propose include 3 major functionalities as follows:

1. Automatic Lid Opener - The lid of the waste bin opens only when a motion is detected near the lid. Furthermore if the imposed level of waste is surpassed, the lid remains closed even in place of motion being detected. An ultrasonic sensor or an IR sensor is to be used coupled with a servo motor to detect and operate the lid.

2. Waste Segregation - Waste thus added to the bin is sent through a separation process. We propose to separate the waste to 3 main categories as Wet, Dry and Metallic waste. The goal is to collect waste in a hygienically suitable manner. The metallic waste is collected separately to send to recycling given the value of the material.
Two different sensors to detect metals (inductive sensor) and moisture will be used for the sorting.

3. Detection of fill level and weight - For the lid to open to accept waste, the fill level should be under the permissible level. For this, an IR sensor is to be integrated. The weight of the collected waste will be indicated,too.

These sensors will be integrated through LabView with the help of the National Instrument DAQ card.

A block diagram of the process is shown below.

Flowchart text:
Start → Detect fill level → Indicate fill level → Fill level > Max level ? — YES → Lid kept closed
Start → Detect fill weight → Indicate fill weight
Fill level > Max level ? — NO → User motion detected ? — YES → Automatic Lid opens → Waste detected? — YES → A metal? → Direct to the metal basket
User motion detected ? — NO → Lid is kept closed
Waste detected? — NO → Moisture detected? — YES → Direct to the wet basket
Moisture detected? — NO → Direct to the dry basket
(NO loops return to Start)

6. Timeline

Task	February			March				April				May				
	FEB 15	FEB 22	FEB 29	MAR 07	MAR 14	MAR 21	MAR 28	APR 04	APR 11	APR 18	APR 25	MAY 02	MAY 09	MAY 16	MAY 23	MAY 30
Conduct research on the project concept.	▬															
Draft the project proposal.		▬														
Acquire the required hardware components.			▬													
Build the custom sensor.				▬												
Test sensors and actuators with basic LabVIEW programs.					▬	▬										
Integrate sensors and actuators into the LabVIEW program.							▬	▬								
Design the LabVIEW user interface.								▬								
Conduct comprehensive testing and address any integration issues.									▬	▬						
Construct the final product by combining all components.											▬	▬				
Identify any issues and implement necessary adjustments.													▬	▬		
Finalize documentation and prepare for project demonstration.															▬	
Final presentation.																▬

7. Conclusion

The proposed system aims for sustainable waste management with the application of sensors bringing in a technological solution. The cleanliness and hygiene is to be ensured near waste bins by the application of this system. In the process, we hope to use 4 sensors (one of which will be made from scratch) and 2 actuators to fulfill the tasks.
With its innovative approach and potential for significant positive impact, we seek approval for the implementation of this system to revolutionize waste management and create a cleaner, greener future for our community.

8. References

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4. Shruthi B Gowda, Balapriya F, and Chaya K R, Enhanced Smart Waste Segregation and Management using Arduino, 2022nd ed., vol. 11. International Journal of Engineering Research & Technology (IJERT), 2022.