SPARKATHON 2025

TITLE PAGE

- Problem Statement ID: **PEC OO18**
- Problem Statement Title: **Smart Dustbin with Auto Lid for Hygienic Waste Management** Title: **Smart Dustbin with Auto Lid for Hygienic Waste Management**
- PS Category: **Hardware**
- Team Name: **BinGenious**

Our Smart Dust Bin

Bingenious – Smart Dust Bin

Proposed Solution

As the problem statement states,

1)**Opening and closing** of lids , hc-sr501 and servo motors are used, controlled by arduino uno.

2)**Ultrasonic sensor**- to check and monitor waste level and arduino controlled buzzer alerts when the bin is ful .

3)**Power system:** Rechargeable Battery (Li-ion 12V / 18650 Cells) and solar panel

4) Rasberry pi's Built in **wifi module integrates IoT-based notifications to inform waste management teams**.

5)**Odor control mechanism:**

Most of the waste collected is a mixture of biodegradable and non-biodegradable, to classify plastic and degradable wastes ,We use **continuity tester** along with **ml models like YOLO** for enhanced classification of images captured by **camera**.

The odor is mainly produced by biodegradable waste is controlled by **spraying deodorant with disinfectant** at regular intervals, activated carbon balls, zeolites, silica gel bags are also used to effectively reduce the rancid.

This classification also leads to increased revenue collection from wastes.

6)**Self cleaning:(if needed)**

i)**High-Pressure Water Spray System:**

water pump is used to clean the dust bin.

ii) Rotating Brush Mechanism

Attach motorized rotating brushes inside the bin.

Two DC motor to rotate brushes against the inner surface is employed along with servo motors to clean all the sides of the bin(one to clean all the sides and other to clean the side of other one).

This is activated with the help of a button.

Uniqueness:

Classification using ml model to control bad Odor : As rancid is produced only by decaying substances we classify wastes using ml model,thus reducing rancid.

Odourcontrol system Components:

Arduino + Timer + Odor Sensor+Exhaust →

Automatically sprays deodorizer at set intervals or when bad odors are detected.

REVENUE COLLECTION:

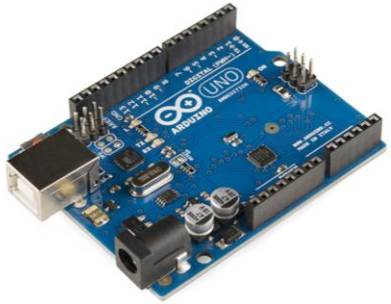
The plastics classified can be further classified into its different grades and recycled. The non recyclable plastics and rest of the materials are incinerated out of which electricity is **generated**(refer reference paper to scale real time revenue), the **carbon residue** left behind can be used for **building roads, good grade bricks** ,**pillars** can also be manufactured which are alternatives for raising demand of bricks and sand. The biogradable wastes are degraded to produce manures and can also be sold.

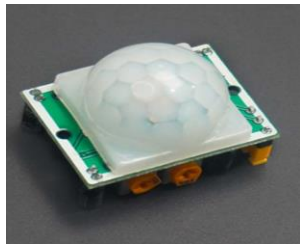
TECHNICAL APPROACH

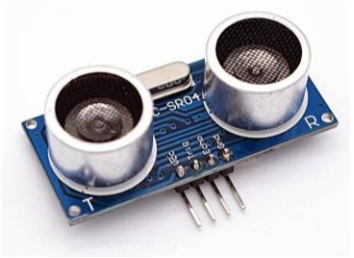
Technologies used:

Hardware:

-**Continuity tester**: classifies biodegradable and non biodegradable based on continuity
-**Arduino Uno:** to control servo motors and collect sensor data
-**Raspberry pi** 4: for ML based waste segregation
-**Ultrasonic Sensor (HC-SR04)**: detecting human presence using
-**PIR Sensor (HC-SR501)**: detecting human presence using radiation
-**Gas Sensor (MQ-135)**: odor detection
-**Servo Motor (SG90)**: lid movements and waste segregation
-**Camera module**: for ML based waste segregation
-**LCD Display**: Shows bin status and waste level
-**Buzzer**: to indicate when bin is full
-**Rechargeable Battery (Li-ion 12V / 18650 Cells)**
-**Solar Panel (6V-12V, 10W)** – For energy-efficient operation
-**Buck Converter (LM2596)** – For voltage regulation







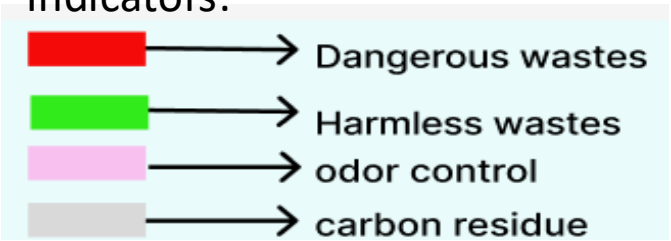
Software:

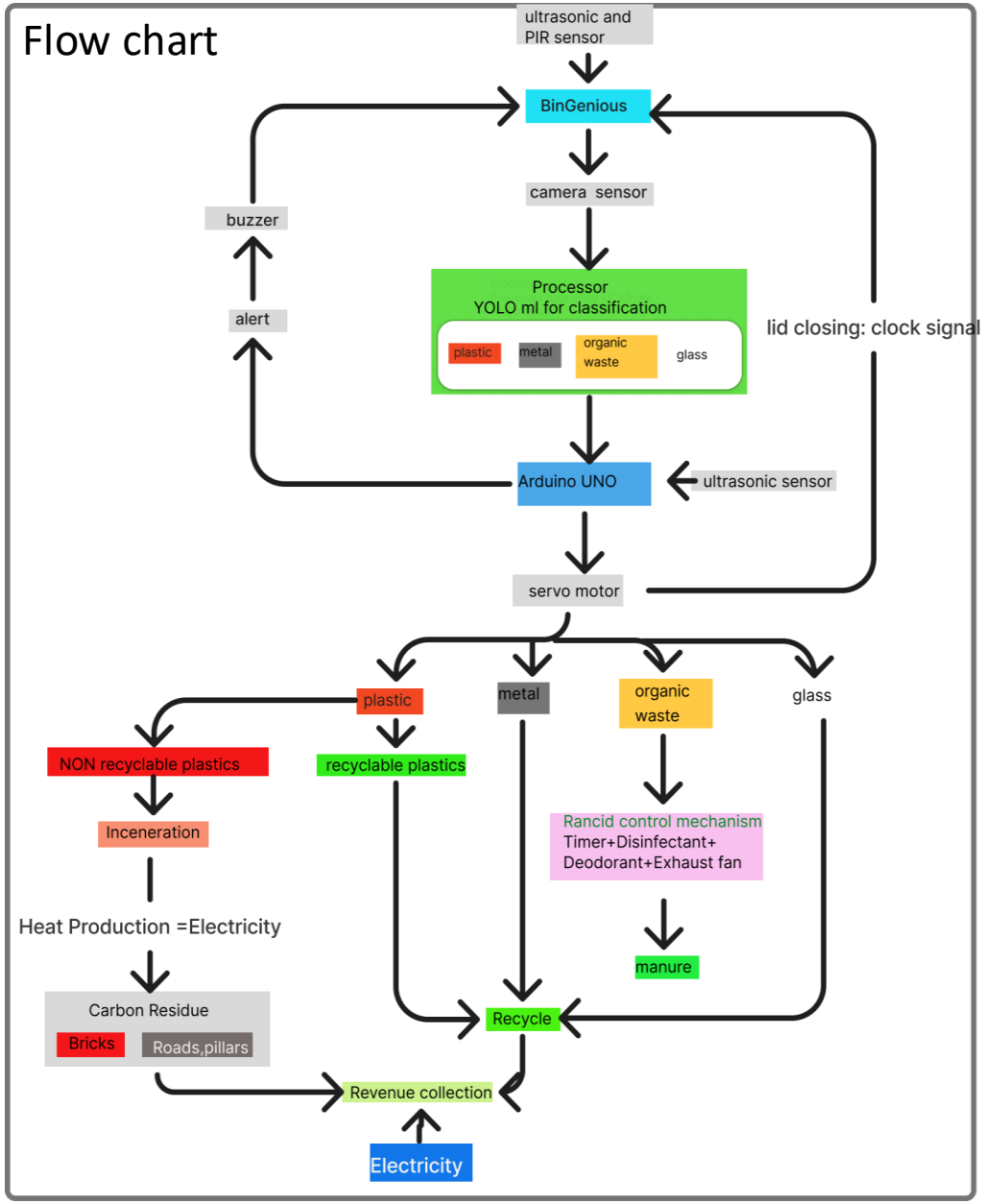
-**TensorFlow**: For model training
-**OpenCV:** For image preprocessing and real-time waste recognition
-**Flask:** For web dashboards and API handling, backend
-**Firebase:** database for local storage
-**html, css and javascript**: front end

FEASIBILITY

- Compared to **existing smart bins which cost upto Rs.50,000** our **BinGenious costs below RS.1000** and is **affordable.**
- Can be **scaled with bulk production**, reducing per-unit cost.
- **Return on Investment (ROI)**: Can be marketed to **hospitals, offices, public spaces, and smart homes**.
- Uses **readily available components** and **open source libraries**.
- Easy to use at it has auto lid and rotaing brush motor mechanism for automatic cleaning along with IoT notifications.

Indicators:





IMPACT AND BENEFITS

Potential Impacts:

-**Hygienic & Contactless Disposal** – Prevents germ spread, ideal for homes, offices, and hospitals.
-**Efficient Waste Management** – IoT-based monitoring ensures timely collection, reducing overflow.
-**Encourages Waste Segregation** – Promotes recycling and sustainability, reducing landfill waste.
-**Cost & Energy Efficient** – Optimizes waste collection, saving fuel and operational costs.
-**Smart City Integration** – Supports urban cleanliness and eco-friendly initiatives.

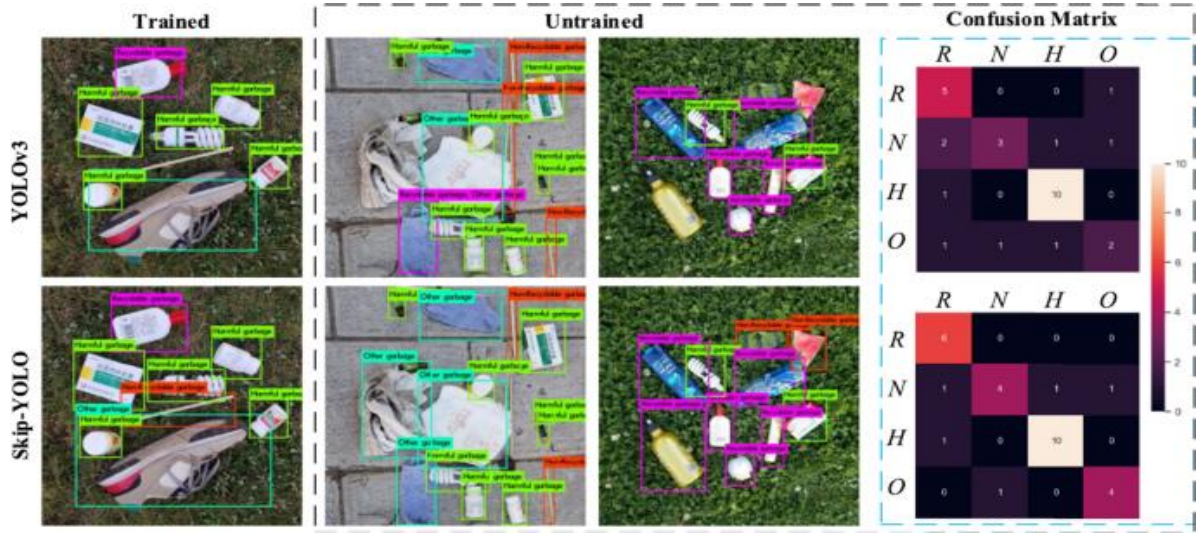
Benefits:

-**Generates revenue**: segregated waste can be Recycled or repurposed.
-**Accurate waste segregation:** uses continuity sensor which increases the accuracy of waste detection.
-**Energy Efficient:** Battery or solar-powered for sustainable operation.
-**Cost Effective model**: made using available hardware and ML models.
-**Odor Control System** – Reduces foul smells, improving environmental conditions.
-**Cost-Effective Waste Management** – Optimizes collection schedules, saving labor and fuel costs.

RESEARCH AND REFERENCES

- People-Centred Development of a Smart Waste Bin
- Development of Smart Waste Bin for Solid Waste Management
- YOLO Refernce paper

- Singapore's revenue collection from waste
- yolo model for live waste classification



AI geerated image for refernce pupose only, actual model would vary