Self-sorting Garbage Bin for an Office Environment

A Technological-Sustainable Approach to Office Waste Reduction

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***Abstract*—In today's environmentally conscious world, the need for efficient waste management solutions has never been more critical. This research focuses on the design and implementation of an innovative self-sorting garbage bin tailored for the specific needs of office environments. Our innovative solution features state-of-the-art sensor technology designed to autonomously categorize and facilitate the disposal of diverse waste materials, fostering recycling practices and minimizing contamination. Our system excels in sorting paper, polythene, and hard plastic, boasting a compact design for space efficiency and exceptional durability for long-lasting performance. The proposed system not only streamlines waste disposal but also aims to raise awareness and encourage responsible waste practices among office personnel. By analyzing the potential benefits, challenges, and costs associated with such a system, this study seeks to provide valuable insights for organizations aiming to enhance their sustainability efforts while maintaining a clean and orderly workspace. The self-sorting garbage bin represents a significant step toward a more sustainable and eco-friendly office environment, offering a glimpse into the future of waste management in corporate settings.**

***Index Terms*—Self-sorting garbage bin, Office waste disposal, Sustainable waste management, Smart waste bin, Recycling**

I. Introduction

Waste management is a critical challenge facing modern societies, and in the pursuit of sustainability, innovation in this area is imperative. This paper introduces the concept of an intelligent self-sorting garbage bin specifically designed for office environments, representing a novel approach to waste disposal. While waste management is a global concern, this research focuses on the context of office settings, which often house a considerable number of employees and produce a significant volume of waste daily. We will take deep dive into the types of waste in an office environments later in this paper. The conventional approach to waste disposal, often reliant on general waste bins, poses several issues, including contamination, inefficiency, and missed recycling opportunities. In contrast, the development of a self-sorting garbage bin aims to address these challenges by leveraging advanced technology and automation to streamline waste segregation and recycling within office spaces.

Sri Lanka, like many other countries, grapples with the growing waste problem. The urbanization and industrialization of this nation have contributed to a surge in waste production, placing immense pressure on existing waste management systems. The need for innovative and efficient waste disposal methods is more pronounced than ever. While our research is not limited to Sri Lanka, the local context provides a poignant example of the waste management challenges that many countries face.

Traditional waste management methods often fall short of the goals of sustainability, recycling, and environmental protection. In the context of an office environment, a lack of awareness and participation among employees can exacerbate these issues. Recycling bins are typically available but are not always used correctly, leading to cross-contamination of recyclables and non-recyclables. The result is an increased burden on waste disposal systems and a missed opportunity to reduce the environmental impact of office waste.

The self-sorting garbage bin concept offers a promising solution to these challenges. By incorporating advanced sensor technology, machine learning algorithms, and automation, it can autonomously separate waste materials into recyclable and non-recyclable categories or more. This not only enhances the efficiency of waste management but also promotes sustainability and environmental responsibility within the office. Employees are more likely to participate in recycling when the process is made easy and convenient, which is precisely what this innovative system aims to achieve.

The impact of this research extends beyond waste disposal efficiency. It also has the potential to influence behavioral change among office workers. Employees interacting with a self-sorting garbage bin are likely to become more conscious of their waste disposal habits, as they witness the tangible effects of responsible recycling. The system can track and provide feedback on the volume of waste recycled, offering insights and incentives for users to reduce their environmental footprint. Consequently, this research seeks to drive sustainable practices and contribute to a more eco-friendly workplace culture.

Additionally, the implementation of smart waste bins in office environments is expected to alleviate the burden on external waste management services. By reducing the incidence of cross-contamination and optimizing waste separation, less effort and resources will be required for waste collection and processing. The cost-effectiveness and long-term sustainability of this approach make it an attractive proposition for organizations looking to enhance their environmental credentials.

In summary, this research introduces the concept of a self-sorting garbage bin tailored for office environments, presenting a comprehensive solution to the challenges associated with waste management. By harnessing technology to automate the waste segregation process, we aim to promote recycling, reduce contamination, and cultivate a culture of sustainability in office environments. The significance of this research extends beyond efficient waste disposal, as it has the potential to drive behavioral change, ease the burden on waste management services, and enhance the overall environmental responsibility of organizations. In the following sections, we will delve deeper into the development, challenges, benefits, and the future prospects of this intelligent self-sorting garbage bin.

II. Types of Waste in Office Environments

Waste is an inevitable product of society; managing this waste more effectively is a need that society has to address [7].Office environments generate a diverse array of waste materials, and effective management is paramount for maintaining a clean and eco-friendly workspace. This section provides an in-depth exploration of the various waste categories commonly found in office settings, along with the challenges they pose.

A. General Office Waste

General office waste encompasses a wide spectrum of materials, the most prevalent of which is paper. Despite the digital revolution, offices still produce substantial quantities of paper waste. This includes discarded documents, used notebooks, and outdated promotional materials. In addition to paper waste, general office waste comprises cardboard, packaging materials, and disposable office supplies such as pens, markers, and staplers. These materials, while essential for daily office operations, often end up as waste. Efficiently managing this category is essential to minimize environmental impact.

B. E-Waste

Electronic waste, commonly referred to as e-waste, is a critical concern in contemporary office environments. It comprises discarded electronic devices and accessories like computers, monitors, keyboards, cables, and even mobile phones. The challenge with e-waste lies in its potential hazardous components, including heavy metals and toxic chemicals. Proper disposal and recycling are vital to prevent environmental contamination and to harness the value of reusable materials within these electronic devices.

C. Hazardous Waste

Certain office operations, such as printer maintenance and cleaning, lead to the generation of hazardous waste. This category includes items like printer toner cartridges, batteries, and specific cleaning agents. Hazardous waste poses significant health and environmental risks when not managed correctly. Specialized disposal procedures are required to ensure the safe handling and treatment of these materials.

D. Plastics and Single-Use Items

In an era marked by convenience, office environments often see the pervasive presence of plastic waste. This includes single-use cups, utensils, and packaging materials. Encouraging responsible plastic use, implementing recycling programs, and reducing the consumption of single-use items are crucial steps toward sustainability. Office personnel should be educated on the environmental impact of these materials and motivated to adopt eco-friendly alternatives.

E. Miscellaneous Waste

Miscellaneous waste encompasses a variety of items found in offices, ranging from broken office equipment to outdated stationery and decorative materials. Proper management of these miscellaneous items is essential to maintain a clutter-free and organized workspace. Recycling, upcycling, or proper disposal methods should be encouraged to minimize the environmental footprint.

Considering the substantial rates at which these waste types are generated within a corporate setting, it is prudent to categorize them into three primary groups: paper, polythene, and hard plastic. This classification not only facilitates more effective waste management but also contributes to a heightened awareness of the diverse materials that collectively constitute the corporate waste stream.

Waste Type	**Categorization**		
	Paper	**Polythene**	**Rigid Plastic**
General Office Waste	1		
E-Waste		1	1
Hazardous Waste	1	1	
Plastics and Single-Use Items			1
Miscellaneous Waste		1	1

These waste categories underscore the waste management challenges faced by office environments. Our research aims to provide valuable insights into addressing each of these waste types effectively, promoting recycling, reducing contamination, and fostering a culture of environmental responsibility within offices. By tackling these challenges head-on, we can work toward creating more sustainable and eco-friendly office spaces.

III. Existing Solutions: A Comprehensive Overview of Current Smart Waste Management Approaches

Researchers have been developing self-sorting garbage bins for offices to streamline waste management and recycling. These innovations include systems that can automatically distinguish between recyclables and non-recyclables(or more categories), making it easier for users to dispose of their trash properly. Some solutions involve image recognition technology, while others leverage sensors or IoT connectivity for more efficient waste sorting and monitoring. These advancements aim to promote environmental responsibility and sustainability in office environments.

A. Madan Kumar et al

This research presents an embedded system for automated sorting of plastic types using Near Infrared Spectroscopy (NIRS). Non-biodegradable plastics, if not disposed of properly, can harm the environment. Efficient recycling demands instant identification and segregation of various plastic polymers. The study employs NIRS for rapid and accurate plastic identification. A cost-effective control system based on Raspberry Pi facilitates waste plastic sorting, and Python programming handles spectrometer interfacing and NIRS data processing, ensuring economic and efficient recycling practices [2].

B. Jiu Huange et al

This research introduces an innovative approach to solid waste sorting, addressing limitations of traditional methods like magnetic and eddy current sorting. The proposed system employs an optical sensor and mechanical separator to determine particle sizes, positions, colors, and shapes as sorting criteria. The mechanical sorting device, controlled by a computer, uses compressed air nozzles to remove target particles from the main waste stream based on sensor-recognized features. This method presents a new avenue for multi-feature recognition in sensor-based sorting technology, enhancing the efficiency of waste recycling and reuse processes [1].

C. Yann Glouche et al.

The research paper introduces a smart waste management system utilizing Radio Frequency Identification (RFID) technology at the bin level. Each waste item is tagged with self-contained information, allowing smart bins to automatically identify and track them without external support. The proposed system enhances selective sorting by aiding users and enables smart bins to communicate their contents to the recycling chain. This innovation streamlines waste management processes, improving efficiency and contributing to a more effective recycling workflow.

D. Catherine Lee's IoT Solution

labelAA Catherine Lee's project involved a self-sorting bin for office environments equipped with Internet of Things (IoT) connectivity. This allowed remote monitoring and management of the bin's waste sorting process. Users received real-time feedback via a mobile app.

E. Suwon Shin and co.

This project introduces an innovative automatic trash basket designed for efficient recycling, specifically sorting metal and paper-based waste. Tailored for office workers and students, the compact trash basket facilitates convenient disposal. The project's standout feature is its reliance on automatic motion, streamlining the waste disposal process. The automation adds a user-friendly touch, enhancing the appeal and practicality of recycling efforts within office and educational environments [6].

F. Ohtani and co.

The research proposes a novel approach to enhance recycling and reuse through a locally autonomous, simple sensor system. Focusing on sorting for reuse, the study introduces an identification system employing an ultrasonic sensor array and neural networks. This system effectively categorizes objects based on shape and material using ultrasonic pressure distribution and acoustic impedance. Experimental results with a prototype sensor system demonstrate the practical viability of this method for shaping and material sorting in recycling processes [4].

G. L.M. Kumar et al

The method of Near Infrared Spectroscopy (NIRS) was used in this work for the on-line and rapid identification of consumer plastics. The use of NIRS allows for the rapid identification and monitoring of the molecular or structural characteristics of the plastic under investigation. An automated procedure capable of sorting plastic, as well as a low-cost embedded system, had been designed to achieve the desired outcome. Furthermore, To protect the personnel from the unhealthy environments that was predominant in plastic recycling plants, wireless was interfaced which was capable of controlling the NIRS instrumentation remotely [3].

H. Ruveena Singh, Dr. Balwinder Singh

The research paper addresses the escalating issue of solid waste management exacerbated by urbanization, emphasizing the necessity for ecologically sustainable practices. Existing manual sorting methods are labor-intensive and time-consuming, leading to a call for a smart waste sorting system. The paper distinguishes between biodegradable and non-biodegradable waste, underlining the environmental and human health risks associated with the latter. The proposed solution advocates for an automated sorting approach to ensure efficient waste management without compromising individual well-being [5].

IV. Weaknesses or limitations of previously implemented solutions

The above explorations may not be exactly fitted to the scope of an office environment. There are some special constraints within the scope such as, durability, cost, physical appearance and easy usage. Apart from these constraints, here are some of the common weak points of the above inventions.

A. Cost and Maintenance

- In the context of office environments, the implementation of self-sorting bins with advanced technology components indeed poses financial challenges. The cost of manufacturing and maintaining such bins, incorporating features like optical sensors and computer-controlled mechanical sorting, can be prohibitively high. This financial burden may render the adoption of these bins economically unviable for smaller businesses or institutions, emphasizing the need for cost-effective waste management solutions.

B. User Error

- In office environments, users often face challenges in accurately disposing of waste, resulting in contamination of sorted materials. Studies show that individuals may be unclear about recycling guidelines, leading to incorrect disposal practices. Simplifying the interaction between users and waste disposal mechanisms is crucial to mitigate contamination and ensure the effectiveness of waste sorting in office settings.

C. Technological Reliability

- In office waste management, the reliability of sorting technologies such as sensors, cameras, and RFID is crucial to prevent improper disposal. Malfunctions or inaccuracies may lead to the misclassification of recyclables and contribute to increased waste contamination. Minimizing complex electronic devices in the sorting process ensures a more robust and dependable waste management system for efficient recycling in office environments.

D. Space and Size

- In office environments, the practicality of waste bins is crucial, considering limited space and the need for aesthetically pleasing designs. Bulky bins can be inconvenient, hindering movement and disrupting office layouts. Compact, geometrically designed bins not only optimize space but also contribute to a cleaner and more organized workspace, aligning with the functional and aesthetic requirements of smaller office settings.

Fig. 1: Bin-e Standard Recycling Waste Bin.

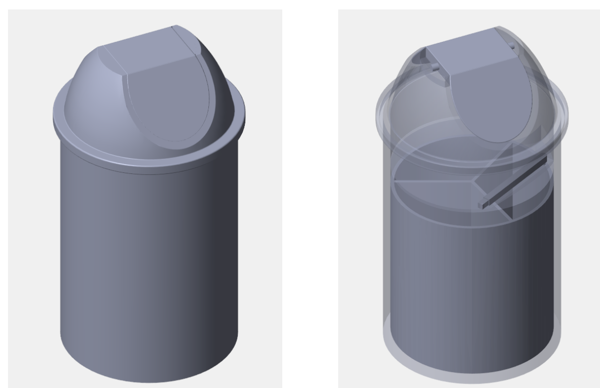
E. Energy Consumption

- Smart bins that rely on more complex electronics and mechanical moments may consume electricity. Energy-efficient design is crucial to minimize operational costs and environmental impact.

V. Smart Waste Sorting Bin - SWSB

Our cutting-edge waste sorting bin redefines recycling efficiency with its thoughtful design and functional features. Equipped with three dedicated compartments for paper, polythene, and hard plastic, the bin facilitates precise waste segregation, promoting sustainable practices in diverse office environments. Constructed with durability in mind, this bin is built to withstand the rigors of daily use, ensuring a long lifespan and contributing to a reduction in overall environmental impact through a very sustainable design. The bin's simple mechanical movements prioritize user-friendly functionality. The lid opens smoothly, providing a hassle-free experience for users while minimizing the risk of mechanical failures. This seamless operation encourages widespread adoption and engagement in recycling initiatives, fostering a culture of environmental responsibility. In response to the growing emphasis on energy efficiency, our waste sorting bin features lower power consumption. This not only aligns with contemporary sustainability practices but also translates to operational cost savings, making it an economically viable choice for businesses and organizations committed to green initiatives.

Complementing its functional prowess, our waste sorting bin boasts an appealing design. The sleek, modern aesthetic enhances the visual appeal of any space, contributing to a positive recycling experience. Thoughtfully selected geometric shapes ensure that the bin seamlessly integrates into various architectural and interior design styles, making it a versatile and aesthetically pleasing addition to any cooperate environment.



(a) Solid View (b) Transparent View

Fig. 2: Physical Appearance

A. Methodology

a) Sensor Integration and Waste Identification: The core of the smart waste sorting bin lies in its inclusion of essential sensors designed to identify specific waste types—paper, polythene, and rigid plastic. Positioned strategically between the lid and compartments, an insertion stage plays a crucial role. When multiple wastes are introduced simultaneously, they gather atop this stage. A small hole with a mechanized system is situated at one corner of the stage, allowing for the sequential movement of wastes through the hole. A sequential waste input is not expected from the users, allowing users to insert bulk of waste at at a time.

In this intricate process, a combination of advanced sensor technologies is employed to precisely identify the type of waste as it traverses the sorting mechanism. Infrared sensors assess the reflective properties of materials, distinguishing between paper, polythene, and rigid plastic based on their unique signatures. RFID technology utilizes tags attached to each waste item, enabling the system to read and identify the waste type through radio-frequency communication. Additionally, machine vision systems, equipped with cameras and image processing algorithms, visually analyze and recognize distinct characteristics of each material. This multi-sensor approach ensures a high level of accuracy and efficiency in waste identification as it passes through the sorting hole.

b) Efficient Sorting Process and Inner Compartment Rotation: As the identified waste descends through the hole, a motor-driven inner compartment at the bottom of the smart dustbin comes into play. This compartment possesses the unique capability to rotate around its axis. Concurrently, sensors identify the waste type during its descent. Based on this identification, the inner compartment smoothly moves to the correct position, ensuring that the waste is directed to the appropriate compartment—whether designated for paper, polythene, or rigid plastic. Importantly, a dedicated sensor is strategically incorporated to precisely identify the current position of the inner compartment. This sensor feedback ensures accurate alignment and facilitates the seamless sorting of waste into the designated compartments.

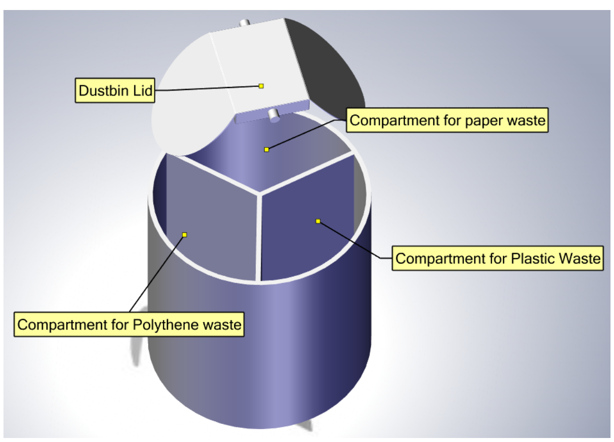


Fig. 3: Inner Three Compartments

c) Efficiency Through Simultaneous Waste Insertion: The system's efficiency is further underscored by its capacity to handle multiple waste insertions simultaneously, eliminating the need for a tedious, one-by-one approach. The insertion stage temporarily holds all introduced wastes for sequential processing. This design consideration not only enhances user convenience but also ensures a smooth sorting process. After all the wastes are inserted into the bin, a brief sorting process commences, eradicating the requirement for users to wait for waste insertion one by one. Tailored for office environments, this smart dustbin fosters sustainable practices while accommodating the dynamic waste disposal needs of busy workplaces.

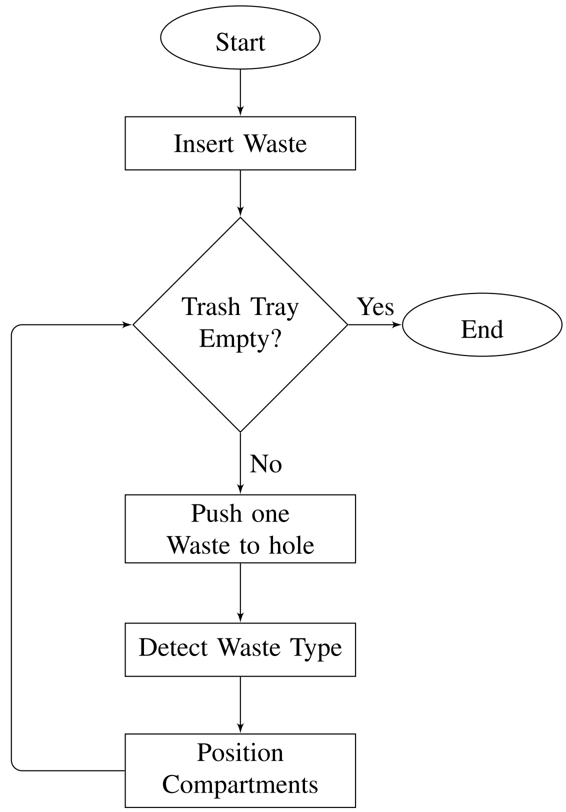


Fig. 4: Flow Chart

d) Durable and Sustainable Design: The smart waste sorting bin, characterized by its minimal complex mechanical movements, few moving parts, and simple motor movement, exhibits notable durability and sustainability. The reduction in complex mechanical components inherently lowers the risk of wear and tear, contributing to increased durability. With fewer moving parts, there are fewer points of potential failure, enhancing the overall longevity of the system. The simplicity of the motor movement not only ensures efficient operation but also minimizes energy consumption, aligning with sustainable design principles.

Additionally, the streamlined design facilitates easier maintenance and repair, further extending the product's lifespan. This approach not only enhances the product's resilience to daily use but also aligns with sustainability goals by reducing the environmental impact associated with manufacturing, maintenance, and disposal.

VI. Simulation On MATLAB Environment

MATLAB provides a powerful environment for simulating dynamic systems. We can model the behavior of our waste sorting bin over time, taking into account factors such as motor movement, sensor inputs, and bin response. This simulation allows us to observe how the system behaves under different conditions without the need for physical prototypes.

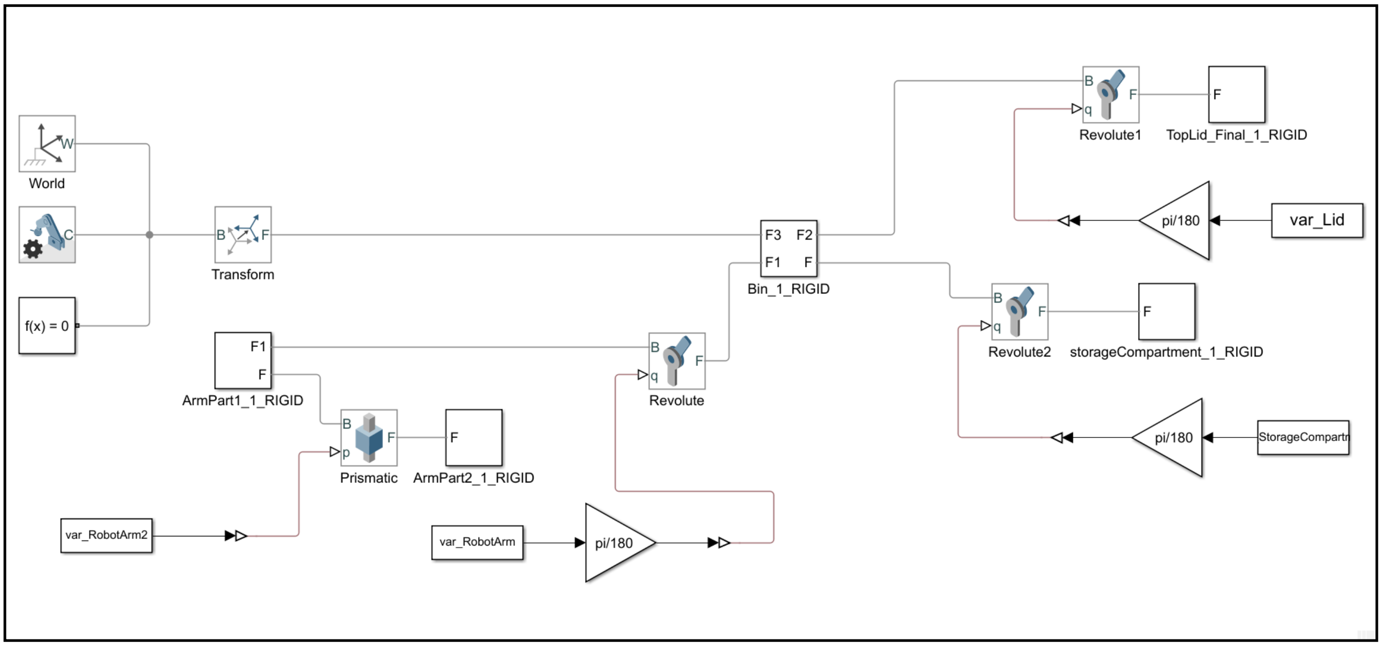


Fig. 5: SIMULINK Model of Smart Dustbin

A. CAD Integration

The simulation begins with the integration of Computer-Aided Design (CAD) elements into SIMULINK. The CAD model comprises five rigid solid bodies representing essential components of the smart waste sorting bin—outer bin with a trash tray, lid, storage compartment, robot arm, and extension arm. This integration ensures a high-fidelity representation of the physical structure within the simulated environment. We have implemented the proposed design using the SIMULINK environment in MATLAB (Fig.5).

B. Defining Motion through Matrices

In SIMULINK, We've modeled the smart waste sorting dustbin by defining motion through matrices for each joint. Using matrices allows precise control of joint movements, enabling accurate simulation of the dustbin's actions. This approach provides a flexible and efficient means to specify and manipulate the motion parameters, ensuring seamless integration with the overall SIMULINK model. By leveraging matrix-based definitions for joint motions, the simulation accurately reflects the intended behavior of the smart waste sorting dustbin, facilitating detailed analysis and optimization within the SIMULINK environment. All the matrices are defined as positions with respect to time.

$$Var = \begin{bmatrix} t_1 & p_1 \\ t_2 & p_2 \\ t_3 & p_3 \\ - & - \\ - & - \\ - & - \\ t_{n-1} & p_{n-1} \\ t_n & p_n \end{bmatrix} \tag{1}$$

C. Reference Frames and Joints

To impart the necessary degrees of freedom to the simulated system, relevant reference frames and joints are incorporated into the SIMULINK model. These additions play a critical role in defining the spatial relationships between different components and enabling realistic interactions. They contribute to the overall flexibility and adaptability of the simulated waste sorting bin.

VII. Results and Evaluation

A. Rotation Count Analysis

In the evaluation of the smart waste sorting bin's performance, we conducted simulations with varying inputs to understand the efficiency of the waste sorting process. The key metric considered is the rotation count of the inner compartment, representing the number of movements needed to accurately sort a batch of waste.

For each simulation run, we introduced 10 random waste items simultaneously into the smart bin. The system, equipped with sensors and a rotating inner compartment, swiftly identified and sorted the waste into the relevant compartments for paper, polythene, or rigid plastic. Notably, the bin has the flexibility to rotate in both clockwise and counter-clockwise directions, optimizing its movement for quicker positioning.

The rotation count is incremented each time the inner compartment moves from one compartment to another during the sorting process. However, if the same type of waste recurs, the compartment remains in its current position, and the rotation count is not increased. This approach ensures that the system focuses on repositioning only when encountering a new type of waste.

Sequence Number	Movements	Number Of Total Moments (Including Initial Moment)
1	Plastic Paper Polythene Plastic Plastic Plastic Polythene Paper Paper Paper	6
2	Paper Plastic Plastic Polythene Plastic Paper Polythene Plastic Plastic Plastic	7
3	Plastic Paper Plastic Plastic Plastic Plastic Plastic Polythene Plastic Paper	6
4	Polythene Paper Paper Paper Paper Plastic Polythene Paper Plastic Paper	7
5	Paper Polythene Polythene Paper Paper Polythene Plastic Paper Polythene Paper	8
6	Polythene Paper Polythene Polythene Plastic Plastic Polythene Paper Paper Paper	6
7	Plastic Paper Plastic Paper Plastic Paper Paper Paper Polythene Paper	8
8	Paper Plastic Polythene Polythene Plastic Paper Polythene Polythene Paper Polythene	8
9	Paper Paper Polythene Polythene Plastic Paper Polythene Paper Paper Paper	6
10	Paper Plastic Paper Polythene Paper Polythene Paper Polythene Polythene Polythene	8

TABLE I: Radom Cases of Sorting

To derive meaningful insights, we repeated this simulation process 10 times, each time introducing a new set of 10 random waste items. The average rotation count was then calculated by summing up the rotation counts from all simulations and dividing by 10 (Table 1). This methodology allows us to assess the average efficiency of the smart waste sorting bin in handling diverse waste inputs and provides a practical measure of its sorting capabilities in real-world scenarios.

The following MATLAB code simulates the act of putting 10 random waste items in to the bin at once.

```
clc; clear all;
generated_sequence = [];
random_sequence = randi([1, 100], 1, 10);
disp(random_sequence);
for index = 1:1:10
    disp(random_sequence(index));
    if random_sequence(index) < 50
        generated_sequence = [
            generated_sequence, "Paper"];
    elseif random_sequence(index) < 80
        generated_sequence = [
            generated_sequence, "Polythene"];
    else
        generated_sequence = [
            generated_sequence, "Plastic"];
    end
end
disp(generated_sequence);
```

Listing 1: Generate 10 Random Waste Items

In these cases, the rotation counts obtained for 10 simulations are provided in Table I. The average rotation count is calculated as follows:

$$
\begin{aligned}
&= \frac{6+7+6+7+8+6+8+8+6+8}{10} \\
&= 7\,(Rotations)
\end{aligned}
\tag{2}
$$

B. *Time Analysis*

Assuming a constant speed for the inner bin motor, this time (T) can be determined experimentally or through motor specifications. You can substitute the appropriate values to get the average time for sorting.

$$
\begin{aligned}
\text{Average Time for Sorting} &= \text{Average Rotation Count} \times T \\
&= 7 \times T
\end{aligned}
\tag{3}
$$

To further optimize the sorting process, different motors with varying speeds can be considered. Experimentation with motors of distinct speeds allows for a comprehensive analysis of how motor specifications impact sorting time. By substituting different motor speeds into the time calculation formula, the most suitable motor can be identified to minimize the sorting time. This exploration contribute valuable insights into the relationship between motor speed and the overall efficiency of the waste sorting bin.

Additionally, it's crucial to consider real-world factors such as motor durability, power consumption, and cost when selecting the most suitable motor for the smart waste sorting bin. A balance between speed and other operational parameters ensures not only efficient waste sorting but also long-term reliability and cost-effectiveness.

This calculation allows us to assess the average efficiency of the smart waste sorting bin in handling diverse waste inputs across multiple simulations.

Results from the above simulation is listed below. The samples are biased in the order of Paper, Polythene and Hard-Plastic. This is because of the accumulation rates for the respective waste categories decent in the above mentioned order. Depending on the cooperate type, these values and order may subjected to change. Through a collection of data regarding the waste accumulation rates, the values and order can be estimated.

VIII. Conclusion

In conclusion, the smart waste sorting bin presented in this research represents a cutting-edge solution to the challenges of efficient and sustainable waste management. By incorporating advanced sensor technologies, including infrared sensors, RFID technology, and machine vision systems, the bin achieves a high level of accuracy in identifying and sorting diverse waste types, such as paper, polythene, and rigid plastic. The seamless integration of these technologies, strategically positioned within the insertion stage and the motor-driven inner compartment, allows for a simultaneous and bulk insertion of waste, catering to the dynamic disposal needs of busy environments like offices.

The design of the system is marked by its simplicity, with minimal complex mechanical movements, few moving parts, and a straightforward motor movement mechanism. This design choice not only enhances the overall durability of the smart bin but also aligns with sustainable principles by reducing wear and tear, potential points of failure, and energy consumption. The streamlined design further facilitates easier maintenance and repair, contributing to the product's longevity and minimizing its environmental impact throughout its life cycle.

MATLAB, specifically the SIMULINK environment, has been instrumental in modeling and simulating the dynamic behavior of the waste sorting bin. Through the use of matrices to define joint motions, the simulation accurately reflects the intended actions of the system, allowing for detailed analysis and optimization without the need for physical prototypes. This approach enhances the efficiency of the design process and contributes to the overall robustness of the smart waste sorting bin.

The evaluation of the system's performance through simulations, considering the rotation count of the inner compartment as a key metric, demonstrates the bin's effectiveness in handling diverse waste inputs. The average rotation count, calculated over multiple simulation runs, provides a practical measure of the bin's sorting capabilities in real-world scenarios. The results indicate that the system efficiently identifies and sorts waste items, optimizing its movement for quicker positioning and demonstrating its adaptability to various waste scenarios.

In summary, the self-sorting waste bin not only addresses the pressing need for efficient waste management but also aligns with sustainability goals through its durable and streamlined design. The successful implementation and evaluation of the proposed system underscore its potential as a viable solution for promoting responsible waste disposal practices in contemporary, fast-paced environments. Furthermore, the integration of smart waste sorting technology not only enhances operational efficiency but also promotes eco-friendly practices. The system's adaptability to dynamic waste disposal needs, coupled with its sustainable design and accurate sorting capabilities, positions it as a forward-looking solution for fostering environmentally conscious waste management practices in modern, high-traffic settings.

IX. Individual contributions

Prabath P.T.(210485C) - Designing the parts(Outer bin with Trash Tray, Storage Compartment) and assembly files in solid-works and exporting to the SIMULINK environment. Adding coresponding motions in SIMULINK. Defining matrices for the motions. Report prepertion (Existing Solutions, Weaknesses in existing Solutions, Methodology).

Prabhashana M.R.M.(210486F) - Designing the parts(Lid) and assembly files in solid-works and exporting to the SIMULINK environment. Adding coresponding motions in SIMULINK. MATLAB code for evaluating the system. Report prepertion (Simulation in MATLAB Environment, Results and Evaluation, Conclusion).

Prabhashwara H.M.R.(210488M) - Designing the parts(Robot Arm) and assembly files in solid-works and exporting to the SIMULINK environment. Report preperation (Introduction, Types of Waste in Office Environments,).

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