

**School of Computer Science**

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

**AI based solid waste classification**

**COMP8157**

**Advanced Database Topics**

**Professor Dr Shafaq khan**

**Milestone 1**

**Presented by**

**(Group Adrenaline)**

**Meet Kevadiya (110092731)**

**Hamza Baig (110089314)**

**Arjun Kheni (110093004)**

**Himani Rabari (110091002)**

Table of Contents

[Introduction: 3](#_Toc128510558)

[Literature/Background Study: 3](#_Toc128510558)

[Proposed Model: 4](#_Toc128510558)

[Functional Requirements: 5](#_Toc128510558)

[References: 6](#_Toc128510558)

**Introduction**

Solid waste management is critical to sustainable development because it influences health and environmental consequences. The appropriate segmentation and categorization of trash are one of the most important processes in waste management, as it aids in effective waste disposal, recycling, and recovery. Yet, conventional waste categorization is a time-consuming and labour-intensive job that frequently leads to mistakes, inconsistencies, and inefficiencies.

To overcome these issues, Artificial Intelligence (AI) may be used to automate waste classification. AI-based solid waste classification systems that use computer vision techniques such as image processing and machine learning algorithms can assist in properly classifying garbage. These systems can identify and sort many sorts of garbage, such as plastics, metals, paper, and organic waste. Along with this an android application will provide a nice user experience.

**Literature/Background Study**

Paper [1] proposes a system that classify the waste into bio and non-bio waste using cameras, Raspberry Pi and deep learning algorithms. An Image of a single waste material is faded to the system which through the help of IOT and deep learning predicts the category best suitable for that waste product.

Chart, bar chart

Description automatically generated

The second research paper [2] is more focused on prediction of waste generation rather than classification. It uses multiple ML techniques such as SVM, Neural Network, and KNN to improve the accuracy of the algorithm. The paper also proposes methods to handle increased amount of waste.

Paper [3] is closely related to what we are planning to work on this project. The paper uses ResNet-50 along with CNN to predict and categorize the waste product based on the image. To improve the efficiency, a dropout layer is added along with ResNet-50 and CNN.

[4] discuss a new type of garbage bin that is connected to the internet and can communicate with a central database. The bin uses an ultrasonic sensor to measure the amount of garbage in it, and a microchip processes this information and sends it to the internet. The bin also has a load size sensor that can measure the weight of the garbage collected. The system is controlled by an ESP8266 node MCU microcontroller and can be further improved by adding other measuring devices.

The last paper [5] performs a comparison of 8 different models with different configurations and datasets to measure which model gives best accuracy. The authors proposed transfer learning with data augmentation for 3 models; ResNet34, DenseNet121, MobileNetV2, and compared the accuracy of their configurations with the same models without the new configurations. The authors are not taking into account what materials are recyclable or organic.

Overall, Everyone is classifying waste based on image classification. These models give desired output while working on image containing single waste product. However, in real life a waste can be one or more items of different categories such as plastic, rubber, food, etc. This scenario is not handled by any of the above research paper. Moreover, The real implication should also provide a platform like an application where user can use this Machine learning model. According to the United States Environmental Protection Agency (EPA), about 25% of the waste generated in the US is mixed and not separated into specific categories for recycling or composting.

**Proposed Model**

MobileNet is a family of lightweight deep convolutional neural network architectures designed for mobile and embedded vision applications with limited computational resources [6].

The proposed model for this project will be MobileNet v2 on the dataset downloaded from Kaggle. The dataset consists of 25,077 images. The dataset will be divided into two parts, training (85%) and test (15%) data; 22,564 images set for training and 2,513 set for testing.

The model will be trained to learn different types of wastes provided in the dataset. The reason for using MobileNet is due to its high accuracy, which was evident in the literature review and the reason that it utilizes less resources which makes it best suited for a mobile application.

Chart, waterfall chart

Description automatically generated

Figure 1 MobileNet Architecture [7]

We are proposing a mobile application built on flutter. The mobile application will let users scan waste, it would identify the type of waste whether the waste is organic, recyclable, or paper, and it would guide the user by letting them know which bin to throw the waste in. The application will use the concept of gamification, which would be there to trigger the dopamine effect. The users will have the option to add friends, create a group, and check their points in the application. The points are gained by recycling garbage. The more the user recycles garbage, the more points he/she will have. The user will scan waste which he/she is not sure of, and will use the application to throw the waste into the correct bin, the application will detect whether the waste is recyclable or not, and will inform the user to throw the waste into its respective bin, this whole activity will give the user a point, encouraging them to use the app more often and compete with their friends, making the process of recycling fun and rewarding. For the identification of waste, a model (MobileNet v2) trained on the dataset will be used.

# Workflow Diagram of the mobile Application:

Diagram

Description automatically generated

The workflow diagram shows two scenarios, one in which the user scans for waste and the other in which the user adds friends. The user will use scan waste option to scan for waste which would store the image into database and request model to identify the type of waste, it will inform the user to throw the detected type of waste into a certain bin and add points to the user’s profile.

Th other use case is the user will search for a friend using name or phone number and add them to their friends list.

## Innovation:

All the research papers we reviewed, did only classification and did not detect multiple objects in an image. We are proposing an application that will detect multiple waste objects. The application will grow awareness and contribute towards proper segregation and recycling of waste by helping users identify waste and by providing awareness.

**Functional Requirements**

User authentication: To access the Waste Classification app, users will be required to sign in or create an account. App will be integrated with Email/ Password and google sign in options for the users.

Waste Classification: The user will be able to take pictures of waste materials or can use live camera in order to utilize a machine learning model to determine the type of waste being captured. Users will be easily able to detect multiple waste materials live at a time and get an idea about its disposal technique.

Information on waste management: The users will be advised of the proper methods for disposing of waste, such as recycling, composting, or landfilling. Users can also check the already disposed data such as amount of waste thrown out is recyclable or non-recyclable and in what amount directly on the Dashboard.

Notifications: The Users will be notified of forthcoming trash pickup schedules or other waste management news. Users can check the waste collection Schedules based upon their postal code directly in a app.

Localization: The app will be localized to support multiple languages and regions like French, English, etc.

**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