Design of a Bulk-Feed Reverse Vending Machine

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Background

Business Case: Reverse Vending Machines (RVMs)

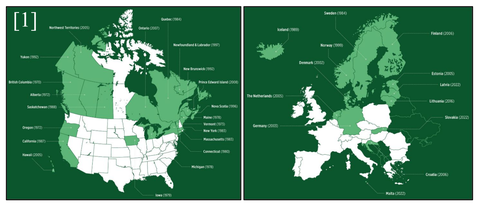
Reverse vending machines (RVMs) are machines, found in most retail stores, that allow users to return recyclable bottles and containers in exchange for a deposit.

Main stakeholders:

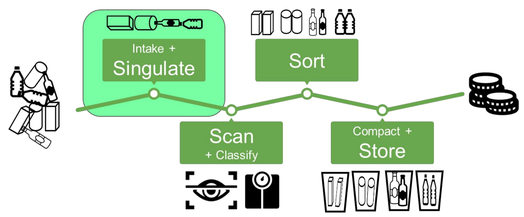
- **Users**: people who return bottles
  - Want a better experience while using RVMs
- **Buyers**: retail stores (e.g., Walgreens) that purchase RVMs
  - Want to attract customers with RVMs that users like
- **Regulators**: governments that pass laws requiring RVMs
  - Want to encourage return of recyclable materials

Market Size:

- Governments in over 50 jurisdictions (with over 300 million inhabitants) have deposit return schemes that require RVMs [1]



Background: How RVMs Work

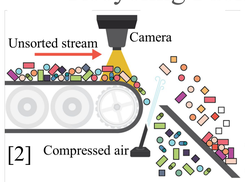


1. **Intake & Singulate**. Returnables are fed into the machine (intake) and organized into a single-file, oriented line (singulation).
2. **Scan & Classify**. Returnables are scanned and classified to determine whether they are returnable, as well as material, deposit amount, etc.
3. **Sort.** Returnable items are separated by material; unreturnable materials are returned to the user.
4. **Compact & Store**. Returnables are compacted and stored in containers that can be removed from the RVM and brought to a recycling facility

Our project focuses on intake and singulation.

Existing Methods: Singulation & Sorting Methods

Recycling Facility



[2]

Components:
- Unsingulated input stream
- Cameras to classify
- Jet of compressed air to sort

Requirements:
- ✗ Lots of space
- ✗ Advanced camera/ID system
- ✗ No heavy/breakable inputs

Bottle Facility

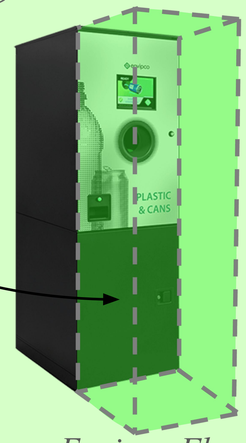
[3]

Components:
- Circulator for agitation
- Shaped divots for singulation

Requirements:
- ✗ Lots of space
- ✗ Relatively homogeneous input sizes and shapes

We designed a bulk-feed intake module for a reverse vending machine. This module allows a user to **pour their returnables all at once** into the machine, instead of loading them one by one.

Our intake module will go here…



Envipco Flex

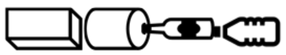
… to make a cheaper, smaller, more versatile alternative to this machine

Envipco Quantum

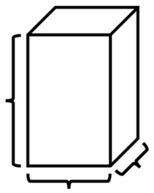
Key Project Requirements

Take in bulk-fed bottles (below 34” high)

Accept all common returnable materials:
- Plastic - Aluminum
- Glass - Tetra Pak



Output bottles single file, oriented lengthwise (at 62” high)

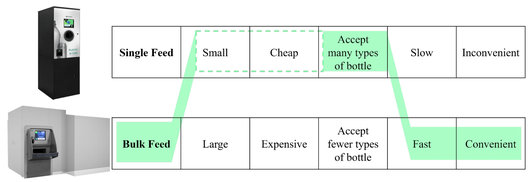


Be no larger than a vending machine

Note: We signed a non-disclosure agreement with Envipco, so we are limited in the content we can include in this poster

Problem Definition

Our Project: Improving Intake & Singulation



Single-feed machines require the user to input bottles one by one. These machines are simple, but the user experience is worse.

Bulk-feed machines let users pour all their bottles in at once. These machines are more complicated, but users prefer them.

Our goal is to combine the user experience of bulk feed with the versatility, and ideally also speed and cost, of single feed.

Prototyping Process

Due to our non-disclosure agreement with Envipco, we are very limited in what we can share about our prototypes.

Prototype 1: Proof of Concept (October)

Time	~ 2 weeks
Spending	~ $50
Materials	Foamboard, paper, PVC
Techniques	Scissors, box cutters, hot glue, tape

Prototype 2: Detailed Design (December)

Time	~ 6 weeks
Spending	~ $1,000
Materials	Wood (MDF, plywood), plastic (PLA), metal (aluminum)
Techniques	Laser cutter, 3D printer, band saw, drill, mill, ordering from ext. vendors

Prototype 3: Final Design (April)

Time	~ 3 months
Spending	~ $1,000 (+ many free parts)
Materials	Metal (aluminum, steel)
Techniques	Band saw, drill, mill, ordering from ext. vendors, sheet metal made by Envipco

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[1] https://www.reloopplatform.org/resources/global-deposit-book-2022/
[2] https://possibility.teledyneimaging.com/wp-content/uploads/2016/09/Artboard-1-copy-2.png
[3] https://cdn.capsulcn.com/Content/Images/uploaded/capsulefiller/CED60-1.png