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NEWSLETTER / LIFE AT GALAXY



LEARNING. DISCOVERY. COMMUNITY.

AI-Powered Waste Management System

1 Student Projects

A month of stories from our school community

YOUR MONTH AT A GLANCE

Inside this issue

Highlights, shared experiences, and student discoveries from April 2025.

Student Projects **3**
AI-Powered Waste Management System 3

GALAXY / STUDENT PROJECTS

Student Projects

AI-Powered Waste Management System

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Class: Year 7 & 8

Category: Robotics, Computer Science

Components: Arduino Uno
Inductive Sensor
Capacitive Sensor
Webcam
Servo Motors

Smart Waste Separation Bin: Using AI to Improve Recycling

Introduction

Waste management plays a crucial role in maintaining a clean and healthy environment. Improper disposal of waste often leads to pollution, health risks, and inefficient recycling processes. One of the biggest challenges is that different types of waste—such as plastics, metals, and organic materials—are often mixed together in a single bin, making recycling difficult.

To address this issue, our project introduces a **Smart Waste Separation Bin**, an automated system designed to identify and sort different types of waste. By combining **artificial intelligence, sensors, and microcontrollers**, the bin can automatically classify waste materials and direct them into the correct compartments. The goal of this project is to promote recycling, reduce environmental pollution, and encourage better waste management habits within schools and communities.

The Need for Smart Waste Management

In many parts of Ghana, waste disposal systems are not well organized, and recyclable materials often end up in the same bin as general waste. This makes recycling inefficient and increases environmental pollution.

In contrast, several developed countries—such as **Germany**—have implemented advanced recycling systems. These systems use smart bins and reward programs to encourage people to recycle. For example, when individuals deposit recyclable materials like plastic bottles, they may receive small financial rewards.

Inspired by these successful systems, our project aims to introduce a **smart recycling solution** that could be used in schools, communities, and public spaces to improve waste separation and recycling efficiency.

Understanding Recycling Habits: Student Survey

To better understand how people interact with recycling systems, we conducted a **survey among 40 students**.

The survey revealed several important insights:

- **82% of students** reported using plastic products daily.
- Initially, **51.3% of students liked the idea** of the smart waste bin.
- When a **reward system** was introduced, interest increased to **82.2%**.

These results suggest that **combining technology with incentives** can significantly increase recycling participation among young people.

How the Smart Waste Separation Bin Works

The smart waste separation bin combines **hardware components and artificial intelligence** to identify and sort different types of waste automatically.

Key Components

The system uses:

- **Camera-based AI model** to identify waste objects
- **Arduino Uno microcontroller** to control the system
- **Inductive sensors** to detect metal materials
- **Capacitive sensors** to detect plastics and other materials

Waste Sorting Process

1. Waste is placed into the bin.
2. The camera captures an image of the object.
3. The AI model classifies the type of waste.
4. Sensors verify the material type.
5. The Arduino activates a mechanism that directs the waste into the correct compartment.

This automated process reduces human effort and improves recycling accuracy.

Testing and Results

During the initial testing phase, the system faced some challenges in accurately identifying certain waste materials. Some items were incorrectly sorted due to sensor sensitivity and limited AI training data.

To improve the system, the team made several adjustments:

- Increased sensor sensitivity
- Retrained the AI model with more image data
- Improved the sorting mechanism

After these improvements, the smart bin successfully identified and separated **plastic bottles, metal cans, and paper waste with higher accuracy**. The system performed reliably during demonstrations and testing within the school environment.

Students and teachers responded positively to the project, appreciating how smart technology can be used to improve recycling and reduce environmental pollution.

Impact on the Community

The project demonstrated how **technology can play an important role in environmental sustainability**.

Benefits of the smart waste bin include:

- Improved waste organization
- Increased recycling efficiency
- Cleaner environments
- Reduced pollution
- Greater awareness about waste management

The project also highlighted how **reward systems can motivate people to recycle more**

actively, especially among students and younger communities.

Future Improvements

Although the project achieved promising results, there are several opportunities for further improvement:

- Increasing the size of the bin to handle larger amounts of waste
- Enhancing durability for outdoor environments
- Integrating IoT connectivity for monitoring waste levels
- Expanding usage to parks, schools, and public spaces

With further development, smart waste bins could become an important solution for improving waste management across Ghana and other communities.

Conclusion

The Smart Waste Separation Bin project demonstrates how **innovation, artificial intelligence, and electronics can be combined to solve real-world environmental problems**.

Despite some initial challenges, the system was successfully improved and now performs its task effectively. By promoting proper waste separation and recycling, the project contributes to cleaner communities, reduced pollution, and healthier environments.

With continued development and support, smart waste management systems like this could help transform how communities handle waste and encourage more sustainable habits for future generations.



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