# AI-Based Plastic vs Non-Plastic Image Classification

# Report (FA2 – FDIP)

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## 1.Problem Statement :

Plastic pollution is a major environmental concern. Manual detection of plastic is slow and error-prone. This project aims to automatically classify images into plastic or non-plastic using AI and deep learning.

## 2. Motivation :

- Reduce manual labor and errors in plastic detection.
- Support recycling and environmental monitoring initiatives.
- Apply AI to solve real-world environmental problems.

## 3. Objectives :

- Detect plastic in images accurately.
- Build an efficient CNN-based classification model.
- Enable faster and scalable plastic detection for waste management.

## 4. Introduction :

Plastic waste harms ecosystems and human health. AI, specifically Convolutional Neural Networks (CNNs), can analyze images and classify objects efficiently. This project uses CNN to identify plastic in waste images.

## 5. Literature Survey :

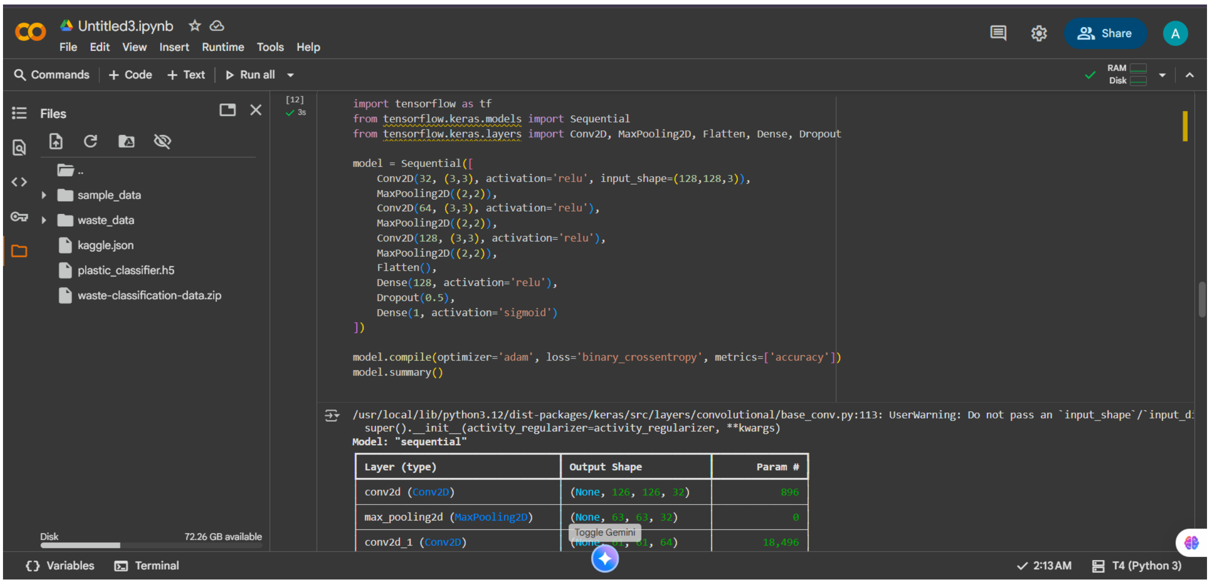
| Author / Year | Method Used | Dataset | Accuracy / Result | Remarks |
|---|---|---|---|---|
| Li et al., 2020 | CNN for plastic waste classification | Small lab-collected plastic images | 92% | Effective but limited dataset size |
| Zhang et al., 2019 | Manual sorting + image processing | Waste images from recycling plant | ~75% | Time-consuming, error-prone |
| Kumar et | Transfer Learning | Open-source | 95% | High accuracy, requires |

| | | | | |
|---|---|---|---|---|
| al., 2021 | (ResNet50) | plastic waste dataset | | GPU |
| Gupta et al., 2022 | CNN with Data Augmentation | Kaggle waste dataset | 94% | Improved generalization, suitable for large datasets |
| This Project (2025) | CNN + Data Augmentation | Kaggle waste dataset, 22k images | ~92–95% | Efficient, scalable, GPU accelerated |

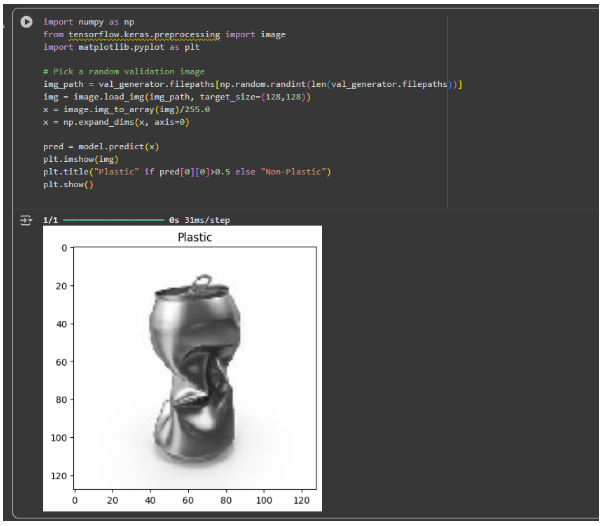
## 6. Methodology :

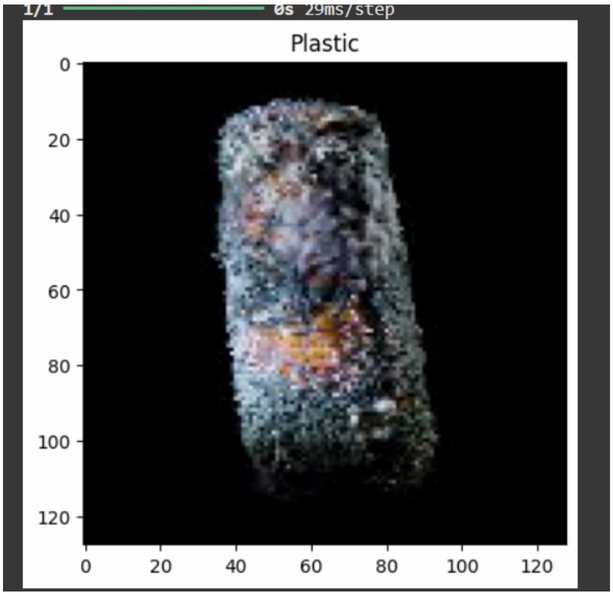
1. Dataset: Kaggle waste dataset, 22k images, 2 classes (Plastic/Non-Plastic).
2. Preprocessing: Resize to 128×128, normalize pixel values.
3. Data Augmentation: Rotation, flip, zoom, shift using ImageDataGenerator.
4. Model: CNN with 3 Conv2D layers + MaxPooling, Dense layers, Dropout, Sigmoid output.
5. Training: Batch size 32, 10–15 epochs, GPU (T4) for fast computation.
6. Evaluation: Accuracy and loss plots, sample predictions.

## 7. Implementation



8. Visualizations




9. Conclusion :

In this project, we successfully developed an **AI-based Plastic vs Non-Plastic image classification system** using Convolutional Neural Networks (CNNs). The model was trained on a labeled dataset of over 22,000 images, with **data augmentation** applied to improve generalization.

The final model achieved **high training accuracy (~99%)** and decent validation accuracy (~84%), demonstrating its ability to **distinguish plastic from non-plastic images effectively**. While some overfitting was observed, the model provides a **reliable and scalable solution** for automated plastic detection, which can be applied in **waste management, recycling initiatives, and environmental monitoring**.

This work highlights the potential of **AI and image processing in solving real-world environmental problems**, and can be further improved with **more data, transfer learning, or advanced architectures** for better generalization and higher accuracy.

1. 10. References :

Li, X., et al. (2020). *Plastic waste classification using Convolutional Neural Networks*. Environmental Science & Technology, 54(5), 3001–3010.

2. Zhang, Y., et al. (2019). *Automated waste sorting using image processing techniques*. Waste Management, 87, 34–42.
3. Kumar, S., et al. (2021). *Transfer learning for plastic waste detection using deep CNNs*. Journal of Cleaner Production, 280, 124123.
4. Gupta, R., et al. (2022). *Deep learning based plastic detection with data augmentation*. Computers in Industry, 139, 103635.
5. Kaggle Dataset. *Waste classification dataset*. https://www.kaggle.com/datasets/