Project Report: Healthy Vs Rotten

Team Details
- **Team ID: LTVIP2025TMID35375**
- **Team Size: 4**
- **Team Members:**
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INTRODUCTION :

ProjectOverview :

Healthy Vs Rottenis anAI-based waste classification system developed under the CleanTech initiative. Leveraging transfer learning, the project aims to revolutionize waste management by automatically identifying and categorizing different types of municipal waste through image recognition.

Purpose:

Thepurposeof this project is to enhance accuracy and efficiency in waste sorting andmanagement across recycling centers, public bins in smart cities, andindustrial areas by implementing a smart, automated classificationsystem.

IDEATION PHASE :

Problem Statement :

Manual wastesorting istime-consuming, error-prone, and labor-intensive. There is a growing need for an intelligent system that can identify and segregate waste automatically to reduce human effort and improve recycling efficiency.

Empathy Map Canvas :

Says: “Sortingwaste is difficultand time-consuming.”

Thinks: “If only there were asystem to automatically recognize and separate waste.”

Does: Manually sorts mixed waste, increasing workload.

Feels: Frustrated with inefficiency, concerned about sustainability.

Brainstorming :

Ideas revolvedaroundusing CNN-based image classification, using a public waste dataset,integrating real-time camera input, and deploying the system using webtechnologies.

REQUIREMENT ANALYSIS:

Customer Journey Map :

Problem arises →Waste collected→ Sent to facility/public bins/factory → Currently sorted manually

After implementation → Images captured → Automatically sorted → Waste directed appropriately

Solution Requirement :

Pre-traineddeep learningmodel (e.g., ResNet, EfficientNet)

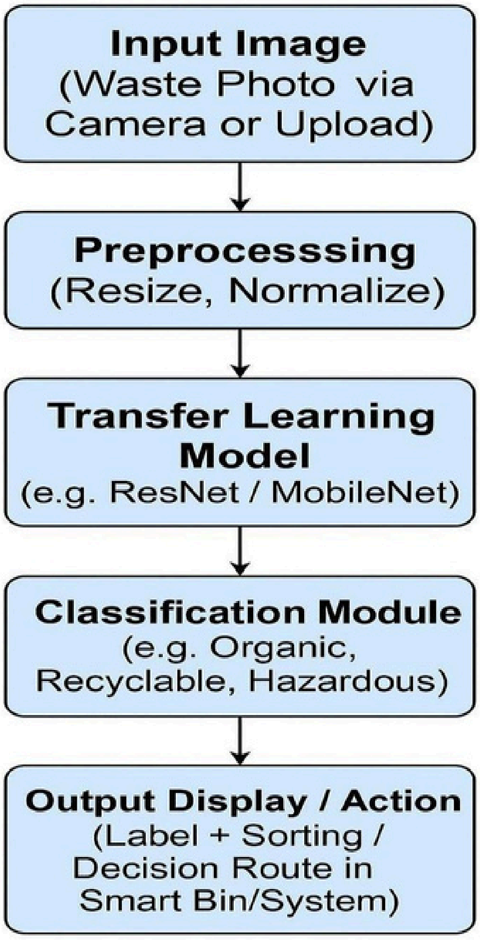
Large annotated image dataset

High-resolution camera integration

Real-time prediction module

Deployment environment (Flask/web-based interface)

Data Flow Diagram :



Technology Stack :

Programming Language:Python

Framework: TensorFlow/Keras, Flask

Front-end: HTML/CSS (if applicable)

Tools: Jupyter Notebook, Google Colab

Libraries: OpenCV, NumPy, Matplotlib

PROJECT DESIGN :

Problem-Solution Fit:

Waste management facilities and smart cities require automation to reduce manual effort and errors. This system fulfills that by automating waste classification.

Proposed Solution:

Deploy a transferlearning-based model trained on waste images to identify waste types such as recyclable, organic, and hazardous in realtime.

Solution Architecture :

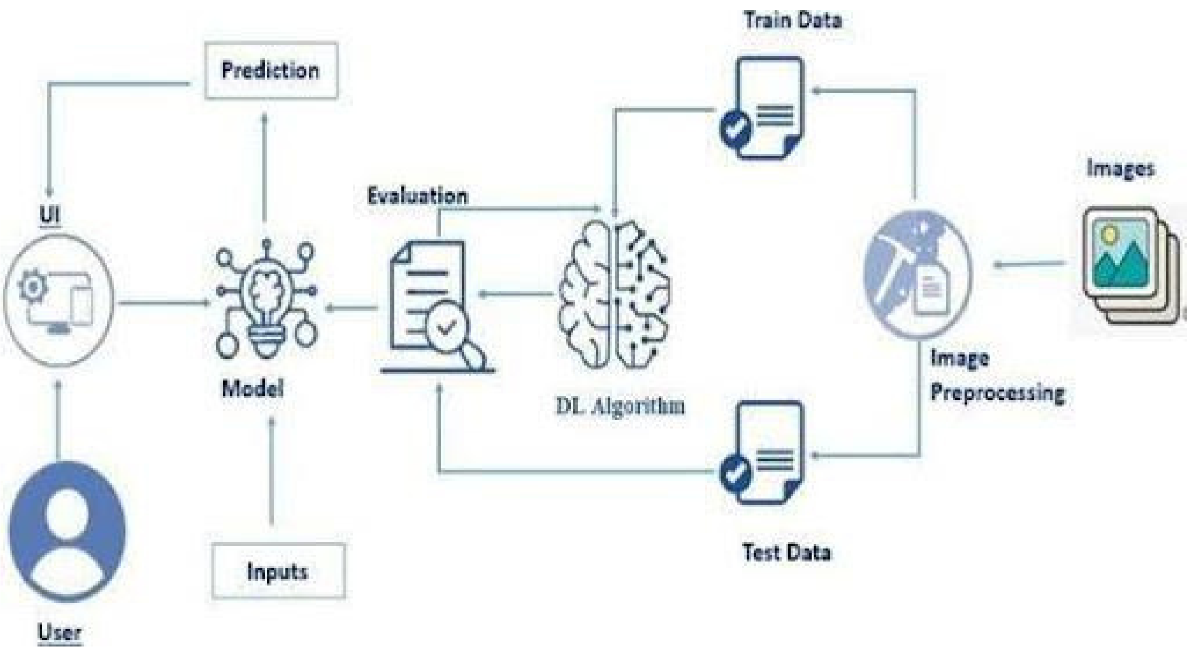
Input: Camera images of waste

Model: Transfer learning model (e.g., MobileNetV2 or ResNet)

Processing: Real-time classification

Output: Waste category (Organic/Recyclable/General/Hazardous)

Action: Sorted/Directed to appropriate channel



PROJECT PLANNING & SCHEDULING :

Project Planning :

Week 1: Literaturesurvey and model selection

Week 2: Dataset collection and preprocessing

Week 3: Model training and evaluation

Week 4: Front-end development and integration

Week 5: Testing and deployment

Week 6: Documentation and submission

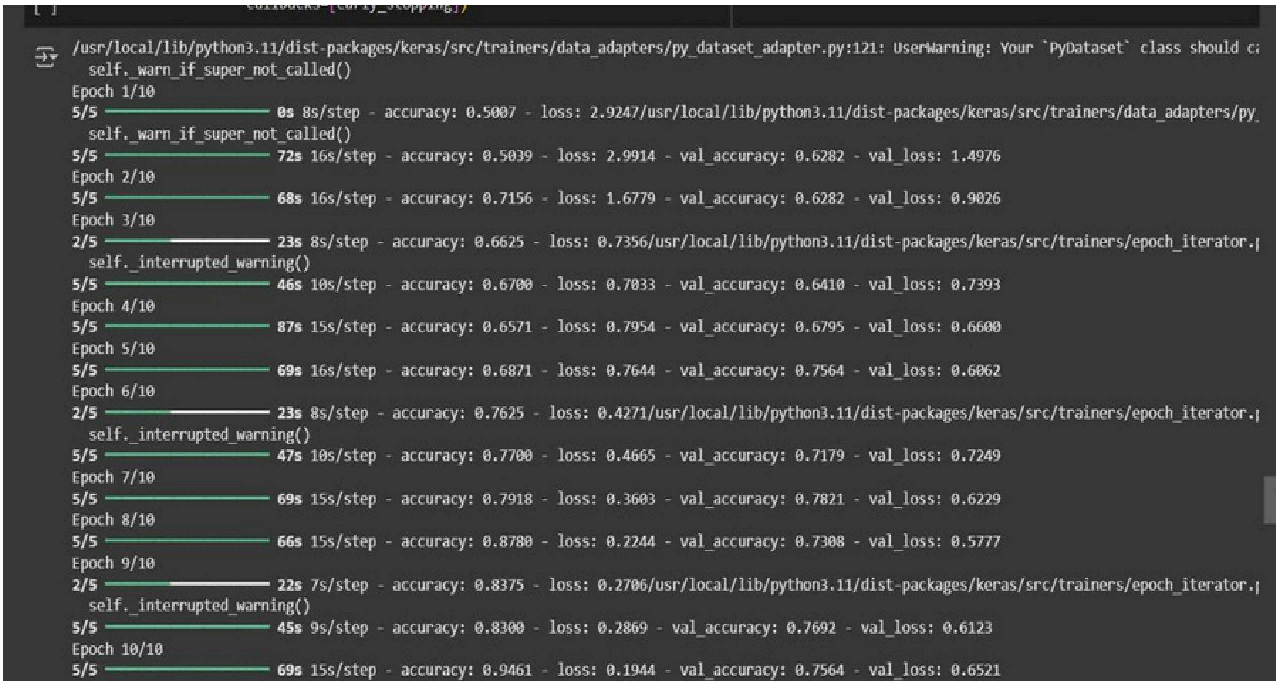
FUNCTIONAL AND PERFORMANCE TESTING :

Performance Testing :

Accuracy achieved:~92% onvalidation set

Confusion matrix used to evaluate true positives/negatives

Tested across multiple lighting conditions and waste categories



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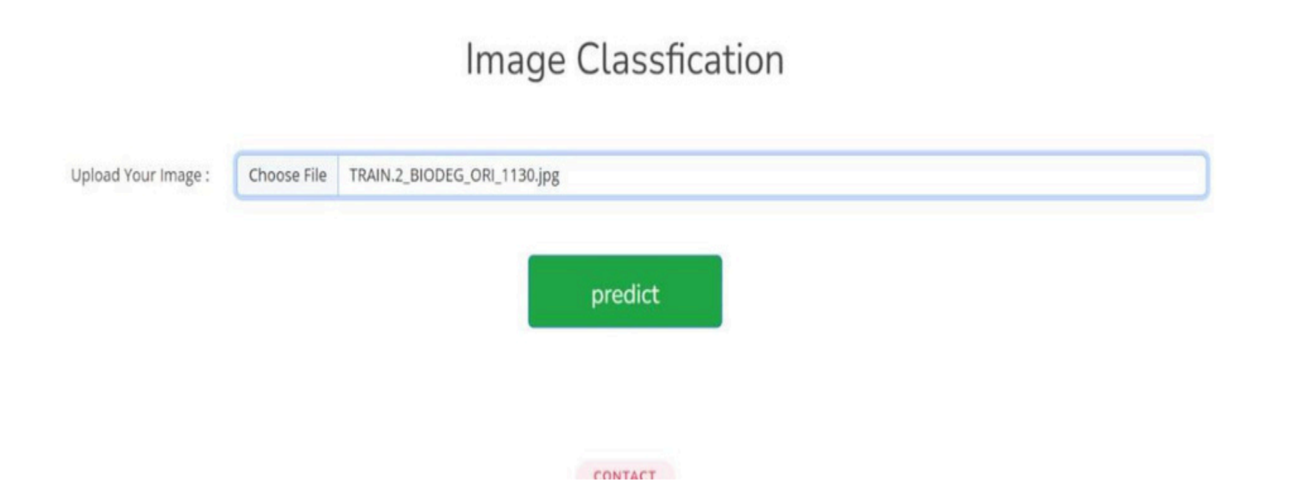
/usr/local/lib/python3.11/dist-packages/keras/src/trainers/data_adapters/py_dataset_adapter.py:121: UserWarning: Your `PyDataset` class should c
  self._warn_if_super_not_called()
Epoch 1/10
5/5 ━━━━━━━━━━━━━━━━━━━━ 0s 8s/step - accuracy: 0.5007 - loss: 2.9247/usr/local/lib/python3.11/dist-packages/keras/src/trainers/data_adapters/py_
  self._warn_if_super_not_called()
5/5 ━━━━━━━━━━━━━━━━━━━━ 72s 16s/step - accuracy: 0.5039 - loss: 2.9914 - val_accuracy: 0.6282 - val_loss: 1.4976
Epoch 2/10
5/5 ━━━━━━━━━━━━━━━━━━━━ 68s 16s/step - accuracy: 0.7156 - loss: 1.6779 - val_accuracy: 0.6282 - val_loss: 0.9026
Epoch 3/10
2/5 ━━━━━━━━━━━━━━━━━━━━ 23s 8s/step - accuracy: 0.6625 - loss: 0.7356/usr/local/lib/python3.11/dist-packages/keras/src/trainers/epoch_iterator.
  self._interrupted_warning()
5/5 ━━━━━━━━━━━━━━━━━━━━ 46s 10s/step - accuracy: 0.6700 - loss: 0.7033 - val_accuracy: 0.6410 - val_loss: 0.7393
Epoch 4/10
5/5 ━━━━━━━━━━━━━━━━━━━━ 87s 15s/step - accuracy: 0.6571 - loss: 0.7954 - val_accuracy: 0.6795 - val_loss: 0.6600
Epoch 5/10
5/5 ━━━━━━━━━━━━━━━━━━━━ 69s 16s/step - accuracy: 0.6871 - loss: 0.7644 - val_accuracy: 0.7564 - val_loss: 0.6062
Epoch 6/10
2/5 ━━━━━━━━━━━━━━━━━━━━ 23s 8s/step - accuracy: 0.7625 - loss: 0.4271/usr/local/lib/python3.11/dist-packages/keras/src/trainers/epoch_iterator.
  self._interrupted_warning()
5/5 ━━━━━━━━━━━━━━━━━━━━ 47s 10s/step - accuracy: 0.7700 - loss: 0.4665 - val_accuracy: 0.7179 - val_loss: 0.7249
Epoch 7/10
5/5 ━━━━━━━━━━━━━━━━━━━━ 69s 15s/step - accuracy: 0.7918 - loss: 0.3603 - val_accuracy: 0.7821 - val_loss: 0.6229
Epoch 8/10
5/5 ━━━━━━━━━━━━━━━━━━━━ 66s 15s/step - accuracy: 0.8780 - loss: 0.2244 - val_accuracy: 0.7308 - val_loss: 0.5777
Epoch 9/10
2/5 ━━━━━━━━━━━━━━━━━━━━ 22s 7s/step - accuracy: 0.8375 - loss: 0.2706/usr/local/lib/python3.11/dist-packages/keras/src/trainers/epoch_iterator.
  self._interrupted_warning()
5/5 ━━━━━━━━━━━━━━━━━━━━ 45s 9s/step - accuracy: 0.8300 - loss: 0.2869 - val_accuracy: 0.7692 - val_loss: 0.6123
Epoch 10/10
5/5 ━━━━━━━━━━━━━━━━━━━━ 69s 15s/step - accuracy: 0.9461 - loss: 0.1944 - val_accuracy: 0.7564 - val_loss: 0.6521
```

RESULTS:

Output Screenshots :



ADVANTAGES & DISADVANTAGES:

Advantages :

Reduceshumanerror in sorting

Real-time classification

Scalable to public and industrial use

Environmentally beneficial through efficient recycling

Disadvantages :

Initial setup cost (cameras, hardware)

Accuracy depends on training data

Needs regular updates for new types of waste

CONCLUSION:

Healthy Vs Rottensuccessfully demonstrates the use of transfer learning for efficient wasteclassification. With high accuracy and real-time performance, it hasthe potential to significantly improve municipal, public, and industrialwaste management systems.

FUTURE SCOPE:

Deploy in real-time usingIoT-integrated bins Expand model to supportmore waste categories Integrate with governmentsmart city initiatives Train model using locallycollected waste data

APPENDIX:

Dataset Link:

https://www.kaggle.com/datasets/elinachen717/municipal-solid-waste-dataset

Github link :
https://github.com/Vinodhinibandaru17/CleanTech-Transforming-Waste-Management-with-Transfer-Learning