SmartBin: Design and Implementation of an AI-Based Automatic Waste Sorting System

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Global waste is increasing every year, and despite awareness campaigns, recycling rates remain low. Current systems rely heavily on human participation, which is often inconsistent and error-prone. This project proposes the development of an adaptive, AI-powered system that automatically sorts waste through image classification and optimizes sorting for each environment. This system could help increase recycling rates by providing a simpler, more intuitive way for users to recycle. An image classification model was developed and trained using a dataset of 15,000 labeled waste images. The model was evaluated using classification accuracy and validation loss. To assess real-world applicability, the model was integrated into a prototype system simulating an automated urban waste bin, which used image-based predictions to direct objects into appropriate categories. The final model achieved a classification accuracy of 90.13% with a validation loss of 0.3581, reflecting strong predictive performance. The prototype system successfully sorted objects based on the model's outputs, which demonstrated reliable operation in a physical environment. In the future, this system could be adapted for diverse locations and waste types, such as streets, hospitals, homes, and factories, with the potential to replace both recycling and general waste bins. Furthermore, these containers could continuously learn from each sorted item and share data with nearby units, forming a learning network.

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