DAMMED

An AI-Powered Multi-Agent System for Sustainable Waste & Resource Management

TEAM: Area55

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Introduction

The **Circular Economy AI** project is an intelligent, AI-driven web application designed to promote sustainable practices by helping users make environmentally responsible decisions regarding products and waste materials. The system aligns with circular economy principles by encouraging **reuse, recycle, refurbish, and responsible disposal** instead of linear consumption.

Using **Generative AI and computer vision**, the application analyzes images or text descriptions of items and provides actionable sustainability recommendations along with **CO_2 savings estimation** and **government incentive points**.

Problem statements and objective

Modern waste management systems often lack:

- Awareness of sustainability choices at an individual level
- Easy-to-use tools for identifying reusable or recyclable items
- Motivation through measurable environmental impact

This results in unnecessary waste, higher carbon emissions, and low adoption of circular economy practices.

The objective of this project is to:

- Assist users in identifying the sustainability potential of everyday items
- Automate decision-making using AI agents

- Quantify environmental impact (CO_2 saved)
- Encourage eco-friendly behavior using points and leaderboards

System Overview

The application is built as a **Streamlit web app** with the following core components:

- **User Interface**
  - Image upload or text input
  - Sustainability insights dashboard
  - Leaderboard and reports
- **Multi-Agent AI Architecture**
  - **Agent A – Item Understanding Agent**
  - **Agent B – Sustainability Decision Agent**
- **Backend Services**
  - User authentication
  - Database storage
  - PDF report generation

8. Technology Stack

Layer	Technology
Frontend	Streamlit
AI Models	Google Gemini (Vision + Text)
Backend	Python
Database	Custom DB (user & entry storage)
Authentication	Custom Auth Manager

Layer	Technology
Reports	ReportLab (PDF generation)

9. Application Workflow

1. User logs in or registers
2. Uploads an image or enters item description
3. Agent A extracts structured item data
4. Agent B evaluates sustainability options
5. CO_2 savings & points are calculated
6. Data is stored in the database
7. User can download a PDF report
8. Leaderboard updates automatically

10 Challenges Faced

9.

- **AI Output Consistency**
- Generative models may return unstructured or noisy responses
- Required regex and validation logic
- **Image Understanding Accuracy**
- Variations in lighting, angle, and object clarity
- **Sustainability Estimation**
- Approximating CO_2 savings without real-world datasets
- **User Data Management**
- Handling multi-user entries securely and efficiently

11. Solutions Implemented

- Structured prompts for AI models
- JSON-based response parsing
- Rule-based sustainability mapping
- Centralized database abstraction

12. Results & Impact

- Encourages conscious consumption
- Makes sustainability measurable
- Gamifies eco-friendly behavior
- Promotes awareness of circular economy principles