AAI – 501 : Introduction to Artificial Intelligence

Final Team Project Proposal

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Recyclable and Household Waste Classification

1. Introduction

Topic Statement:
The project aims to develop a system for classifying waste into recyclable and non-recyclable categories using machine learning algorithms.

2. Problem Discussion and Algorithms

Problem Discussion:
Waste management is a significant challenge, and improper waste classification can lead to environmental pollution and inefficiencies in recycling processes. This project addresses the problem of accurately classifying waste items to improve recycling efforts and reduce environmental impact.

Algorithms to Investigate:

- Convolutional Neural Networks (CNNs) for image classification
- Transfer learning with pre-trained models such as VGG16, ResNet, or InceptionV3, etc.
- Data augmentation techniques to enhance model performance

3. Related Course Topics

- Classification algorithms
- Deep learning and neural networks
- Computer vision (CV)
- Data preprocessing and augmentation
- Model evaluation and metrics

4. Expected System Behaviors and Problem Types

Expected Behaviors:

- The system should correctly classify images of waste items as recyclable or non-recyclable.
- The model should generalize well to various types of waste not seen during training.
- The system should provide a confidence score for each classification to indicate the certainty of its predictions.

Problem Types:

- Image classification
- Waste sorting based on images

5. Focus Areas

Issues to Focus On:

- Image preprocessing and data augmentation to handle varied lighting, angles, and backgrounds
- Choosing appropriate deep learning architectures and fine-tuning them for optimal performance
- Evaluating model performance using metrics like accuracy, precision, recall, and F1 score
- Addressing class imbalance in the dataset
- Ensuring the model's scalability and efficiency for real-time applications

6. References

1. He, K., Zhang, X., Ren, S., & Sun, J. (2016). Deep residual learning for image recognition. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 770-778).
2. Simonyan, K., & Zisserman, A. (2015). Very deep convolutional networks for large-scale image recognition. arXiv preprint arXiv:1409.1556.
3. Szegedy, C., Vanhoucke, V., Ioffe, S., Shlens, J., & Wojna, Z. (2016). Rethinking the Inception architecture for computer vision. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 2818-2826).
4. Kaggle dataset: Recyclable and Household Waste Classification. Retrieved from https://www.kaggle.com/datasets/alistairking/recyclable-and-household-waste-classification/data
5. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep learning. MIT Press.

7. Team Member Contributions:

Member 1: Ayush Kumar	Member 2: Vedant Kumar	Member 3: Satyam Kumar
• Technical research • Research and select appropriate deep learning architectures (e.g., VGG16, ResNet, InceptionV3). • Implement the chosen models using a deep learning framework (e.g., TensorFlow, PyTorch). • Train the models on the preprocessed dataset.	• Technical research • Collect and clean the dataset from Kaggle. • Perform data augmentation techniques to increase dataset variability (e.g., rotation, flipping, cropping). • Ensure the dataset is balanced and handle class imbalance issues. • Split the dataset into training, validation, and test sets.	• Technical research • Evaluate model performance using metrics like accuracy, precision, recall, and F1 score. • Perform cross-validation to ensure model robustness. • Choose the best-performing model • Fine-tune hyperparameters for optimal performance.

8. Collaboration and Communication : We will use GitHub for version control and collaboration. Constant communication will be maintained through Slack or another agreed-upon platform.