**BSD 3205 : EMBEDDED SYSTEMS GROUP PROJECT**

**CHEMBA SMART BIN PROJECT**

**Group Members**

| **Melody Gichini** | **19/04274** |
| --- | --- |
| **Nelson Tommogo** | **20/04172** |
| **Mumo Nzinga** | **18/03476** |
| **Allan Gachomo** | **20/04649** |
| **Joshua Keli** | **20/03988** |
| **Noel Wesley** | **20/04653** |
| **Peter Muhoro** | **20/03226** |
| **Monica Nabifwo** | **20/03218** |
| **Ariguzo Chinyere** | **20/03440** |

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# **1.0 Introduction**

## **1.1 Purpose**

The purpose of this document is to comprehensively present the current status and progress of our ongoing project. It serves as a detailed record that not only encapsulates the challenges we aim to address but also outlines the strategies and resources we are employing to navigate these challenges. This document is designed to provide transparency into our project’s development and foster a collaborative environment. By documenting our journey, we aim to showcase our team’s dedication and the innovative approaches we are taking to achieve our goals. It is a testament to our commitment to delivering a solution that is not only effective but also sustainable.

**1.2 Project Overview**

In an era where innovation and efficiency are paramount, our project stands as a beacon of progress. We are not just creating a product; we are crafting a solution that will revolutionize the way waste management systems operate. This overview delves into the essence of our mission to create a smart bin that can detect when the level of trash is full and then send a notification to a company that picks up the trash. It is a narrative of ambition, precision, and foresight, driven by a team whose diverse expertise is matched only by their unwavering commitment to excellence.

# **2.0 Problem Statement**

## **2.1 Current Challenges**

The journey to revolutionize waste management through our smart bin project is paved with a series of challenges that we are determined to overcome. One of the primary hurdles is the development of a reliable detection system that accurately determines when the bin reaches full capacity. This system must be sensitive enough to account for different types of waste while being resilient against false triggers caused by non-trash items or temporary fluctuations.

Another significant challenge is establishing a seamless communication protocol that ensures timely and secure notifications to the trash collection company. The system must function flawlessly across various network conditions and remain operational in diverse environmental settings, from urban landscapes to remote areas.

Additionally, we face the task of designing the smart bin to be user-friendly and accessible, encouraging widespread adoption and proper use. It must integrate into existing waste management infrastructures without requiring extensive modifications or disruptions to current operations.

Lastly, we are addressing the need for sustainable and cost-effective production of the smart bins, ensuring that they are not only environmentally friendly but also economically viable for mass production and deployment.

## **2.2 Impact of the Problem**

The inefficiencies of traditional waste management systems have far-reaching consequences that extend beyond mere inconvenience. The problem of overflowing bins and irregular trash collection contributes to environmental degradation, public health risks, and economic losses. By introducing a smart bin capable of detecting fill levels and signaling for timely collection, we aim to mitigate these issues significantly. This innovation promises to reduce littering and the proliferation of pests, lower carbon emissions through optimized collection routes, and enhance the cleanliness of public spaces. Moreover, it has the potential to streamline operations for waste management companies, leading to cost savings and improved service quality. The ripple effect of solving this problem could lead to a cleaner, healthier, and more sustainable world, underscoring the profound impact that our project endeavors to achieve.

# **3.0 Project Progress**

## **3.1 Completed Milestones**

Our project has achieved significant milestones that lay the groundwork for a transformative waste management system. A pivotal achievement has been the successful simulation of our smart bin model in Tinkercad. This simulation has allowed us to meticulously test and refine the bin’s detection algorithms and notification mechanisms in a controlled virtual environment. By simulating various scenarios, we have ensured that our smart bin can accurately gauge fill levels across a spectrum of waste types and conditions, marking a crucial step towards real-world application.

## **3.2 Work in Progress**

As we build upon our completed milestones, our team is currently focused on two main fronts. Firstly, we are in the process of assembling the physical components of the smart bin, translating our digital blueprints into tangible reality. This involves meticulous work to ensure that each sensor and module functions as intended, creating a cohesive and reliable system. Simultaneously, we are developing a dedicated website that will serve as the communication hub for our smart bins. This platform will not only receive notifications when a bin reaches full capacity but will also provide analytics and insights to optimize trash collection routes and schedules, enhancing the efficiency of waste management operations.

Also we will integrate the smart bin with a website so that our clients can be able to keep track of their waste management processes. Here is the github repository where we will be pushing the code for the website to: <https://github.com/Nelson-Tommogo/SmartWasteWeb>

# **4.0 Resource Requirements**

## **4.1 Materials Needed**

The creation of our innovative smart bin requires a carefully selected array of electronic components, each playing a pivotal role in the functionality of the final product. The **Arduino Uno R3** serves as the brain of our bin, orchestrating the interactions between various sensors and outputs. Paired with this microcontroller are two **LED** lights that provide visual feedback on the bin’s status. The **ultrasonic distance sensor** is the key to measuring the fill level, offering precise and contactless detection. Ensuring the circuit’s integrity, two resistors manage the current flow, preventing potential damage to other components. The **breadboard** facilitates a flexible and solder-free assembly, allowing for easy modifications and troubleshooting. Lastly, a **buzzer** acts as an audible alert system, signaling when the bin reaches full capacity. Together, these components form the cornerstone of our smart bin’s operational prowess.

## **4.2 Budget Estimation**

To bring our smart bin from concept to reality, a prudent financial plan is essential. Our estimated budget stands at KSH 1850, a figure that reflects both the cost-effectiveness and the quality of the materials we have chosen. This budget allocation ensures that we can source reliable components while maintaining fiscal responsibility, ultimately contributing to the project’s sustainable development and long-term viability.

# **5.0 Solution Design**

## **5.1 Packaging the Solution**

The smart bin, an epitome of ingenuity in waste management, will be presented in a package that is as smart as the technology it encases. The design will be sleek, modern, and compact, ensuring that it seamlessly integrates into the urban landscape while being robust enough to withstand the rigors of outdoor environments. The packaging will be eco-friendly, reflecting our commitment to sustainability, and will include clear instructions for installation and use. The smart bin’s aesthetic appeal and functional design will not only encourage adoption but also promote environmental consciousness among its users.

## **5.2 Implementation Strategy**

Our approach to implementing the smart bin solution is methodical and user-centric. We will initiate a pilot program in select locations to gather user feedback and make necessary adjustments. This will be followed by a phased rollout, prioritizing areas with the highest need for efficient waste management solutions. Training sessions for waste management personnel and informational campaigns for the public will accompany the rollout to ensure smooth adoption. Continuous monitoring and support will be provided to address any operational issues promptly, guaranteeing the reliability of our smart bins and the satisfaction of all stakeholders involved.

# **6.0 Use Case Analysis**

## **6.1 Target Audience**

The primary users of our smart bin solution are municipal authorities and waste management companies who are at the forefront of tackling urban sanitation challenges. Additionally, the system is designed for public spaces such as parks, streets, and commercial areas where efficient waste disposal is crucial. By catering to these stakeholders, our solution directly impacts the broader community, contributing to a cleaner and more sustainable environment for all city dwellers.

## **6.2 Application Scenarios**

1. **Urban Centers:** In bustling city squares where foot traffic is high, our smart bins will ensure that waste does not overflow, maintaining the aesthetic and hygiene of these communal spaces.
2. **Parks and Recreational Areas**: The bins will provide a discreet and efficient way to manage waste, keeping natural landscapes pristine for visitors to enjoy.
3. **Commercial Complexes**: Shopping centers and business districts can leverage our smart bins to manage waste more effectively, enhancing the customer experience and operational efficiency.

## **6.3 Benefits**

* **Environmental Conservation:** By preventing overflows and reducing litter, our smart bins contribute to a cleaner environment and lower carbon footprint.
* **Operational Efficiency**: Optimized collection schedules mean fewer trips for trash pickup, resulting in cost savings and reduced emissions.
* **Public Health**: Regular and timely waste disposal minimizes the risk of diseases spread by pests attracted to trash, safeguarding community health.
* **Data-Driven Insights**: The data collected from the bins can inform better waste management policies and practices, leading to smarter urban planning decisions.

# **7.0 Conclusion**

## **7.1 Summary**

This document has chronicled the ambitious journey of our smart bin project, detailing the innovative strides we have made towards revolutionizing waste management. We have outlined the pressing challenges that our project seeks to address and the significant impact our solution will have on environmental conservation and public health. Our progress report highlights the successful simulation of our smart bin in Tinkercad, the ongoing assembly of its components, and the development of a dedicated notification system. We have also provided a transparent overview of the materials required and the estimated budget, ensuring accountability and fiscal prudence.

## **7.2 Closing Remarks**

As we reflect on the milestones achieved and the path that lies ahead, we are filled with a sense of optimism and determination. The progress we have made is a testament to our team’s expertise, creativity, and collaborative spirit. We stand at the cusp of a new era in waste management—one that is smarter, more efficient, and aligned with the principles of sustainability. Our commitment to this cause is unwavering, and we move forward with the conviction that our efforts will lead to a cleaner, healthier future for our communities.