***AI-Based Waste Management System***

STATISTICAL MACHINE LEARNING (CSET -211)

Submitted by-

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**Abstract**

This project leverages Artificial Intelligence to classify waste into biodegradable and non-biodegradable categories using Convolutional Neural Networks (CNNs). The model achieved an accuracy of 93.83%, demonstrating its potential to improve waste management efficiency and support eco-friendly practices.

**Introduction**

The rapid generation of waste globally poses a significant challenge to environmental sustainability. Traditional waste segregation is labor-intensive and prone to inefficiencies. This project employs Convolutional Neural Networks (CNNs) to automate waste classification, addressing these challenges and supporting effective recycling and disposal.

**Aim and Objectives**

**Aim-**

To develop an AI-based system capable of classifying waste into biodegradable and non-biodegradable categories. This classification enhances waste management efficiency and lays the groundwork for sustainable practices.

**Objectives-**

1. Efficiently classify waste types into biodegradable and non-biodegradable categories.
2. Optimize the classification model for real-world applications.
3. Lay the foundation for advanced classifications like waste-to-energy and waste-for-construction initiatives.

**Methodology**

1. **Dataset Preparation**: Images resized to 224x224, normalized, and augmented to improve model generalization.
2. **Model Design**: CNN trained using TensorFlow and Keras, comprising convolutional, pooling, dense, and dropout layers.
3. **Training and Evaluation**: Early stopping and learning rate scheduler were employed to optimize performance.
4. **Testing**: Model achieved a test accuracy of 93.83%.A graph of a line

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**Experimental Results**

1. **Training Accuracy**: 94.50%
2. **Validation Accuracy**: 93.83%
3. **Test Accuracy**: 93.83%

These results demonstrate the model's reliability for waste classification and its potential for practical deployment.

**Future Scope**

1. Expand dataset to include more waste categories.
2. Develop multi-class classification capabilities for complex waste categorization.
3. Optimize the model for real-time edge deployments.
4. Integrate the system with IoT-based automated segregation systems.
5. Implement waste-to-energy and road construction material utilization for non-biodegradable waste.

**Conclusion**

The project successfully developed a CNN-based system for waste classification, achieving an accuracy of 93.83%. This model serves as a step towards smarter waste management and sustainability. Future work will focus on enhancing its capabilities for broader applications, including waste-to-energy conversion and integration into IoT systems.

**GitHub Link**

**https://github.com/Rajvanshi-Dhruv/Waste-Management-System/tree/main**