Chapter 12
Sustainable Waste Management OOA-Enhanced MobileNetV2-TC Model for Trash Image Classification

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ABSTRACT

E-waste is an invisible, indirect waste that contaminates natural resources like the air, water, and soil, endangering the ecosystem, people, and animals. Long-term waste accumulation and contamination can harm the resources found in the environment. Since traditional waste management systems are very inefficient and the number of people living in urban areas is increasing, waste management systems in these areas face challenges. However, by combining a variety of sensors with deep learning (DL) models, waste resources can be used effectively. For this chapter, firstly, the Trashnet dataset with 2527 images in six classes and the VN-trash dataset, which comprises three classes and 5904 images, are collected. Then the collected images are preprocessed using truncated gaussian filter. After that, pre-trained convolutional neural network (CNN) models (Resnet20 and VGG19) are applied to the images in order to extract features. In order to enhance the predictive performance, this study then creates a MobileNetV2 model for trash classification (TC) called MNetV2-TC.

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1. INTRODUCTION

In the rapidly urbanising world of today, waste creation is an inevitable byproduct of modern living. The sheer amount of items that are thrown away, commonly known as "trash," from homes to businesses, presents a serious threat to the sustainability of the environment (Zhang, Yang, Zhang et al, 2021). Fundamentally, trash is any variety of items that are either no longer considered necessary or have passed their prime and are no longer useful (Gupta, 2020). The term "trash" encompasses a wide range of materials, from plastic bottles, food packaging, and paper used in households to industrial byproducts like electronic waste and construction debris (Masand et al., 2021). The problem is not only the sheer amount of waste generated, but also the variety of materials involved, each of which needs a different disposal strategy to reduce its negative effects on the environment. Keeping up with this ever-increasing waste mountain has become increasingly important as urbanisation and consumption patterns change (Vo, Vo, & Le, 2019).

Effective waste management techniques are receiving more attention as a result of the pressing need to address the growing waste crisis (Tiyajamorn et al., 2019). A crucial element of efficient waste management is the precise and methodical classification of waste. Appropriate trash classification is important because of how it affects resource recovery, recycling, and environmental preservation (Yu, 2020). Different waste types require different disposal techniques, and improper waste segregation can lead to pollution of the environment, increased use of landfills, and lost recycling opportunities (Ozkaya & Seyfi, 2019). Communities can improve the efficiency of their waste management procedures, lessen their impact on the environment, and get closer to a more sustainable future by using sophisticated classification techniques to understand the composition of waste (Mao et al., 2021).

Waste sorting has historically been a labour-intensive procedure that relies on hand labour to separate various materials (He et al., 2020). But with the advent of DL, an artificial intelligence subfield motivated by the composition and operations of the human brain, the trash classification industry has undergone significant transformation (Yang et al., 2020). DL algorithms that have demonstrated remarkable performance in tasks related to image classification and recognition are convolutional neural networks (CNNs) (Zhang, Zhang, Mu et al, 2021). These algorithms are highly accurate at differentiating between different materials when applied to trash images, which makes them indispensable tools for automating the waste sorting process (Gupta et al., 2022). Effective trash management techniques are becoming more and more necessary as communities deal with the fallout from inappropriate waste disposal. Classifying and managing various types of trash through the use of advanced technologies, especially DL, is one promising solution that is soon to be realised (Mythili & Anbarasi, 2022).

1.1. Motivation

The pressing need for efficient waste management is the driving force behind the classification of trash images. Waste production both increases in quantity and variety as urbanisation picks up speed. Conventional waste sorting techniques are error-prone and labor-intensive. Using DL to power image classification expedites the process by identifying different materials automatically. This improves resource recovery, encourages appropriate recycling, lowers environmental pollution, and boosts the effectiveness of waste management systems. Trash image classification ultimately aims to address the growing difficulties associated with contemporary waste disposal by developing a more technologically sophisticated and sustainable method.