

**MKSSS'S Cummins
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WASTE CLASSIFICATION

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Waste Classification System Using Deep Learning



PROBLEM STATEMENT

- Manual waste segregation is slow and inaccurate
- Leads to improper recycling
- Increases pollution and harms environment
- Need for fast, automatic, AI-based classification system



PROJECT OVERVIEW

Deep Learning model classifies 6 waste types

Uses MobileNetV2 for efficiency and speed

Includes preprocessing, augmentation, fine-tuning

Integrated with Tkinter GUI for real-time predictions

DATASET & TOOLS USED

Dataset

- Kaggle Waste Classification Dataset
 - 6 categories: cardboard, glass, metal, paper, plastic, trash
 - ~5000 images, train/test split

Tools and Technologies

- Python, TensorFlow, Keras
- OpenCV, PIL, Matplotlib
- Tkinter (GUI), VS Code

METHODOLOGY

- Resize images to 224×224 and normalize pixel values
 - Apply data augmentation (rotation, shift, flip)
 - Load MobileNetV2 without top layers
 - Add custom dense classification layers
 - Train with frozen layers, then fine-tune entire model
 - Evaluate using accuracy curves & confusion matrix
 - Integrate final model into GUI

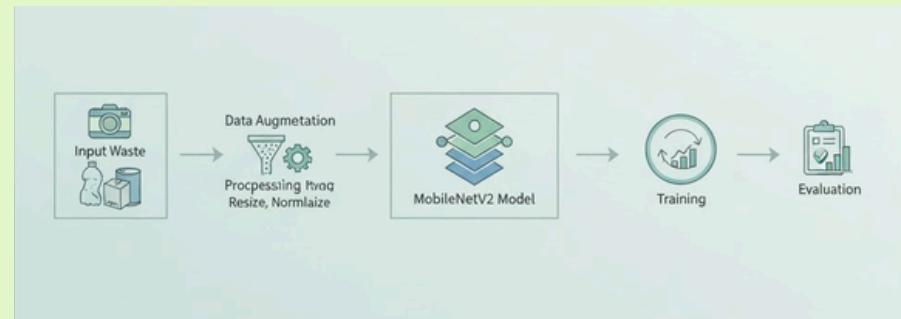
MOBILENET V2 ARCHITECTURE

- Lightweight CNN designed for mobile/edge devices
 - Uses depthwise separable convolutions → faster & smaller
 - Pretrained on ImageNet for strong feature extraction
 - Custom head added for 6-class classification
 - Highly efficient for real-time predictions

TRAINING PIPELINE

Input images → preprocessing → augmentation

- Initial training with base layers frozen
- Fine-tuning at low learning rate
- Softmax output for multi-class prediction
- Optimizer: Adam
- Loss: Categorical Crossentropy



RESULTS & OBSERVATIONS

Results:

- Training accuracy: 85%
- Validation accuracy: ~72%
- Testing accuracy :~78%
- Strong performance on paper, plastic, cardboard

Observations:

- Trash class accuracy lower due to fewer samples
- Augmentation improved generalization
- MobileNetV2 faster than custom CNNs
- Fine-tuning boosted validation accuracy

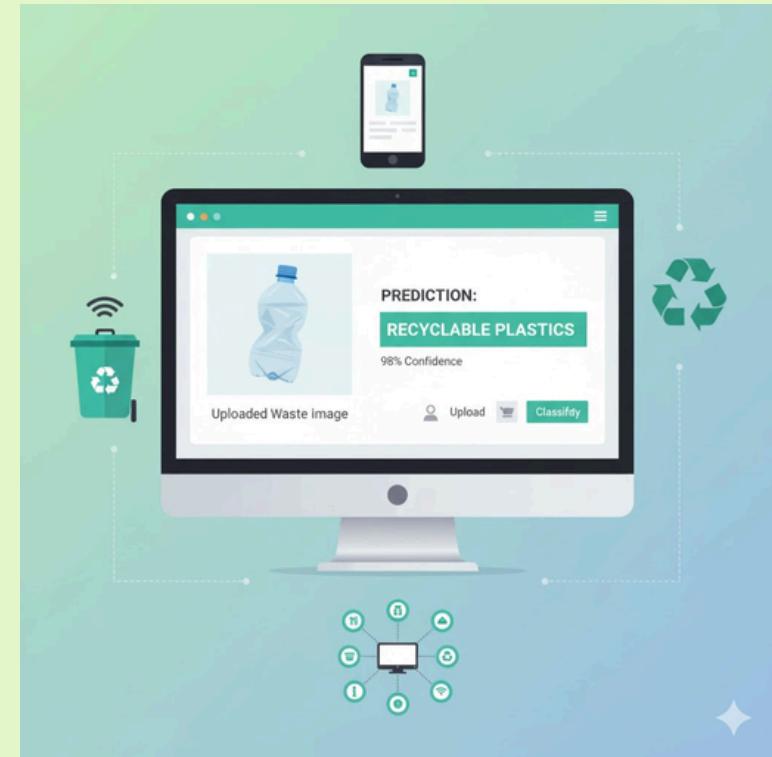
GUI & APPLICATIONS

Tkinter GUI:

- Allows user to upload image
- Displays predicted waste category in real-time
- Simple and user-friendly interface

Applications:

- Smart waste bins
- Automated sorting at recycling plants
- Municipal waste monitoring
- Mobile/Web waste identification apps



CONCLUSION

- Deep Learning successfully automates waste classification
 - MobileNetV2 offers high accuracy with low computation
 - GUI proves practicality and usability

FUTURE SCOPE

- IoT-enabled smart bins
- Deploy as mobile/web app
- Add more data for improved accuracy
 - Real-time camera-based classification
 - Cloud analytics for waste tracking

THANK YOU

