

**School of Computer Science**

**Masters in Applied Computing (M.A.C)**

**AI based solid waste classification**

**COMP8157**

**Advanced Database Topics**

**Professor Dr Shafaq khan**

**Presented by**

**(Group Adrenaline)**

**Arjun Kheni (110093004)**

**Himani Rabari (110091002)**

**Hamza Baig (110089314)**

**Meet Kevadiya (110092731)**

Table of Contents

Abstract: 3

[Introduction and Motivation:](#_Toc128510558) 4

[Literature/Background Study:](#_Toc128510558) 4

[Proposed Model:](#_Toc128510558) 5

[Results: 5](#_Toc128510558)

[Limitations: 5](#_Toc128510558)

[Conclusion and future work: 5](#_Toc128510558)

[References: 6](#_Toc128510558)

List of figures

Figure 1: 4

[Figure 2:](#_Toc128510558) 5

[Figure 3:](#_Toc128510558) 6

[Figure 4:](#_Toc128510558) 5

[Figure 5: 5](#_Toc128510558)

[Figure 6: 5](#_Toc128510558)

[Figure 7: 5](#_Toc128510558)

[Figure 8: 6](#_Toc128510558)

**Introduction and Motivation**

Effective management of solid waste is crucial for promoting sustainable development and preventing adverse health and environmental impacts. However, the traditional method of sorting and categorizing waste is a tedious and time-consuming task that often leads to errors, inconsistencies, and inefficiencies. To address these challenges, Artificial Intelligence (AI) can be leveraged to automate waste classification. By employing computer vision techniques like image processing and machine learning algorithms, AI-based solid waste classification systems can accurately classify different types of waste such as plastics, metals, paper, and organic waste. Furthermore, an android application can be developed to enhance the user experience.

**Literature/Background Study**

The first paper proposes a system that uses cameras, Raspberry Pi, and deep learning algorithms to classify waste into bio and non-bio categories [1]. The second paper focuses on predicting waste generation using multiple machine learning techniques [2], while the third paper uses ResNet-50 and CNN to categorize waste based on images [3]. The fourth paper describes a garbage bin connected to the internet that uses sensors to measure the amount and weight of garbage collected [4]. The fifth paper compares the accuracy of different models for waste classification using image recognition [5], but none of the papers handle the scenario where waste contains multiple items of different categories. Moreover, a platform like a user-friendly application is necessary to make these models more accessible.

Chart, bar chart

Description automatically generated

Figure 1

In general, waste is being classified using image recognition technology, but current models are only able to classify single waste products. However, in reality, waste can consist of multiple items belonging to different categories, such as plastic, rubber, and food. None of the above research papers have addressed this scenario. Additionally, it is important to have a user-friendly platform, such as a mobile application, to make machine learning models more accessible to users. According to the United States Environmental Protection Agency, about 25% of the waste generated in the US is mixed and not separated into specific categories for recycling or composting, highlighting the need for better waste management solutions.

**Proposed Model**

MobileNet is a set of neural network architectures specifically designed for use in mobile and embedded vision applications that have limited computational resources [6].

For this project, the MobileNet v2 architecture will be employed with a dataset of 25,077 images downloaded from Kaggle. The dataset will be divided into training (85%) and test (15%) data, with 22,564 images used for training and 2,513 for testing. The MobileNet v2 model will be trained to identify different types of waste in the dataset. This architecture was chosen due to its high accuracy, as demonstrated in previous research, and because it requires fewer resources, making it suitable for use in a mobile application.

Chart, waterfall chart

Description automatically generated

Figure 2 [7]

Our proposed mobile application, developed using Flutter, aims to simplify waste classification for users. The application will allow users to scan waste using their mobile phone camera, and using the MobileNet v2 model trained on a dataset, it will classify the waste as organic, recyclable, or paper. The application will then guide users on which bin to throw the waste in. To make the process of waste management more engaging, we will incorporate gamification features that trigger the dopamine effect. Users will be able to add friends, create groups, and earn points by correctly recycling waste. The more waste a user recycles, the more points they will earn. Users can scan waste they are unsure of and use the application to determine the correct bin to dispose of the waste, earning points in the process. These features will encourage users to use the application frequently and compete with their friends, making the recycling process fun and rewarding.

# 

# **Workflow Diagram of the mobile Application:**

Diagram

Description automatically generated

Figure 3

The workflow diagram illustrates two different actions that a user can take: scanning for waste and adding friends.

* If the user selects the option to scan for waste, they can take a photo which will then be saved in a database. The system will use an algorithm to determine the type of waste and instruct the user to dispose of it in the appropriate bin. Additionally, the user will earn points towards their profile for successfully disposing of the waste.
* On the other hand, if the user chooses to add friends, they can search for individuals using their name or phone number and add them to their friends list.

## 

## **Innovation:**

From our review of the research papers, we have found that all of them have focused solely on the classification of waste in images, without detecting multiple objects. However, we propose an application that will be able to detect multiple waste objects in an image.

By implementing this feature, we aim to increase awareness and promote proper segregation and recycling of waste. The application will help users identify waste objects and provide information on how to properly dispose of them. Ultimately, we hope to contribute towards greater environmental awareness and encourage responsible waste management practices.

**Functional Requirements:**

The Waste Classification app will have several functional requirements.

* User authentication: Users will need to sign in or create an account in order to access the app, with options to sign in using email/password or through their Google account.
* Waste Classification: The app will allow users to take photos of waste materials or use the live camera feature to identify multiple types of waste using machine learning.
* Information of waste management: Information on proper waste management techniques such as recycling, composting, and landfilling will also be provided to users. The app will display data on the amount of waste thrown out and the percentage of recyclable and non-recyclable waste, available directly on the user's dashboard.
* Notifications: Users will receive notifications for upcoming trash pickup schedules and other waste management news, and they will be able to check waste collection schedules based on their postal code directly in the app.
* Localization: The app will support multiple languages and regions, including French, English, and others.

**Results**

**Limitations**

**Conclusion and future work**

**References**

[1] Smart Waste Management and classification system for smart cities using cutting edge approach. Available at: https://www.researchgate.net/publication/360230167\_Smart\_Waste\_Management\_and\_Classification\_System\_for\_Smart\_Cities\_using\_Deep\_Learning (Accessed: February 28, 2023).

[2] I. Ihsanullah, G. Alam, A. Jamal, and F. Shaik, “Recent advances in applications of artificial intelligence in solid waste management: A Review,” Chemosphere, vol. 309, p. 136631, 2022.

[3] O. Adedeji and Z. Wang, “Intelligent Waste Classification system using deep learning convolutional neural network,” Procedia Manufacturing, vol. 35, pp. 607–612, 2019.

[4] M. K. Hasan, M. A. Khan, G. F. Issa, A. Atta, A. S. Akram, and M. Hassan, “Smart Waste Management and classification system for Smart Cities using deep learning,” 2022 International Conference on Business Analytics for Technology and Security (ICBATS), 2022.

[5] Srivatsan, K., Dhiman, S., & Jain, A. (2021). Waste Classification using Transfer Learning with Convolutional Neural Networks. *IOP Conference Series: Earth and Environmental Science*, *775*(1), 012010. https://doi.org/10.1088/1755-1315/775/1/012010

[6] A. G. Howard et al., "MobileNets: Efficient Convolutional Neural Networks for Mobile Vision Applications," arXiv:1704.04861, 2017.

[7] Akay, M., Du, Y., Sershen, C. L., Wu, M., Chen, T. Y., Assassi, S., Mohan, C., & Akay, Y. M. (2021). Deep Learning Classification of Systemic Sclerosis Skin Using the MobileNetV2 Model. *IEEE Open Journal of Engineering in Medicine and Biology*, *2*, 104–110. https://doi.org/10.1109/ojemb.2021.3066097