Memo

To: Jarred Maclean, Recycling Manager, Facilities Management

From: Abdullah Shah, Antonio Vallarta, Tanuj Dargan

Cc: Monika Smith

Date: 13/02/2025

Re: Proposal to Implement Smart Waste Bins with Automated Object Identification for Enhanced Source Segregation

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This proposal examines the feasibility of using camera-assisted object identification to automate waste sorting on campus. By integrating a Raspberry Pi camera system with existing waste bins, the technology will direct trash into the appropriate compartments, thereby reducing the manual sorting workload for waste management staff.

Client Background

The University of Victoria (UVic) is globally recognized as a leader in sustainability, ranking second in Canada and fourth worldwide for promoting sustainable cities and communities [1]. Between 2009 and 2018, UVic increased its landfill diversion rate from 58% to 74% through effective recycling and composting initiatives [4]. However, to achieve its ambitious goal of an 81% diversion rate as outlined in the university's latest Strategic Plan [3], additional innovative methods are needed to address the challenge of ~~plastic and~~ improperly sorted waste, which currently account for 18% of landfill trash [4].

plastic

With the impending closure of Hartland Landfill in 2040 [2], UVic faces mounting pressure to enhance its waste management systems to reduce environmental and financial impacts. Automated waste sorting bins equipped with object identification technology could provide an effective solution to streamline sorting, reduce human labor hours, and significantly increase the campus's landfill diversion rate [5].

1. Problem Definition

1.1. Need Statement:

Waste management workers at the U of V currently face the challenge of manually sorting through mixed waste before it can be properly disposed of or recycled. This process is time-consuming, costly, and inefficient. Implementing an automated object identification system can help alleviate these burdens, improve sorting accuracy, and optimize waste management operations.

1.2. Goal Statement:

The goal is to implement an automated waste sorting system that integrates seamlessly with existing campus infrastructure, reduces manual sorting requirements, and enhances UVic's waste diversion rate to meet its 81% target.

1.3. Objectives:

~~The proposed automated object identification bins~~ aim to:

An effective solution should ideally be able to achieve the following outcomes:

- Simplify and improve the efficiency of waste segregation at the source.
- Reduce manual sorting labor for campus waste management staff.
- Increase the recycling rate of plastics, metals, and other recyclable materials.
- Contribute to UVic's 81% landfill diversion rate target.
- Provide a scalable model for future waste management technologies.

1.4. Constraints:

The proposed project must adhere to the following constraints:

- A maximum budget of $100,000.
- A two-year timeline for implementation.
- Compliance with UVic's safety and environmental regulations.
- Seamless integration with existing bins and campus infrastructure.

1.5. Benefits:

The implementation of automated waste sorting bins offers several benefits:

1.1. Reduced Worker Labor: Automation reduces the need for manual sorting, freeing up staff for other tasks.
1.2. Improved Recycling Rates: Accurate sorting at the source ensures more recyclable materials are diverted from landfills.
1.3. Cost Savings: Reduced labor hours and improved sorting efficiency and lower waste management expenses.
1.4. Sustainability Leadership: Demonstrates UVic's commitment to environmental innovation, reinforcing its reputation as a global sustainability leader.

2. Plan of Action

2.1. Technical Plan

Assessment of Current Waste Practices

- Analyze current waste volumes and identify the types of materials improperly sorted.
- Review waste collection and labor data from Facilities Management.
- Determine the potential impact of automated sorting on landfill diversion rates.
- Discuss with waste management workers on their concerns and challenges.

Evaluation of Object-Identification Technology

- Research available object-recognition systems that can identify waste materials such as plastics, metals, and paper.
- Compare hardware options, including Raspberry Pi microcontrollers, cameras, and mechanical chute systems for bin sorting.
- Assess scalability, reliability, and cost-effectiveness of these technologies.
- Test for feasibility in varying environmental conditions, including sub-zero winter temperatures, humid & rainy and warm & dry settings.
- Evaluate system's capacity on amount of waste processable simultaneously and its physical constraints on design.

Prototype Development and Testing

- Design and build a prototype automated sorting attachment for existing bins.
- Test the prototype for accuracy, ease of use, and integration with current waste management systems.
- Compare different materials to save on costs and to be in line with UVic's sustainability goals.

Campus Survey and Feedback

- Conduct surveys with students and staff to gather feedback on the automated bins' functionality and usability.
- Assess potential barriers to adoption and refine the design based on user input.

Cost Analysis and Feasibility Study

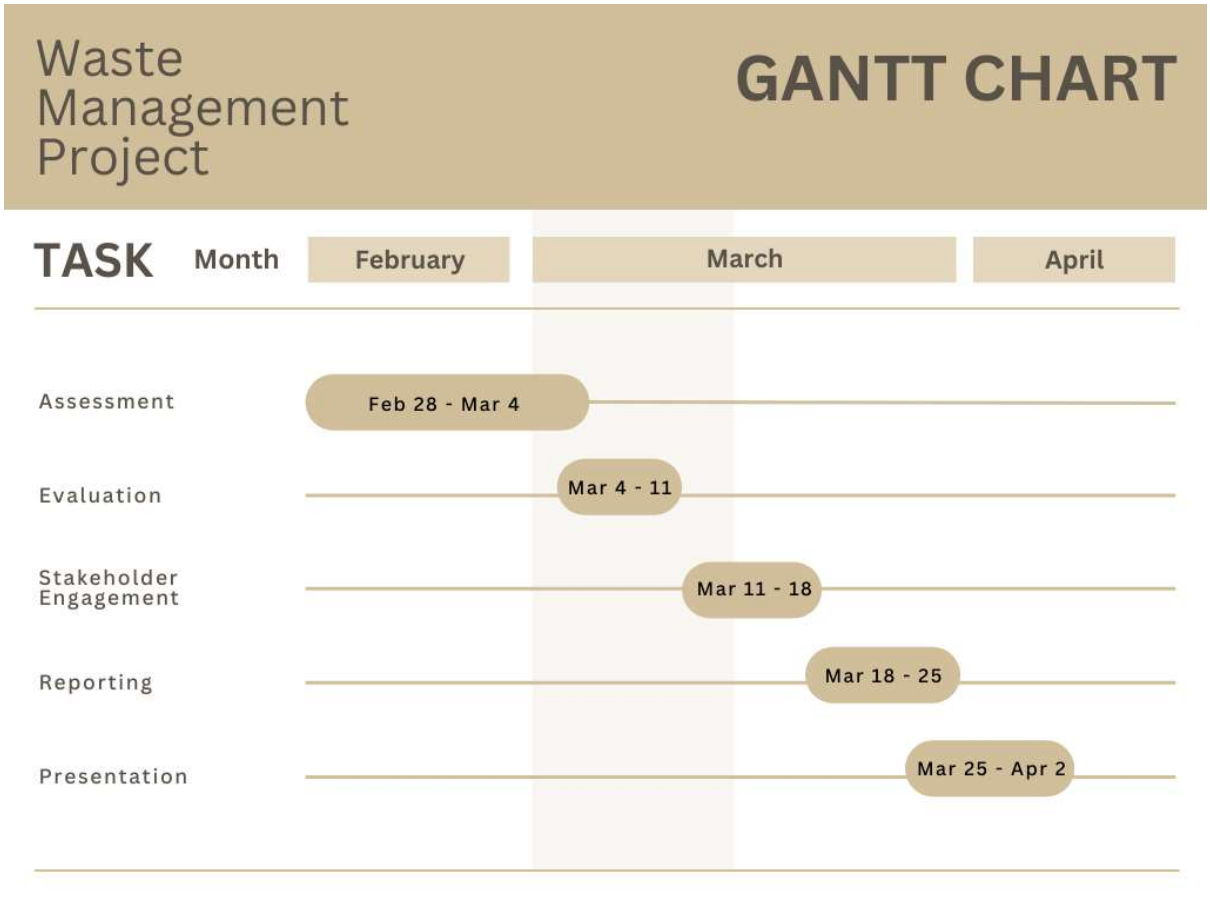
- Calculate the total cost of implementation for a pilot program (e.g., 10 bins) and a full-scale rollout across campus.
- Compare the cost-effectiveness of this system with current waste management practices

2.2. Management Plan

Timeline: shown in Table 1, below:

A feasibility study will be conducted over the next few weeks. An indicative timeline is ~~as follows~~:

Duration	**Phase**
Assess Campus Waste & Identify Benefits	Feb 28 – Mar 3
Evaluate RVM Models & Site Survey	Mar 4 – Mar 10
Engage Stakeholders & Collect Feedback	Mar 11 – Mar 17
Compile Findings & Write Report	Mar 18 – Mar 24
Present Feasibility Report	Mar 25 – Apr 1



Budget:
The study is projected to cost approximately $1,180, broken down as follows: in Table 2, below:

Task	Hours	Rate	Total Cost
Assess Campus Waste Generation & Potential Benefits	10	$20.00/hr	$200.00
Evaluate RVM Models & Site Assessment	8	$20.00/hr	$160.00
Stakeholder Engagement and Survey	16	$20.00/hr	$320.00
Report Writing	25	$20.00/hr	$500.00
Total			**$1,180.00**

2.3. Qualifications

We are computer science students at the University of Victoria with expertise in programming, hardware integration, and data analysis. Our academic background and hands-on experience with Raspberry Pi systems and object-recognition technologies provide us with the technical skills required to design, prototype, and evaluate the proposed automated sorting system.

3. Conclusion

Automated object-identification bins represent an innovative and practical solution to address UVic's waste management challenges. By streamlining waste segregation at the source, this system can reduce labor costs, improve recycling rates, and support UVic's sustainability goals. The feasibility study aims to evaluate the technical, financial, and logistical aspects of implementing this solution, ensuring it aligns with the university's environmental priorities and budget constraints. This project has the potential to set a new standard for campus waste management systems, solidifying UVic's reputation as a leader in sustainability. We look forward to your feedback and are eager to collaborate on this groundbreaking initiative.

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Provide date of access when citing websites

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