Published by :
https://www.ijert.org/
An International Peer-Reviewed Journal

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 14, Issue 11, CONFLUENCE - 2026

AI Bin-Brain: Ai-Powered Smart Waste Segregation and Management System

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Abstract

A Waste segregation is a one of the most major problems for environment. It can lead to increasing pollution, inefficient recycling, and improper disposal of recyclable and organic wastages. Sometimes the manual identification of waste items can be time consuming and gives an error. This project presents AI BIN BRAIN, AI-POWERED SMART WASTE SEGREGATION designed to identify automatically and classify different types of waste using image – based Machine Learning. Proposed system uses (CNN) Convolutional Neural Network Model to analyze uploaded or captured waste items and classify them into categories like paper, plastic, organic, metals etc. After identifying the waste items our system gives simple options like recycling and reusing the waste. The recycling option helps user to find nearby recycle centres, while reuse option gives simple ideas for using the waste materials again. The application also has a simple dashboard, waste scanning, progress tracking, and rewards to encourage users to manage waste properly. The system uses AI to identify waste and helps users to choose the right way to dispose the wastages and help to take better decisions. Here we use the Google Maps API – to show the nearby recycle centre within the mentioned kms.

***Keywords*: Artificial Intelligence, Waste classification, CNN, Waste segregation, Smart Waste Management, Machine learning.**

I. INTRODUCTION

Waste management is one of the major environment challenges in this world. Due to the increasing in population the amount of waste in environment is also increasing. This waste causes population and harms the environment. Proper waste management is very important to keep our surrounding health and clean. If we did improper disposal of a waste, it can cause environmental pollution and it create serious health problem. We can find the waste items in a different locality such as households, educational institutions, offices, industries and public places. There are different types of categories for that some different method of treatments is used like recycling and reuse. Manual waste segregation is a time - consuming and difficult for people. It can also be hazardous to their health. Therefore, an AI-based intelligent system is need to make waste segregation faster, safer and easier. AI-based systems can analyse images and classify the waste according to its material types. And some useless things will have still value, so that it can be reused and recycled with the proper method. So, there is a need for a smart system that it can help the people to make the better decisions in a proper waste management, about the waste management. Then this Binbrain AI, it aims to make this process easier and faster by using the AI, artificial intelligence and machine learning, ML technologies. This system can, it will help the users to understand what type of waste it has and provide suitable suggestions for its proper handling to manage it properly. So, it can also guide the users to finding the useful ways to reuse the materials instead of throwing the materials for waste. It needs recycling. The application, it can help users to connect with the suitable recycling or collection centres near their locations. The main objective of this research is that to developing an AI-based system so that it can identify and classify the different types of waste by using uploaded images or camera scanning. This system will aim to recognize the categories like plastic, paper, glass, metal, organic waste, and e-wastages, and hazardous waste. This will help to reduce the manual effort and it will support for proper waste segregation decisions to

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International Journal of Engineering Research & Technology (IJERT)
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take. If an item, it will be reused means the system will suggest creative and practical ways how we can use that wastages. And if the item is recyclable, the system will give some more recycling centre options. So, we can contact them. This will aim to encourage the responsible waste handling and reduce the unnecessary disposal. The research, it aims to helps the users to find the nearby recycling centres or waste collection locations for recyclable items or the materials. So, it will provide the location related to the information. Then it will help and encourage the users to dispose the waste responsibly and it also aims to encourage the users to participate actively and in daily real-time every day to waste segregation through a reward system. So, the users may earn the points or receive certificates after meeting some reaching specified participation criteria. So, this feature is motivating the users to adopt environmentally, and it will be a daily habit. In conclusion it will combine the waste classification and it will give the reuse recommendations and recycling centres guidance, collection of request management, and the users gets rewards in one platform. So, the research aims to make the waste segregation easier, faster, and users promote more responsible on the waste management practices.

II. RELATED WORK

A. Classification of Trash for Recyclable status

The researchers they have introduced the Trash net dataset it is containing around 2,527 images of the glass, paper, cardboard, plastic, metal and general trash. So, this work helped to download the dataset for training image classification models. But the limitation is that the image background is like waste photography.

B. Trash Annotations in context for Litter detection

This study is introduced a dataset of the litter images it was captured in a real world their surroundings. Taco it will includes the cluttered back ground and different outdoor situations. It is helpful for the understanding that why waste shed work beyond the controlled images.

C. Recyclable Waste Image Recognition Based on The Deep Learning

The Researchers. They have proposed a deep learning model. That is mainly based on a network to identify the recyclable waste or items. Their model is automatically read and analyse then it will give the report based on the features like 95.87% accuracy for classification on traghetti's work will supports using the Deep Learning to identify the waste from the uploaded images.

D. Computer Vision for Solid Waste Sorting: A critical Review of The Academic Research

This review mainly talks about the computer vision method used in waste sorting or the identification. It will discuss the shifts that from traditional machine learning to deep learning then highlights the difficulty of applying the laboratory results to real waste conditions.

E. Automated Waste Sorting and Recycling Classification Using Artificial Neural Network and Features

This work is combined the image features with the artificial neural networks to classify waste for the recycling. It gives the 91.7% accuracy on the dataset of 2,400 images. Based on the three categories. It demonstrates that combining the visual features it is helps to sort automatically of the decisions.

F. A Smart Municipal Waste Management System Based on Deep learning and Internet of Things

This research is proposed a waste management system by combining the deep learning, cloud computing, and connected smart bins. It will explore the waste classification at the source sides and it will use the mobile applications to locate nearby bins. This project is this system also it uses the IoT based components.

G. Efficient Source - Level Waste Segregation Using CNN based on the Waste classifier With the IoT

This will study that it compared the already trained CNN architectures and it gives the accuracy level is 93% for the inspection V3 and it gives the 94.4% for the Exception in Its experiments.

H. Swachh Snap: Smart Waste Monitoring and Reporting Using the AI powered mobile application

This work will be described a mobile framework for the waste classification, location based on the reporting and municipal collection management. It is a proposed features includes the location tracking, alerts, complaint monitoring and the route optimization. These are the ideas are useful. When we are designing for the administrator's dashboard. And waste collection request workflow for the bin Brain AI.

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III. LITERATURE SURVEY

Table I

Author name	Approach	Parameter	Strength	Weakness
[1]. J. Bobulski and M. Kubanek, "Deep learning for plastic Waste Classification system," Applied Computational Intelligence and Soft Computing, vol. 2021, pp. 1–7, 2021. doi: 10.1155/2021/6626948. CrossRef Google Scholar	Plastic type wasted Nd CNN for solving the waste polluting environments.	120 × 120 × 3 input image size; approximately 4 million parameters	Automatic classification, reduced manual sorting, suitable for portable devices.	74% accuracy, performance depends on image quality, difficulty with overlapping objects.
[5]. M. Malik et al., "Waste Classification for Sustainable Development Using Image Recognition with Deep Learning Neural Network Models," Sustainability, vol. 14, no. 12, p. 7222, 2022. doi: 10.3390/su14127222. CrossRef Google Scholar.	It studies waste classification using DL model.	Image dataset, neural network architecture, image preprocessing, model training, testing, and classification accuracy.	Automates waste classification; supports sustainable waste management; improves waste identification through image recognition; reduces manual sorting.	Requires a large and diverse image dataset; classification may be affected by lighting, background, and image quality; similar waste materials can be difficult to distinguish.
[18]. L. Yong, Liying, et al. "Application of MobileNetV2 to waste classification." Plops one 18.3 (2023): e0282336.	It studies classifying using mobilenetV2.	Image dataset, MobileNetV2 architecture, inverted residual blocks, depthwise separable convolution, and classification accuracy.	Lightweight model; requires less computational power; faster processing; suitable for mobile and embedded devices.	Performance depends on dataset quality; may struggle with visually similar waste categories; accuracy can be affected by complex backgrounds.
[3]. D. Khetarpal et al., "Trash Detection: Advanced Classification of Waste Materials Using ML Techniques," IEEE, pp. 1–6, 2024. doi: 10.1109/otcon60325.2024.10688146. View Article Google Scholar.	It studies about the disposal system using CNN for identify.	Image dataset, feature extraction, ML classification models, training and testing data, and classification performance.	Automates trash detection; improves waste identification; reduces manual sorting efforts; supports efficient waste management.	Performance depends on image quality and dataset diversity; complex backgrounds and overlapping waste objects may affect detection accuracy.
[16]. A. Alou Rani, Abdullah, M. Usman Ashraf, and Mohammed Aloraini. "Smart waste management and classification system using advanced IoT and AI technologies." Peer Computer Science 11 (2025): e2777,2025	It studies AI-based waste management like classification methods, techniques that are used	IoT sensors, waste data collection, AI-based classification, real-time monitoring, and smart waste management.	Enables real-time waste monitoring; automates waste classification; improves waste collection efficiency; supports smart and sustainable waste management	Depends on sensor accuracy and internet connectivity; implementation and maintenance costs may be high; system performance depends on reliable data collection.

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IV. SYSTEM DESIGN AND PROPOSED METHODOLOGY

In this work, we proposed a machine learning algorithm – based framework for smart waste segregation and management to ensure suitable reuse and recycling suggestions, AI-based waste classification system, will locate recycling centres, and to encourage the waste management through the rewards. It provides an efficient waste identification and management solution. This system allows users to upload images of waste, classify and segregate waste for reuse and recycle and also eco points are rewarded.

A. Dataset

The paper utilized the Waste Dataset obtained from synthetic data set, which comprises waste images categorized into four primary classes: Hazardous, Recyclable, Organic, and Non-recyclable. This JGRKRWEFW/Nbfdfsbnvbcncncv dvdbvadataset was employed to train the proposed AI model to accurately identify and classify different types of waste based on their visual characteristics.

B. Waste image capture and upload

After logging the users can capture their waste items using cameras or they can upload the image. After sending that image the system further processes the image and identify the image that which type of categories the image belongs to.

C. *Image pre-processing*

The uploaded image is processed before its classification, and the system, it will resize the image and it will remove the unnecessary noises, and it will prepare a suitable format for the AI model.

D. *AI waste classification*

The uploaded picture or image is processed using artificial intelligence and computer vision techniques. The system will analyse the important features of the image and it will identify the type of the waste. That waste is can be classified into different types of categories like plastic, paper, glass, Metal, organic, e-waste and hazardous waste.

E. *Category decision*

After waste classification. The system will identify the which category that waste belongs to such as hazardous, non-recyclable, organic recyclable.

F. *Recommendation and Reward*

After the identification and classification of images, the system recommends what can be done with waste and based on the obtained eco scores are given.

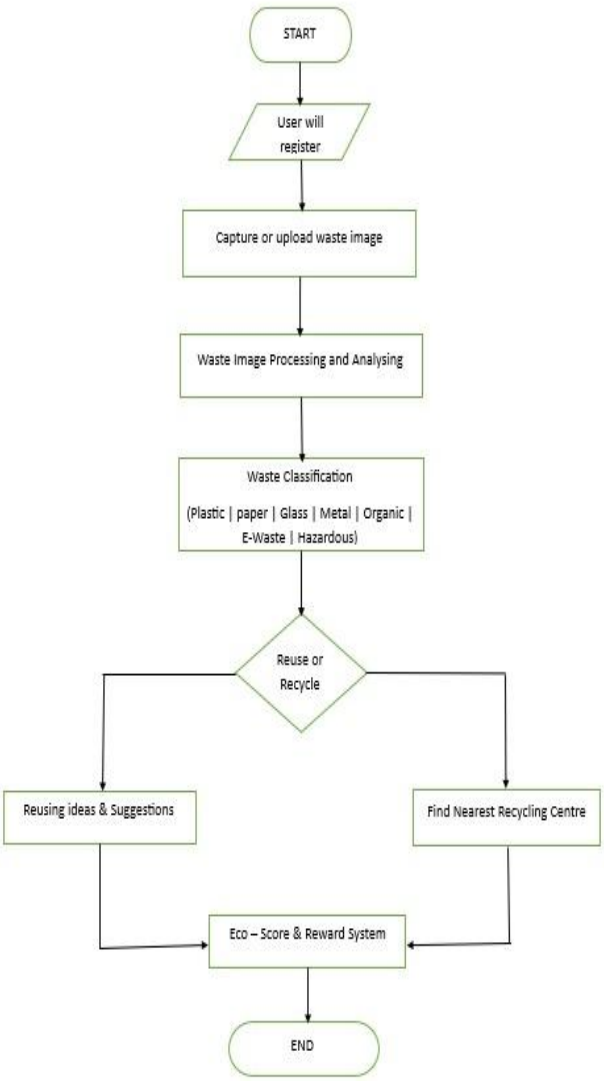


Fig1: Work flow of AI BIN

The proposed software waste segregation system uses the artificial intelligence, computer vision and machine learning to identify and classifying the different types of wastages. The user can scan the image or upload the image of waste using camera. Then AI system analyses the image and identify the waste category, such as plastic, paper, organic, e waste, metal or hazardous waste using CNN model. After identifying the waste categories, it will provide the suitable suggestions for the users. If the waste is reusable the system provides ideas and suggestions for reusing the item. If it is recyclable the system will help the users to find the nearest location of recycling centres or collection locations using google API map so that the users can send the request to the admin so if they want, they will accept

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International Journal of Engineering Research & Technology (IJERT)
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or no. Based on the data collected, eco points are also rewarded.

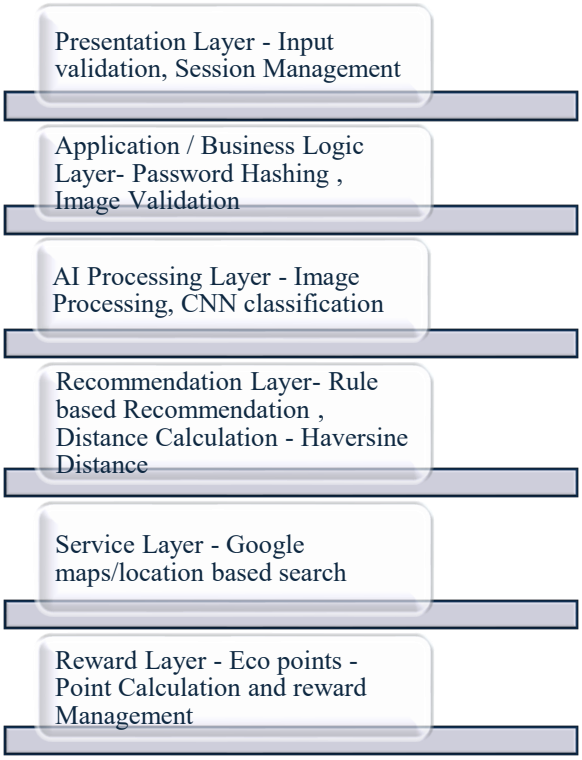


Fig 2: Layered Architecture of AI BIN BRAIN

The user will have created an account in AI BIN BRAIN, here we use password hashing which involves the conversion of plaintext password into unreadable format to a cryptographic hash function which is saved in the database not revealing the exact text. Hashing technique is applied during login process. The new hash and stored hash are compared, if matched the access is granted, thus the user's identity is verified.

Algorithm 1: CNN based Classification

CNN based classifications outlines the CNN – based waste classification that is processed when the image is uploaded to determine its type. It starts by allowing user to upload image, after which the image undergoes resize to fit in consistency. The CNN algorithm is used to extract necessary features from the image to classify them among reuse and recycle.

Algorithm 2: Reuse and recycling recommendation

This algorithm outlines the system as when the image is received, it is evaluated among the reuse data available in database to predict whether the uploaded image is belonging to reuse category. Then based on above prediction, the system provides recycling suggestions and recommendations to the user.

Algorithm 3: Nearest Recycling calculation

Here the system obtains the current location of the user and through geographical maps accordingly finds the list of recycling centres from database and calculates the distance using haversine formula and sort the data to precise the distance between centre and the user and most convenient places are recommended first.

Algorithm 4: Eco score Calculation

The system receives and verifies the user eco activity; it functions by assigning points based on the predefined set of rules in the database. It uses point calculation algorithm to reward scores and also updates the user's running score for activity.

V. IMPLEMENTATION

A. Development Environment

The proposed model was developed using python which includes several libraries and frameworks for image processing, handling data, training of model and to evaluate performance. Deep learning framework used for developing and training the AI model. Scikit-learn was used to assess model's effectiveness.

B. Tools and Technologies

The entire system used python, other tools used are mentioned in the table. VS code provided the development and execution environment.

Table II

Tools and Technologies used

Purpose	Tool
Programming language	Python
Data Acquisition	Kaggle
Framework	TensorFlow
Image preprocessing	Open CV
Model type	CNN
Training and validation	Scikit-learn
Development platform	VS Code
Deployment	Flask

C. Developmental workflow

This model follows a streamlined that starts with user authentication and ends by generating eco score and rewards. Once the user is authenticated, they can upload images, which are classified as different categories. Based on the result of classification, the system will recommend for reuse and recommendations.

It allows users to locate nearby areas for proper disposal and finally generated eco score with rewards. This paper aims to adopt sustainable practices for environmentally responsible behaviour.

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D. Dashboard design

The dashboard consists of user information, waste classification statistics, recent history of classification, reuse and recycle recommendations and nearby recycling centre locations. It also consists of eco scores and rewards displayed.

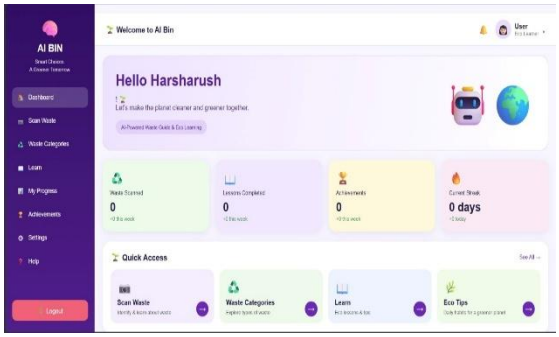


Fig 3: Dashboard Overview

E. Scan waste

The scan waste page is used by the users to capture, upload images for automatic identification and classification. The image once uploaded is processed by the trained model, analysing features of the image and categorising into Hazardous, Recyclable, organic and non-recyclable. After the classification is completed, prediction is displayed which helps users to opt for proper methods to reuse, recycle or disposal.

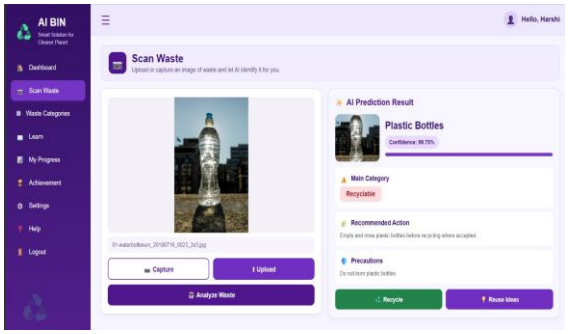


Fig 4: Scan Waste

F. Reuse and Recycle

This page includes providing suggestions for managing waste materials based on classification results, the proposed model recommends possibility of reusing the materials or disposal of waste. It's like a practical guide for users to convert waste to useful products. This process will have a sustainable impact on environment.

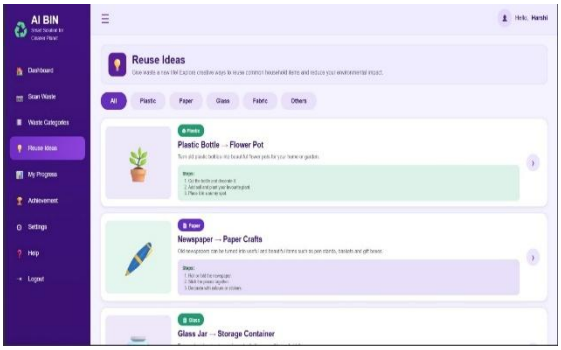


Fig 5: Reuse and Recycle

G. Eco scores

The Eco- points page allows the users to actively take part in waste management activities by rewarding them with points. The total scores, user scores, levels of achievement are recorded to adopted eco friendly practices, thereby increasing awareness waste management and disposal and maintaining clean environment.



Fig6: Eco Scores and Rewards

F. Locating nearby centres

The proposed system integrates a recycling centre locator that allows users to identify nearby facilities based on their geographic location. It provides detailed information such as the names, addresses, and exact positions of available centres. This feature enables users to easily find appropriate disposal and recycling options, thereby encouraging responsible waste management practices and supporting environmental sustainability.

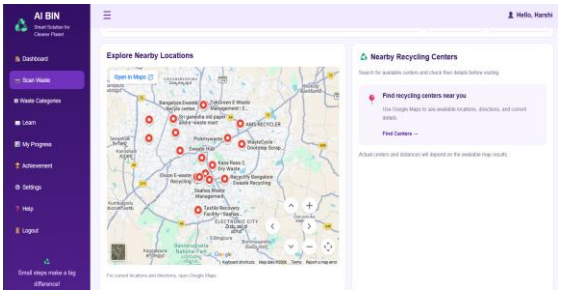


Fig 2: Location based service

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International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
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G. Typical user's workflow

Table III

User Activity	System Response
Register / Login	Authenticates the user.
Access Dashboard	Displays available features.
Upload Waste Image	Accepts the image for analysis.
Scan and Classify Waste	Identifies the waste category using the trained AI model.
View Classification Results	Displays the predicted category and classification details.
View Recommendations	Provides reuse and recycling suggestions.
Earn Eco-Points	Updates user scores and rewards.

VI. FUNCTIONAL TEST CASES

Table IV

ID	Module	Test case	Expected	Result
T1	Authentication	Register with valid details	Account created	[Pass/Fail]
T2	Authentication	Sign in with correct and incorrect credentials	Access only when correct	[Pass/Fail]
T3	Waste Image capture	Capture via camera	Image captured	[Pass/Fail]
T4	Waste Image Upload – Valid File	Supported image format	Upload successful	[Pass/Fail]
T5	Waste Image Upload – Invalid File	PDF / empty / blurry image	Error or warning message	[Pass/Fail]
T6	Waste Classification – Common Types	Plastic / Paper / Metal / Glass / Organic	Correct category displayed	[Pass/Fail]
T7	Waste Classification – Unknown	Unrecognized image	"Unknown" result displayed	[Pass/Fail]
T8	Recycling Recommendations	Plastic / Paper / Metal / Glass / Organic	Appropriate reuse/recycling guidance shown	[Pass/Fail]
T9	Nearby Recycling Centre Locator	Location enabled / disabled	Centres displayed or permission message	[Pass/Fail]
T10	No nearby centres found	Location with no matching results	No centres found message displayed	[Pass/Fail]
T11	Centre details	Select a recycling centre	Centre address and available details displayed	[Pass/Fail
T12	Eco-Score & Rewards	Complete recycling/reuse activity	Points awarded, dashboard updated, reward eligibility	[Pass/Fail]

VII. Results and discussions

The proposed system integrates multiple modules to provide an efficient platform for waste identification and management. It enables secure user access, image uploading, and automatic classification into four categories: Hazardous, Recyclable, Organic, and Non-recyclable. Based on the results, the system provides suitable reuse and recycling recommendations and helps users locate nearby recycling centres. The eco-score and reward system encourages sustainable practices through points and activity tracking. Although challenges such as image quality and recycling centre data accuracy remain, the system demonstrates the potential of AI in improving waste segregation, promoting environmental awareness, and supporting sustainable waste management. The overall implementation highlights the potential of artificial intelligence in addressing waste management challenges and promoting environmental sustainability. Automated waste classification helps minimize manual identification errors and supports efficient waste segregation. The recommendation module increases user awareness by suggesting appropriate reuse and recycling practices. Furthermore, the integration of location-based services connects waste identification with accessible recycling facilities, while the eco-score and reward system encourages continued user participation in sustainable activities. However, certain challenges, such as variations in image quality, the availability and accuracy of recycling centre information, and system scalability, may affect overall performance. Despite these limitations, the proposed system offers a practical approach to improving waste management practices, strengthening environmental awareness, and supporting the principles of a sustainable circular economy.

VIII. Conclusion and Future Work

This system will show a simple approach for managing waste items with the help of AI models. This system will allow users to capture or upload image of the waste things after that AI model will analyses the waste items and identifies, give the category of that waste item. After identifying the waste item, it gives us that for which category that waste item is belongs to. After categorised it will suggest the two options like reuse and recycle. The main goal of this project is that not only to identifying the waste but also. It should guide users that correct action after identification. By providing the better reusable tips and recycling centres information. the system helps the users to make the better decisions about waste disposal. In the future AI Bin Brain application can also be enhanced with

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the more advanced features to make waste management easier and faster with more efficient. So, these improvements of the system will encourage the users to use daily and provide better solution and it will reach for more users. Mobile application: It used to develop a mobile app with easy image scanning and waste detection. Offline detection: This is help full for without online we can use the app like it will allow the basic waste classification without the internet connection. Multi language support: It will support for multiple languages so that more users can use the application easily.

References

[1] J. Bobulski and M. Kubanek, "Deep learning for plastic Waste Classification system," Applied Computational Intelligence and Soft Computing, vol. 2021, pp. 1–7, 2021. doi: 10.1155/2021/6626948. Cross Ref Google Scholar

[2]. Sidharth, R., Rohit, P., Vishagan, S., Karthika, R., & Ganesan, M. (2020, June). Deep learning based smart garbage classifier for effective waste management. In 2020 5th international conference on communication and electronics systems (ICCES) (pp. 1086–1089). IEEE. View Article Google Scholar

[3]. D. Khetarpal et al., "Trash Detection: Advanced Classification of Waste Materials Using ML Techniques," IEEE, pp. 1–6, 2024. doi: 10.1109/otcon60325.2024.10688146. View Article Google Scholar

[4]. Sunny, M. S. H., Dipta, D. R., Hossain, S., Faruque, H. M. R., & Hossain, E. (2019, May). Design of a convolutional neural network based smart waste disposal system. In 2019 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT) (pp. 1–5). IEEE. View Article Google Scholar

[5]. M. Malik et al., "Waste Classification for Sustainable Development Using Image Recognition with Deep Learning Neural Network Models," Sustainability, vol. 14, no. 12, p. 7222, 2022. doi: 10.3390/su14127222. CrossRef Google Scholar

[6]. W. Mao, W. Chen, C. Wang, and Y. Lin, "Recycling waste classification using optimized convolutional neural network," Resources Conservationand Recycling, vol. 164, p. 105132, 2020. doi: 10.1016/j.resconrec.2020.105132. CrossRef Google Scholar

[7]. O. Adedeji and Z. Wang, "Intelligent Waste Classification System using Deep Learning convolutional neural network," Procedia Manufacturing, vol. 35, pp. 607–612, 2019. doi: 10.1016/j.promfg.2019.05.086. CrossRef Google Scholar

[8]. Fahmi, M., Yudhana, A., & Sunardi, S. (2023). Image Processing Using Morphology on Support Vector Machine Classification Model for Waste Image. MATRIK: Jurnal Manajemen, Teknik Informatika dan Rekayasa Komputer, 22 (3), 553–566. CrossRef Google Scholar

[9]. P. R. Kshirsagar et al., "Artificial Intelligence-Based Robotic technique for reusable waste materials," Computational Intelligence and Neuroscience, vol. 2022, pp. 1–9, 2022. doi: 10.1155/2022/2073482. CrossRef Google Scholar

[10]. B. Fang et al., "Artificial intelligence for waste management in smart cities: a review," Environmental Chemistry Letters, vol. 21, no. 4, pp. 1959–1989, 2023. doi: 10.1007/s10311-023-01604-3. CrossRef Google Scholar

[11]. A. Ahmed and A. Asadullah, "Artificial intelligence and machine learning in waste management and recycling," Engineering International, vol. 8, no. 1, pp. 43–52, 2020. doi: 10.18034/ei. v8i1.498. CrossRef Google Scholar

[12]. Fu, B., Li, S., Wei, J., Li, Q., Wang, Q., & Tu, J. (2021). A novel intelligent garbage classification system based on deep learning and an embedded Linux system. IEEE access, 9, 131134–131146. View Article Google Scholar

[13]. F. R. Maulana, T. A. S. Weyant, Y. Pratama, and K. Mutijarsa, "Design and Development of Smart Trash Bin Prototype for Municipal Solid Waste Management," IEEE, 2018. doi: 10.1109/ictss.2018.8550013. View Article Google Scholar

[14]. Rahman, M. W., Islam, R., Hasan, A., Bithi, N. I., Hasan, M. M., & Rahman, M. M. (2022). Intelligent waste management system using deep learning with IoT. Journal of King Saud University-Computer and Information Sciences, 34 (5), 2072–2087. CrossRef Google Scholar

[15]. P. M. Jardosh, S. S. Shah, and P. J. Bade, "SEGRO: Key towards modern waste management," 2020 International Conference for Emerging Technology (INCET), 2020. Doi: 10.1109/incet49848.2020.9154113

[16]. A. Alou Rani, Abdullah, M. Usman Ashraf, and Mohammed Aloraini. "Smart waste management and classification system using advanced IoT and AI technologies." Peer Computer Science 11 (2025): e2777,2025.

[17]. Deverell, Dhanashree Vipul, and Pavinder Singh Mann. "Artificial Intelligence-Based Waste Management: A review of classification, techniques, issues, and challenges." Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery 15.2 (2025): e70025.

[18]. L. Yong, Liying, et al. "Application of MobileNetV2 to waste classification." Plops one 18.3 (2023): e0282336.

[19]. M. Trihardyansyah, Muhammad, M. Saifi, and Sundari Retno Adnani. "WASTE CLASSIFICATION USING TRANSFER LEARNING WITH MOBILENETV2 TO SUPPORT ENVIRONMENTAL MANAGEMENT." JITK (Journal Ilma Gengatharan dan Technology Computer) 12.1 (2026): 135-143.

[20]. G.-L. Huang, Guang-Li, et al. "A combination model based on transfer learning for waste classification." Concurrency and Computation: Practice and Experience 32.19 (2020): e5751.

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