Real-Time Trash Classification Using Machine Learning

Waste management is a critical aspect of environmental sustainability, and accurate trash classification plays a crucial role in efficient recycling and waste disposal.

Introduction: Importance of Waste Management

1

Environmental Impact

Improper waste disposal contributes to pollution, greenhouse gas emissions, and habitat destruction.

2

Resource Conservation

Recycling valuable materials reduces the need for extraction of new resources.

3

Public Health

Efficient waste management prevents the spread of diseases and improves sanitation.

Problem Statement: Accurate Trash

Manual Sorting

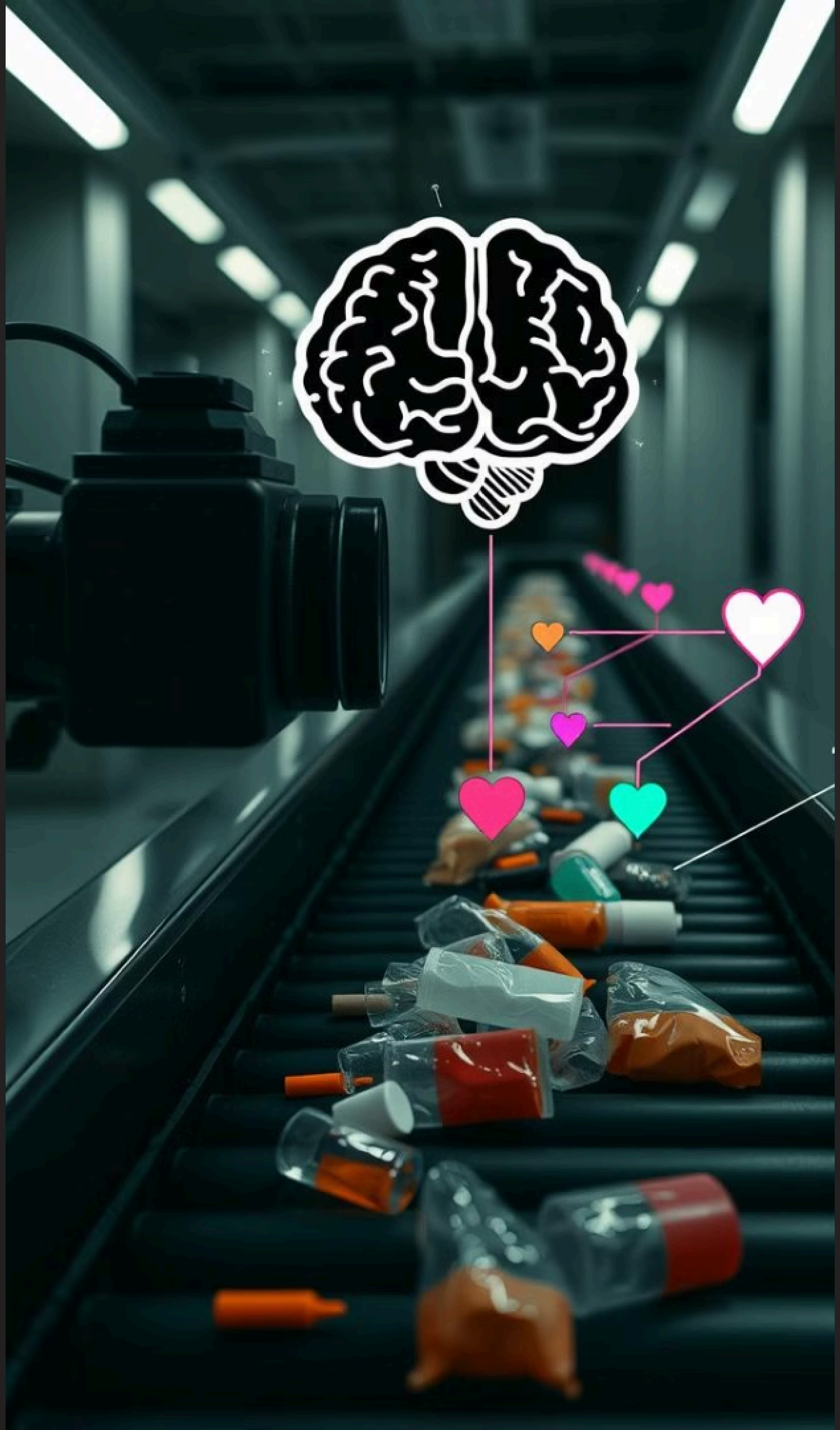
Manual sorting is time-consuming, labor-intensive, and prone to human error.

Inconsistent Labeling

Variations in trash types and labeling practices can lead to inaccurate classification.

Environmental

Misclassified waste can contaminate recycling streams and reduce the effectiveness of waste management systems.



Proposed Solution: Computer Vision Techniques

Image Recognition

Computer vision algorithms can automatically identify and classify different types of trash based on visual features.

Real-Time Processing

Real-time classification allows for immediate feedback and efficient sorting at waste collection points.

Data-Driven Approach

Machine learning models can continuously learn and improve their accuracy with more data.

Data Collection and

1 **Image Acquisition**

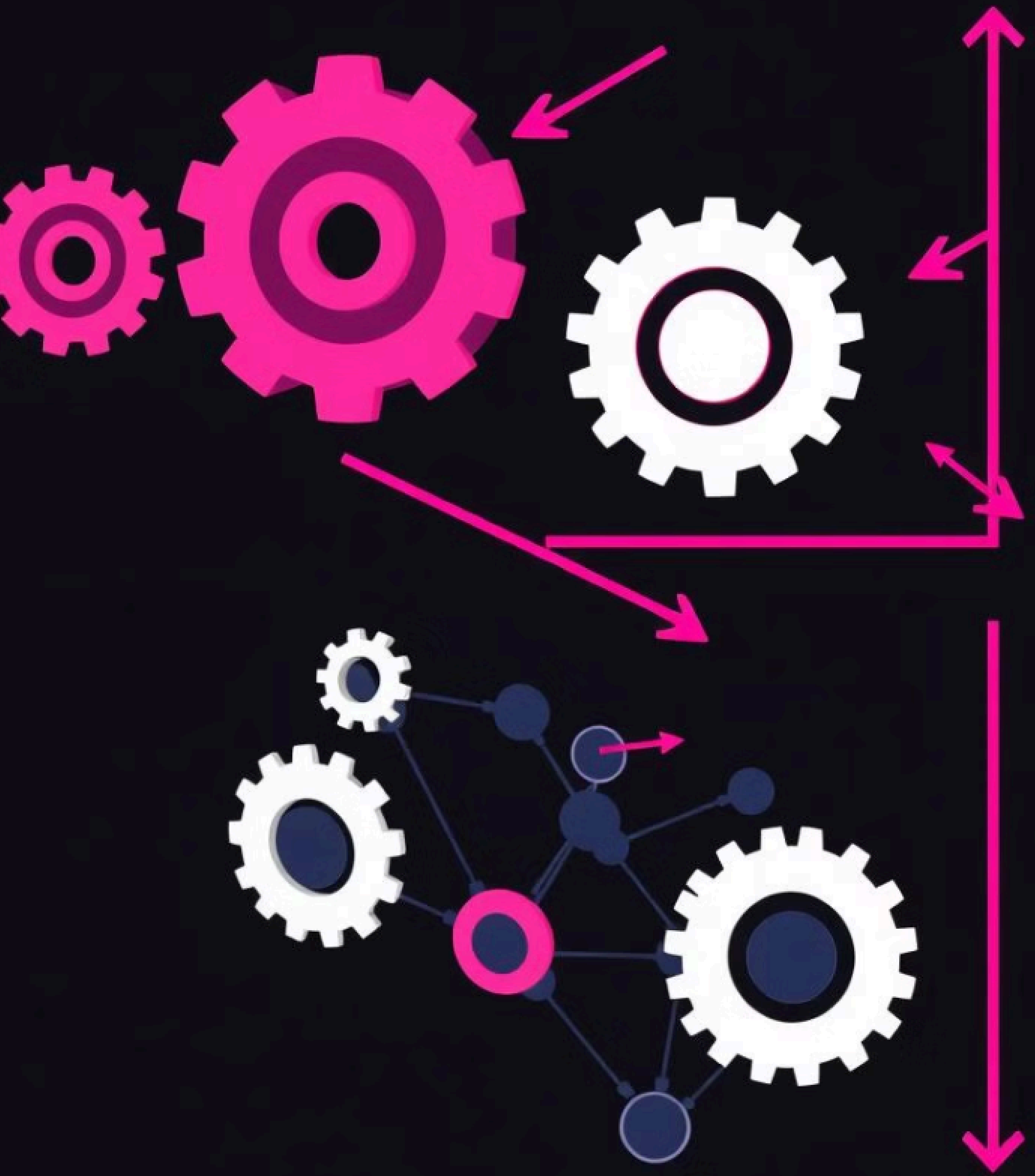
Collecting a large and diverse dataset of images representing different types of trash is crucial for model training.

2 **Data Augmentation**

Enhancing the dataset by applying transformations such as rotation, scaling, and flipping can improve model robustness.

3 **Labeling and**

Accurately labeling each image with the corresponding trash category is essential for supervised learning.



Convolutional Neural Network (CNN) Architecture

Layer Type	Function
Convolutional Layer	Extract features from the input image using kernels.
Pooling Layer	Reduce the dimensionality of the feature maps and prevent overfitting.
Fully Connected Layer	Combine features from different layers and make a final prediction.

Image Processing with Python Imaging Library (PIL)

1

Image Loading

PIL provides functions to load images from various file formats.

2

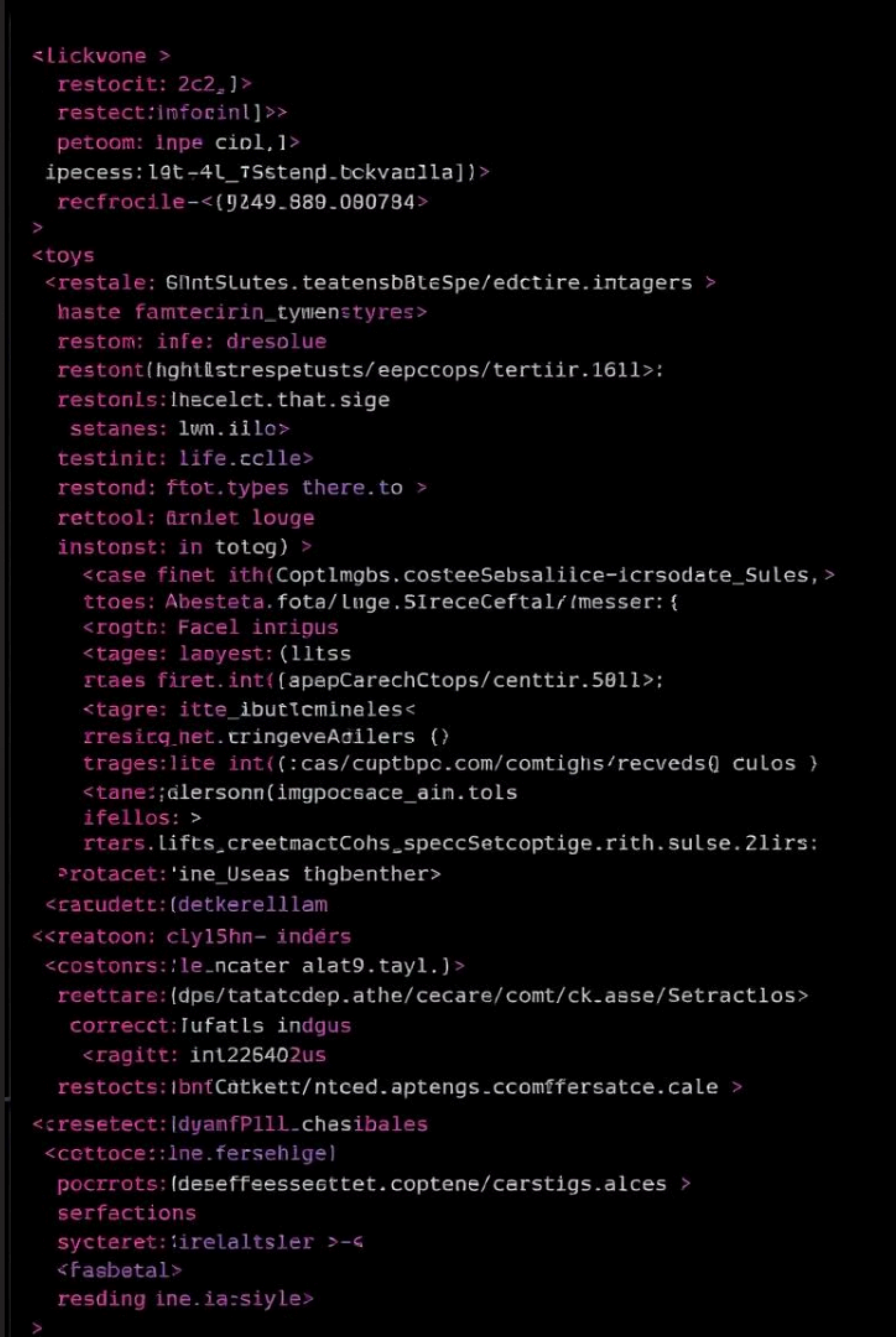
Image Resizing

Resizing images to a consistent size is important for model training.

3

Image Conversion

PIL allows for conversion between different image formats and color spaces.



Numerical Operations with NumPy

Array Representation

NumPy allows for efficient storage and manipulation of image data as multi-dimensional arrays.

Matrix Operations

NumPy provides a wide range of mathematical functions for performing operations on arrays.

Vectorization

Vectorized operations significantly improve the efficiency of image processing tasks.

Model Training and Optimization

1 **Backpropagation**

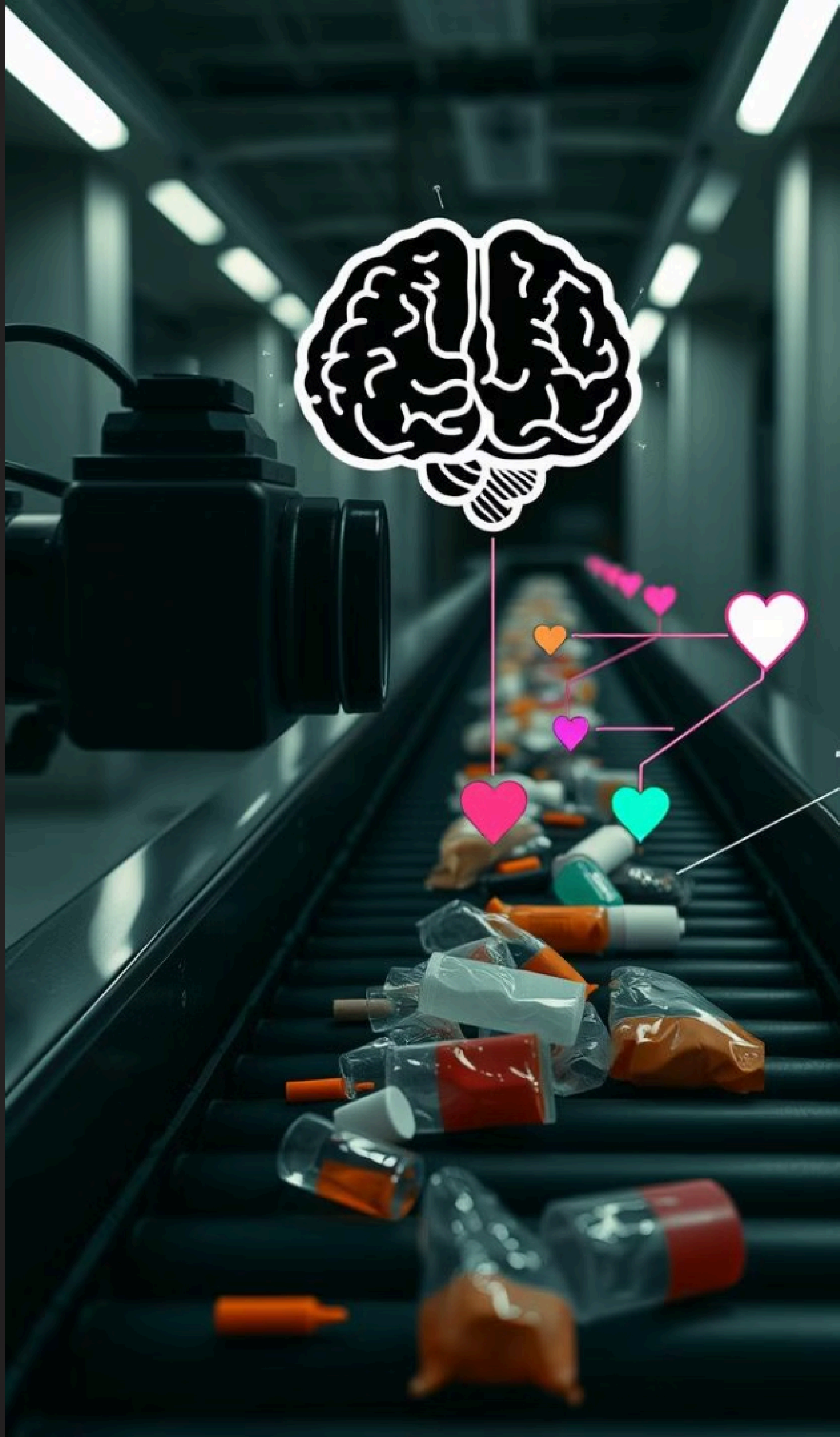
The model learns by adjusting its parameters to minimize the difference between predicted and actual labels.

2 **Hyperparameter Tuning**

Optimizing hyperparameters such as learning rate and batch size can improve model performance.

3 **Regularization**

Techniques like dropout and weight decay prevent overfitting and improve generalization.



Evaluation on Test

Plastic Bottle

The model correctly identifies the plastic bottle with a prediction probability of over 90%.

Glass Jar

The model correctly identifies the glass jar with a prediction probability of over 90%.

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Thank You

We would like to express our sincere gratitude for your interest in our project. Your feedback and support have been invaluable.