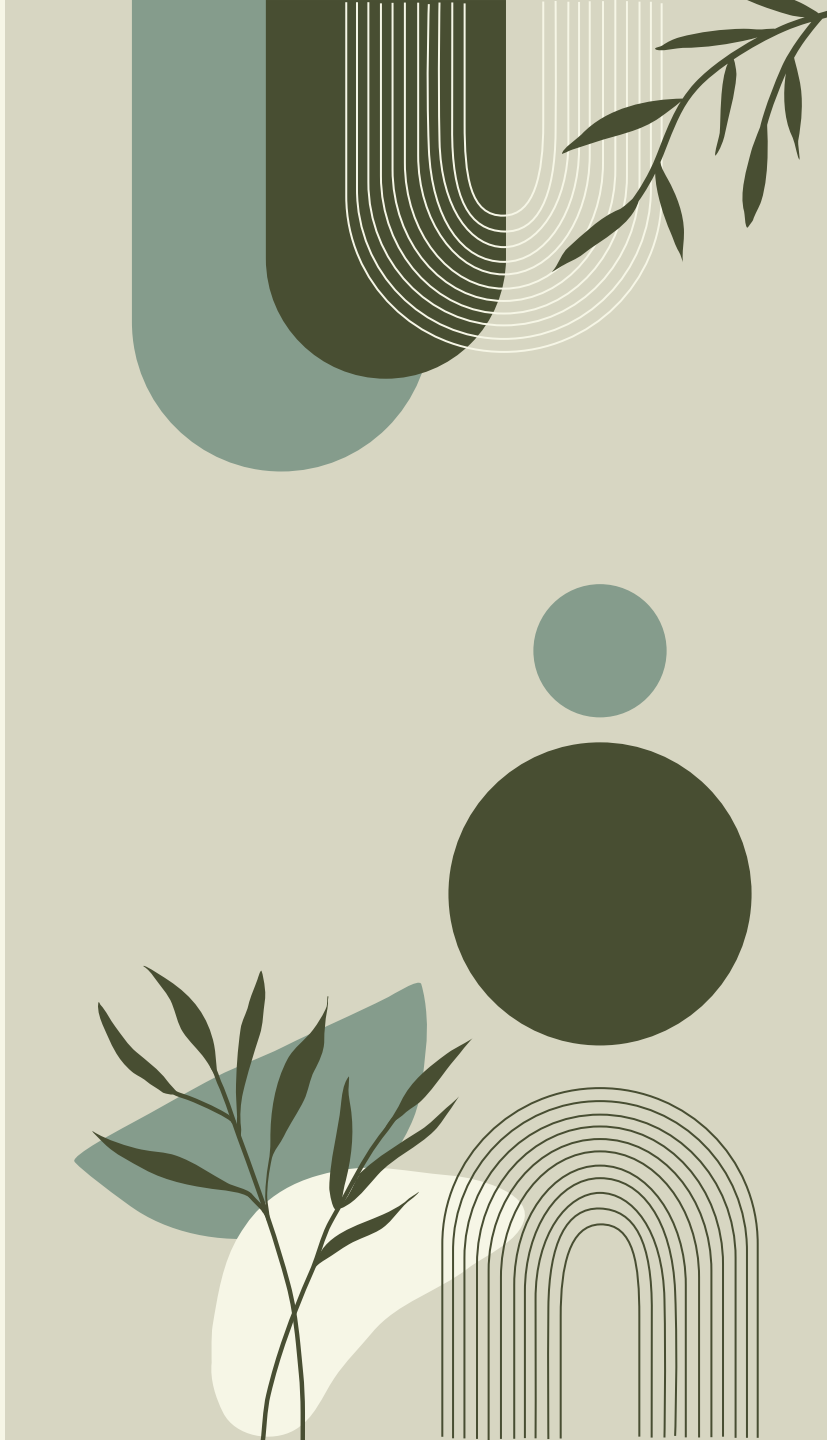
WASTE To WOW

Home Waste Management Recommendation System - Recycling or Upcycling

Team 7



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Data Analytics and Intelligent System Integration

- Krishna Sameera Surapaneni

System Requirement Analysis

- ***Actors***:

  Individuals or organizations interacting with the system, providing data inputs, receiving recommendations, and accessing waste management information.

- ***Use Cases:***

  Waste Classification: The system processes data from various sources such as images, sensors, and text inputs to classify waste accurately into categories such as recyclable, non-recyclable, hazardous, organic, etc.

  Recommendation Generation: Based on the classified waste data, the system generates recommendations for proper waste management practices, including recycling options, disposal methods, and potential reuse opportunities.

High-level Data Analytics and Machine Learning Functions

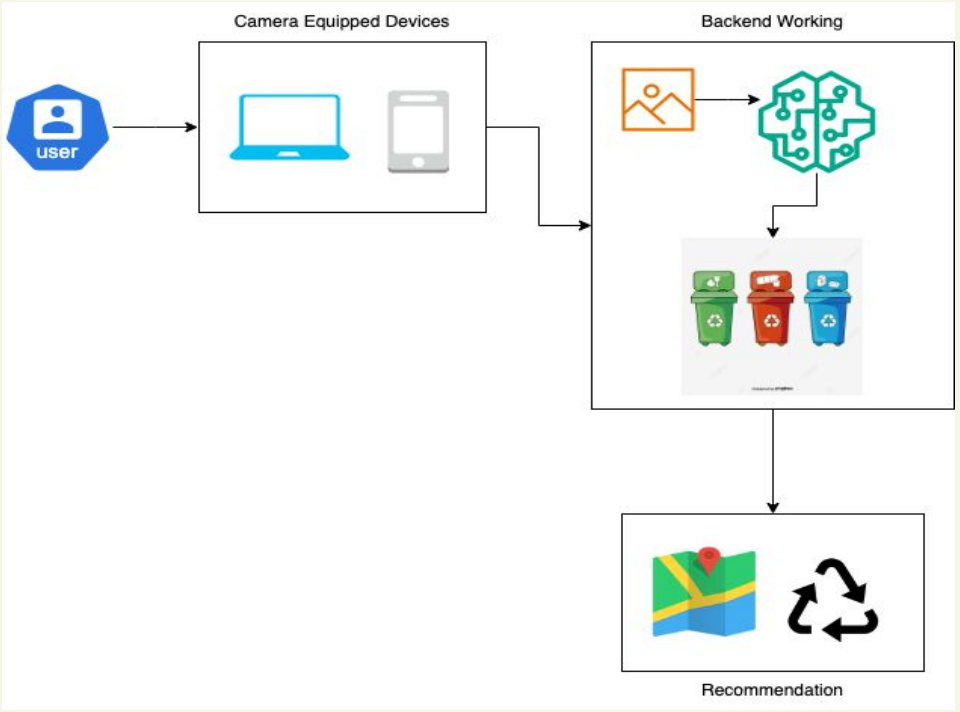
- ***Objective:*** Develop an intelligent garbage classification and waste management system for addressing improper household waste disposal.

- ***ML Model:*** Advanced ML model like YOLOv8 is employed for accurate garbage classification. ML function is specifically trained on garbage-related characteristics during elicitation.

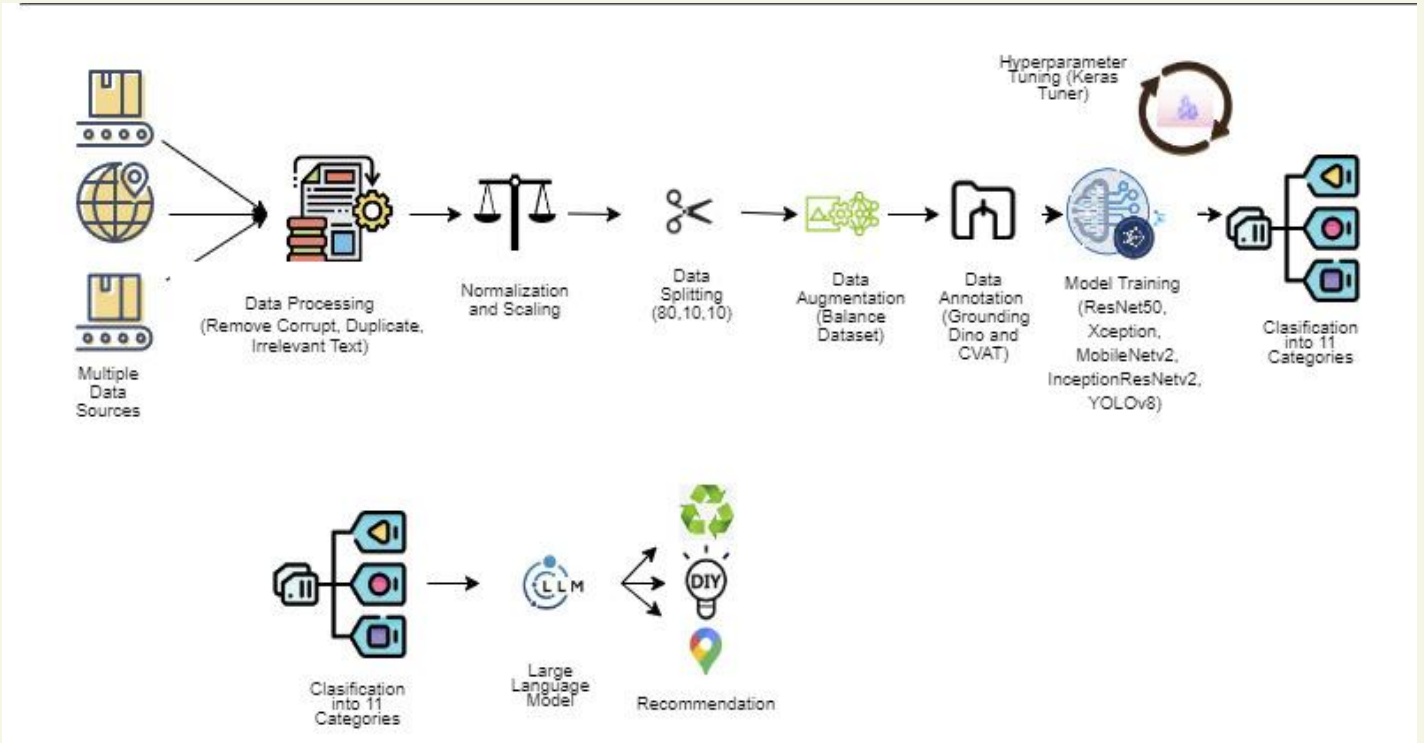
- ***Recommendation:*** Provides tailored recommendations for disposal methods (recycling, upcycling, donation). Real-time user interface is deployed for garbage classification, with Google Maps API integration.

System Design

- Users interact through a user interface connected to camera-equipped devices like smartphones or laptops.
- Captured waste images are transmitted to the backend system for classification using YOLOv8 algorithms.
- YOLOv8 precisely identifies waste categories such as hazardous, biodegradable, recyclable, etc.
- Language Model (LLM) integrated provides disposal, recycling, or upcycling recommendations based on waste classification.
- Delivers recommendations and classifications back to the user interface alongside the waste image.
- Leverages connectivity to integrate with external resources like the Google Maps API for accessing safe disposal locations.

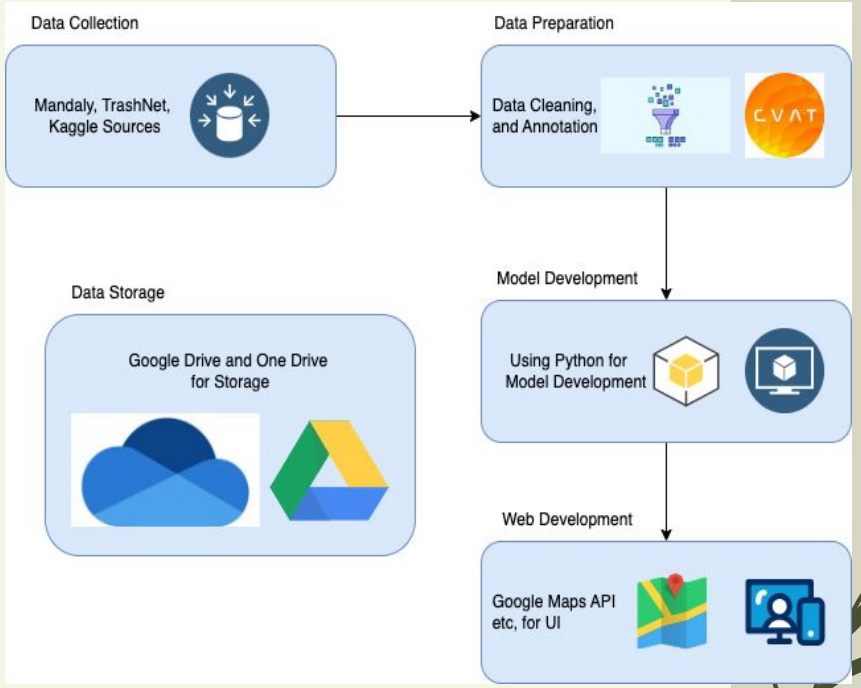


System Design



System Supporting Platforms, Cloud Environment and Data Repository

- ***Data Storage and Management Platforms***: Relied on Google Drive for storing and managing diverse image datasets sourced from platforms like Mendeley and TrashNet.
- ***Machine Learning Frameworks***: Utilized TensorFlow or PyTorch for developing and deploying sophisticated ML models (Xception, ResNet-50, YOLOv8 etc).
- ***Model Training and Inference:*** Utilized local computing resources (CPU/GPU) for model training and inference.
- ***Collaborative Environment:*** Google Colab used for prototyping and experimenting with ML algorithms collaboratively.
- ***Integration with External Resources:*** Google Maps API and Llama API to recommend nearby disposal facilities, recycling centers, or donation centers based on user location and upcycling techniques.



System Evaluation and Visualization

- Siddharth Solanki

Analysis of Model Execution and Evaluation Results

- ***Comprehensive Assessment:*** Utilizes various metrics for classification and object detection models, including confusion matrix and mAP50, offering a thorough evaluation of performance.

- ***Insightful Metrics:*** Derives accuracy, precision, recall, and F1 score from the confusion matrix for classification models, while emphasizing mAP50 for object detection, providing deep insights into model performance

- ***Performance Highlights:*** ResNet50's F1-score of 0.91 and 91% accuracy for classification, and YOLOv8's impressive mAP50 scores, showcasing high accuracy across diverse thresholds and classes.

Evaluation Results

Model	mAP50	mAP 50-95	Inference Time (ms)
YOLOv8-m (1100 images)	0.579	0.409	0.6
YOLOv8-s	0.745	0.699	1.7
YOLOv8-m	**0.827**	**0.773**	**2.7**

Achievements and Constraints

- ***Achievements:*** Significant progress made by incorporating real-life photos and enhancing infrastructure. Expanded dataset improves model performance, ensuring accurate waste classification in diverse environments.

- ***Innovative Solutions:*** Development of an user-friendly interface empowers individuals in waste management. Linking household waste to relevant businesses promotes sustainability and environmentally conscious recycling habits.

- ***Constraints:*** High-level categorization of waste items due to resource limitations. Priority given to broader categorization to function effectively within constraints.

System Quality Evaluation of Model Functions and Performance

- ***Efficient Training*:** Overcame initial training challenges by scaling up resources. Reduced training time from a day to a couple of hours, enhancing system performance.

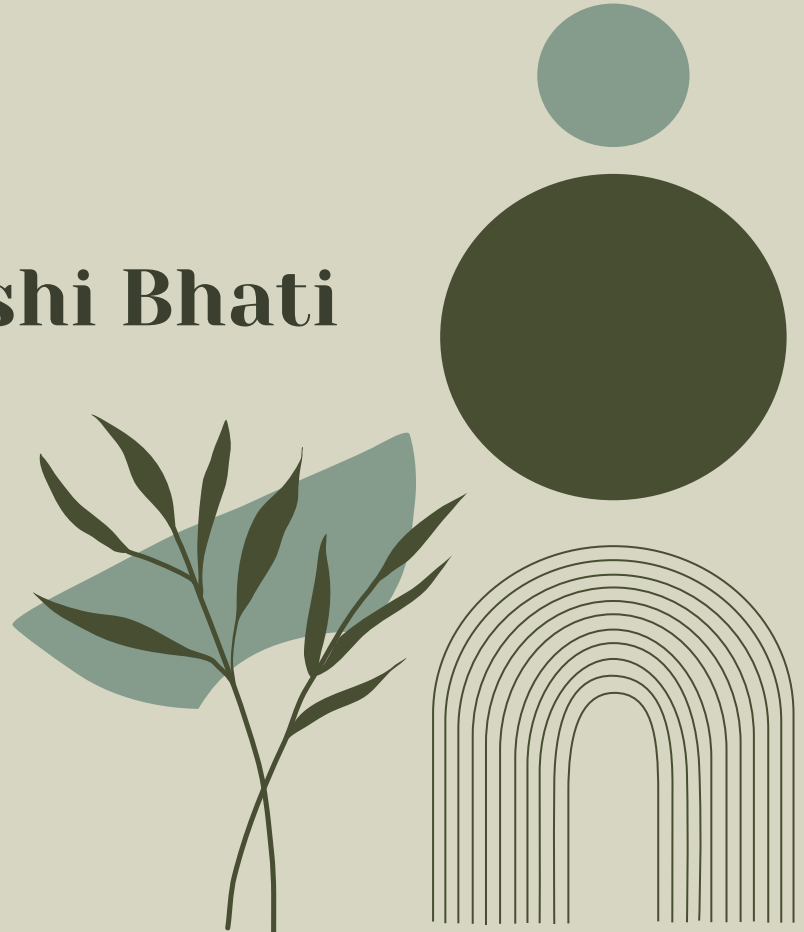
- ***Response Time Optimization*:** System response time measured from item presentation to recommendation delivery. Typically, object detection takes 2.7 ms of inference time, while recommendations within 2-3 seconds.

Code Walkthrough

- Sonali Arcot

Demo

- Vidushi Bhati



Thank You