SWABHAV – A SMART REVERSE VENDING MACHINE FOR WASTE SEGREGATION AND REWARD DISTRIBUTION

Project Reference Number: 48S_BE_6089

College: *RNS Institute Of Technology, Bengaluru*
Branch: *Department Of Electronics And Communication Engineering*
Guide (S): *Dr. Vipula Singh*
Dr. Leena Chandrashekhar
Student (S) : *Mr. Balaji P V*
Mr. Pranava Pandit R

Keywords:

Reverse Vending Machine, Waste Segregation, Smart Recycling, Reward System, Sustainable Automation, LED Advertising, Waste Management

Introduction/Background:

With rising concerns around waste management and plastic pollution, there is a growing need for automated, user-friendly solutions that encourage responsible disposal and recycling. Traditional waste bins fail to incentivize people or promote segregation at the source. To bridge this gap, we introduce **Swabhav**, a **reverse vending machine** that accepts waste materials, segregates them into **plastic and non-plastic**, and rewards users based on the type and quantity of waste deposited.

Swabhav also incorporates **a large LED screen** on its exterior to display **advertisements**, enabling **revenue generation** to support operational sustainability. Furthermore, the collected plastic is **recycled into usable products** such as **plant pots and keychains**, which are then **sold on top of the machine**, creating a circular economy loop.

Objectives:

- To automate the collection and categorization of plastic and non-plastic waste.
- To reward users with coins, chocolates, or tokens based on the waste submitted.
- To promote recycling through attractive incentives.
- To integrate an LED display for advertising and awareness content.

- To recycle collected plastic into useful products like pots and keychains.
- To create a compact, user-friendly machine that can be deployed in public spaces.

Methodology:

The project integrates multiple hardware and software components to build a fully functional reverse vending machine. Here's a breakdown:

Hardware Components:

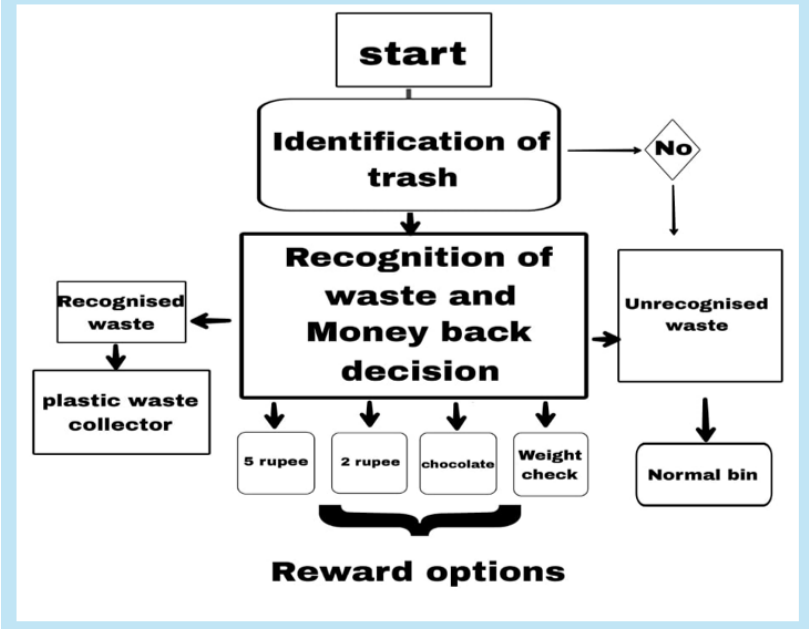
- **Raspberry Pi (Model 4):** Acts as the brain for image processing and AI-based classification of waste materials**.**
- **Camera Module**: Captures images of the inserted waste for material type detection using machine learning.
- **Microcontroller (Arduino Mega 2560):** Acts as the central control unit.
- **LDR and IR Sensors:** Detect object insertion and help determine material type.
- **Weight Sensor:** Measures the weight of the deposited material.
- **Servo and DC Motors:** Operate mechanical components like waste separator and reward dispenser.
- **Coin/Token Dispenser & Chocolate Box:** Provides tangible rewards to the user.
- **LED Matrix/Display Panel:** Displays messages, instructions, and advertisements.
- **Plastic Collection & Storage Unit:** Stores segregated plastic waste.
- **Top Display Shelves:** Showcase products (pots/keychains) made from recycled plastic.

Software Logic & Flow:

1. **Object Detection via Camera** (connected to Raspberry Pi) captures the image of the inserted item.

2. Raspberry Pi runs a **pre-trained image classification model** to detect whether the item is **plastic or non-plastic**.
3. Based on classification, control signals are sent to Arduino Mega for physical sorting.
4. The **weight sensor** captures the weight of the item.
5. Reward logic is applied: more weight = more reward.
6. LED matrix displays a “Thank you” or “Reward granted” message.
7. External LED screen continues to display scheduled advertisements or awareness messages.
8. Collected plastic is stored, later converted into value-added goods like **keychains or plant pots**, displayed on the top shelf.

Block Diagram:



Results & Conclusions:

The prototype successfully performs all intended operations:

- Accurately detects and categorizes waste.
- Dispenses rewards based on waste type and weight.
- Provides user-friendly interaction through display feedback.
- Displays rotating advertisements on the external LED screen.

- Reuses plastic waste to make value-added items, reducing plastic footprint.

Preliminary testing in a controlled environment showed consistent operation, motivating users to engage with the machine. Swabhav provides a scalable and practical solution for waste management in public places like bus stations, colleges, malls, and parks.

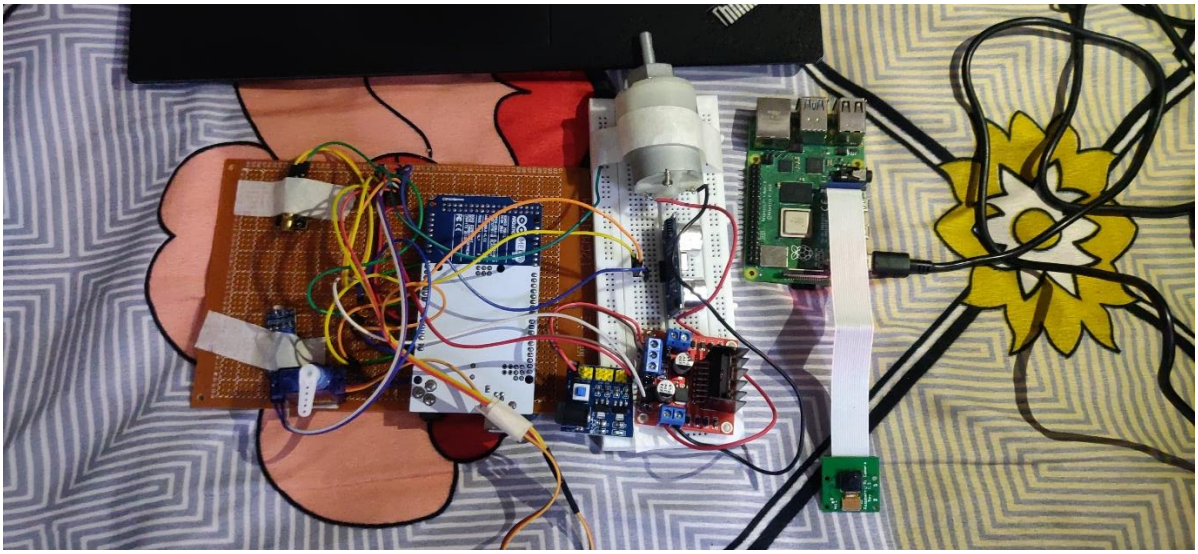
Project Outcome & Industry Relevance:

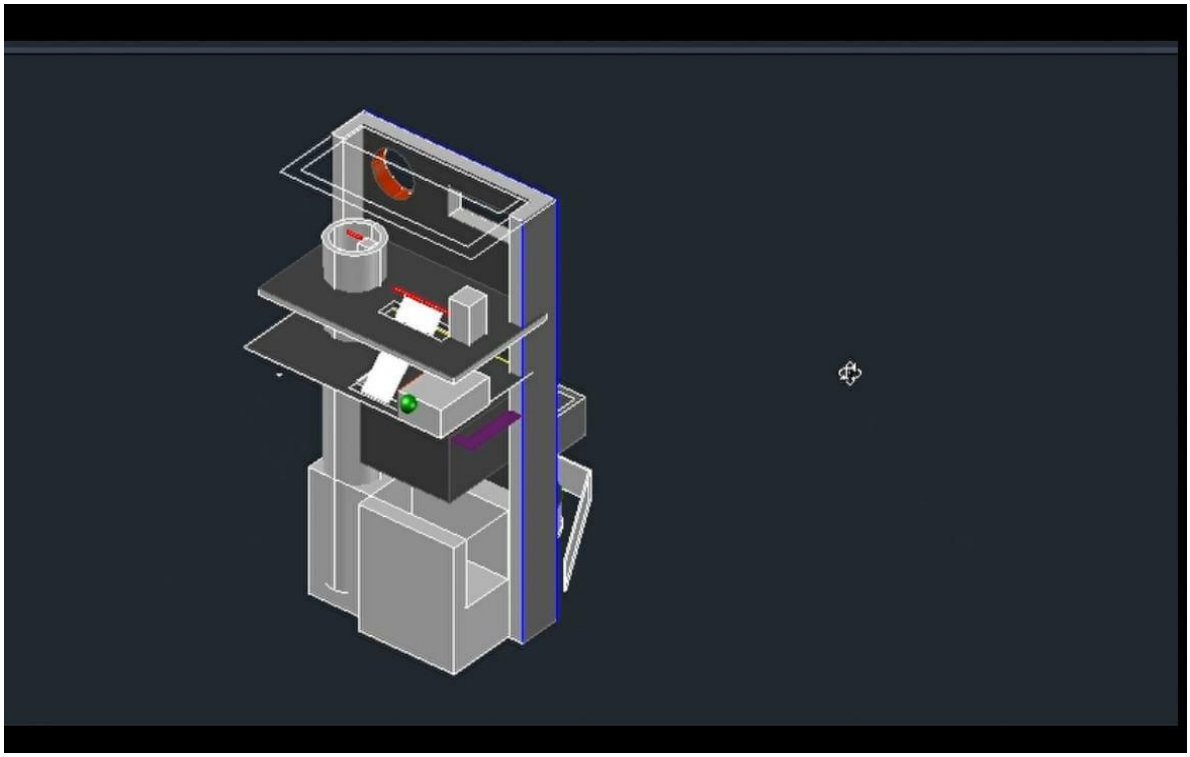
Swabhav addresses critical needs in urban waste management and sustainability. It offers a dual value proposition:

1. **Eco-Incentivization** – Encouraging public participation in waste segregation.
2. **Monetization Potential** – Through recycled product sales and advertisement space.

It has clear applications in municipalities, smart cities, educational campuses, and private sectors. It also aligns with **Swachh Bharat**, **Atmanirbhar Bharat**, and **Digital India** initiatives.

Working Model vs. Simulation/Study:





Project Outcomes and Learnings:

- Practical experience in embedded systems, automation, and sensor integration.
- Understanding of sustainable product design and circular economy.
- Gained insight into public behavior and incentivization models.
- Developed skills in teamwork, hardware prototyping, and field testing.

- Learned real-world application of reward systems and revenue modeling through ads.

Future Scope:

- **Facial Recognition or RFID Cards** for personalized rewards.
- **Mobile App Integration** to track user deposits and reward points.
- **AI-based waste classification** for better accuracy.
- **Solar-Powered Operation** to reduce energy dependency.
- **Live Cloud Monitoring** for centralized data collection and maintenance alerts.
- **Partnership with FMCG brands** for targeted ad campaigns and promotional gifting.
- **Expansion to e-waste collection** and recycling units.