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DEPOSITION OF WASTAGES USINGREVERSE VENDING MACHINE

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***Abstract*—The project involves the installation and operation of a reverse vending machine in a selected area, where users can deposit recyclable materials, such as plastic bottles and aluminum cans, and receive rewards in return. The study aims to evaluate the effectiveness of the reverse vending machine in reducing waste and promoting recycling behaviors among users.The application of AI and smart sensors in waste management can offer several advantages, including better waste management, improved recycling rates, and more effective tracking of waste. Convolutional neural networks (CNNs) can be used to identify different types of waste in real-time, using algorithms like RESNET50 to classify images. Protecting user information is important throughout the process. RFID point cards can be used to incentivize users to properly dispose of their waste by rewarding them with points. Ultimately, the use of AI and smart sensors in waste management has the potential to enhance waste management practices and promote sustainability. The project's expected outcomes include reducing waste in the selected area, promoting recycling practices, and raising awareness about the importance of sustainable waste management. The findings of the project will contribute to the existing literature on reverse vending machines and their potential for waste reduction and recycling.**

***Keywords*—** Reverse Vending Machine(RVM), RESNET50, RFID, Waste reduction,

I. INTRODUCTION

This paper will focus on the importance of recycling and waste management in addressing the global environmental challenges of waste pollution and resource depletion. It will introduce the concept of RVMs as a practical solution to incentivize recycling and encourage proper waste disposal. It will also emphasize the relevance of RVMs in promoting circular economy principles, where waste materials are recycled and reintegrated into the production cycle, reducing the need for raw materials extraction and waste generation.

The project will delve into the technologies used in RVMs, such as sensors, Arduino microcontrollers, sorting mechanisms, and image recognition models like RESNET-50, which enable efficient and accurate waste sorting and identification. It will highlight the benefits of using RESNET-50 in RVMs, including improved accuracy and speed in waste sorting, leading to higher recycling rates and reduced contamination.

The project's outcomes are expected to contribute to the existing literature on reverse vending machines and their potential for waste reduction and recycling. The results of this research project have the potential to offer useful information and understanding about how effective a particular technology is in reducing waste and encouraging recycling behaviors. Such insights could be valuable to individuals and groups involved in waste management, sustainability efforts, and policy-making.

II. RELATED WORK

Author: Nielsen, R.D. and Hagen, K. (2019)Title: Reverse Vending Machines for Used Beverage Containers: This systematic review provides an overview of the existing literature on reverse vending machines for used beverage containers. It discusses the technology, functionality, benefits, challenges, and environmental impacts of RVMs, and presents best practices from various case studies.

Author: Abu-Dalbouh, A., et al. (2020) Title: Reverse Vending Machines for Plastic Bottle Recycling: A Review of Design, Technology, and Innovation This review article focuses on the design, technology, and innovation of reverse vending machines for plastic bottle recycling. It discusses the different types of RVMs, including their functionalities, sorting mechanisms, and payment systems, and highlights the challenges and opportunities associated with RVM implementation.

Author: Zhu, Q., et al. (2018) Title: Reverse Vending Machine for Recycling Activities: This conference paper provides an overview of reverse vending machines for recycling activities. It discusses the technology, benefits, challenges, and social impacts of RVMs, and presents case studies from different countries. It also highlights the potential of using advanced technologies, such as IoT and machine learning, in RVMs.

Author: Fornasier, M.F., et al. (2017) Title: Reverse Vending Machines for Recycling: This review article provides a comprehensive analysis of the empirical evidence and research directions related to reverse vending machines for recycling. It discusses the effectiveness of RVMs in increasing recycling rates, user acceptance, and social impacts, and presents recommendations for future research and RVM implementation strategies.

Author: Rajput, D.S., et al. (2019) Title: Reverse Vending Machine: A Review on Challenges and Opportunities for Recycling: This research article reviews the challenges and opportunities associated with reverse vending machines for recycling. It discusses the technical, economic, and social challenges of RVM implementation, and presents opportunities for improving RVM performance, user behavior, and stakeholder collaboration.

III. Proposed Work

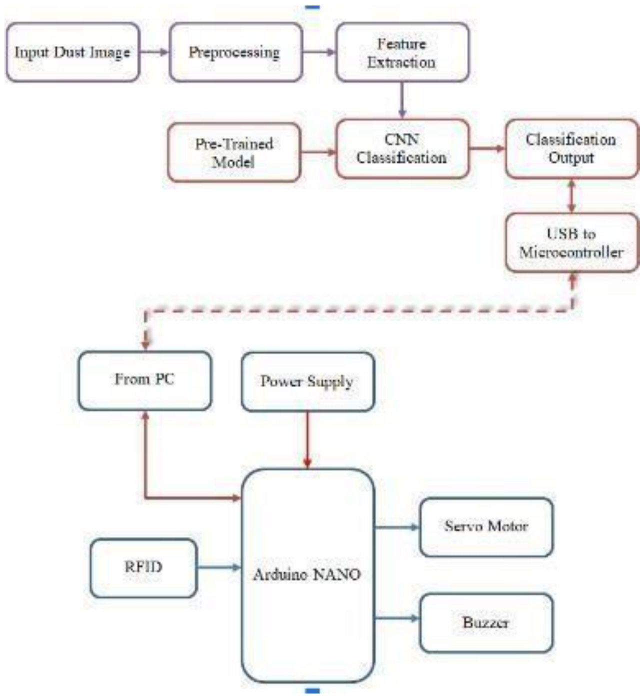
A. Methodology:

The system for the waste segregation bin consists of two functional components: Image Classification and Real-time Embedded System. The bin uses both of the modules to achieve the required operational results. The bin is also structurally divided into two sections, the Detection Section and the Segregated waste section. The system uses a camera to take a picture, which is then processed by the image classification system, which sends the trash to the detected section type. The detected section type is divided into the x-axis into two halves, each for the two major class labels, i.e., Biodegradable waste and Non-biodegradable waste.

Once the trash item is disposed into the device the sensors are starting to recognize the trash with help of a camera installed in the personal computer. The image classification occurs with the implementation of RESNET50 infrastructure-based Convolutional Neural Networks(CNN). The image classification is based on the predefined data set which models are trained on the Arduino microcontroller.

If trash is biodegradable, then the duty cycle of the servo motor, connected to the separator disk responsible for rotating the disk to sort out the waste into one of the two sections, is set to 12.5. Consequently, the motor rotates from the neutral state of duty cycle 7.5, which is 90 degrees, to 180 degrees, and in the biodegradable section. If trash is non-biodegradable, then the duty cycle of the motor is set to 2.5, which is 0 degrees, and the motor goes from 90 to 0 degrees to the non-biodegradable side. After 5 s, the motor rotates back to a neutral 7.5-duty cycle at 90 degrees. This is to ensure that the trash falls into the required section without failure.

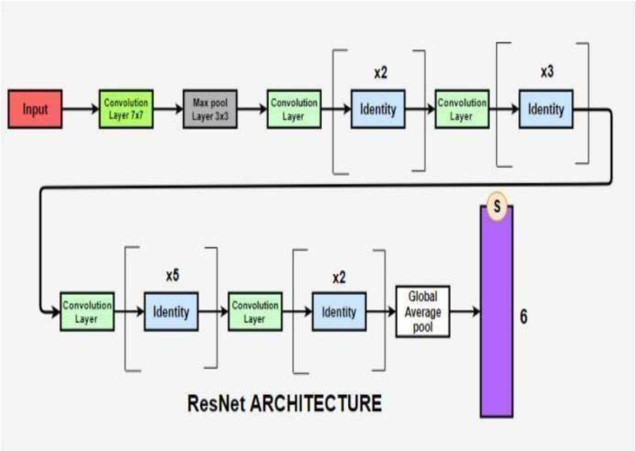
B. System Architecture:



C. RESNET50:

ResNet-50 is a convolutional neural network (CNN) architecture that was introduced by Microsoft Research in 2015. It is part of the ResNet50 (short for "residual networks") family of deep learning models, which are known for their ability to train very deep neural networks without suffering from the vanishing gradient problem, thanks to the use of residual connections.ResNet-50 specifically consists of 50 layers, hence the name "ResNet-50". It has a highly modular structure and is based on the concept of residual blocks. A residual block is a building block of the ResNet50 architecture that allows for the gradient to bypass one or more layers, enabling the network to learn residual mappings. This allows for the efficient training of very deep neural networks with improved accuracycompared to traditional architectures.

ResNet-50 architecture includes multiple stages of convolutional and pooling layers, followed by fully connected layers for classification. The network uses 3x3 convolutional filters for feature extraction, and it also includes bottleneck blocks, which use 1x1, 3x3, and 1x1 convolutional filters to reduce computational complexity while maintaining high accuracy. The output of the final fully connected layer is passed through a softmax activation function to produce class probabilities for image classification tasks. ResNet-50 has been widely used in various computer vision tasks, such as image classification, object detection, and image recognition, and has achieved state-of-the-art performance in many benchmark datasets. It has also been used as a base architecturefor many other variants of ResNet50, such as such as ResNet-101 and ResNet-152, which have even deeper architectures for a more challenging tasks.



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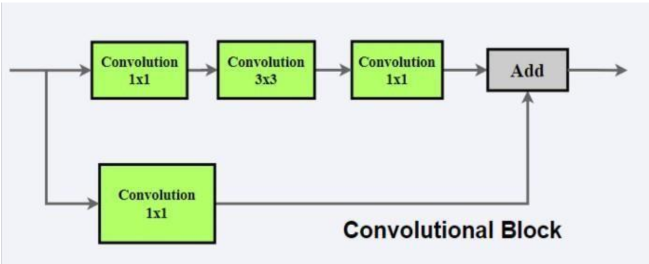

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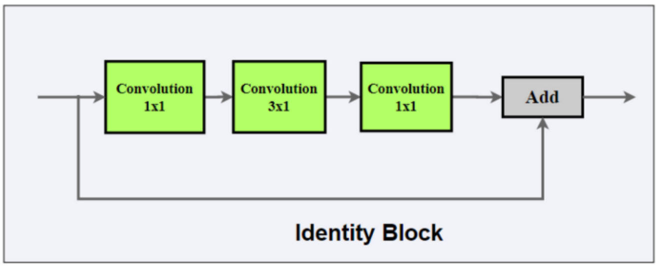


(c)

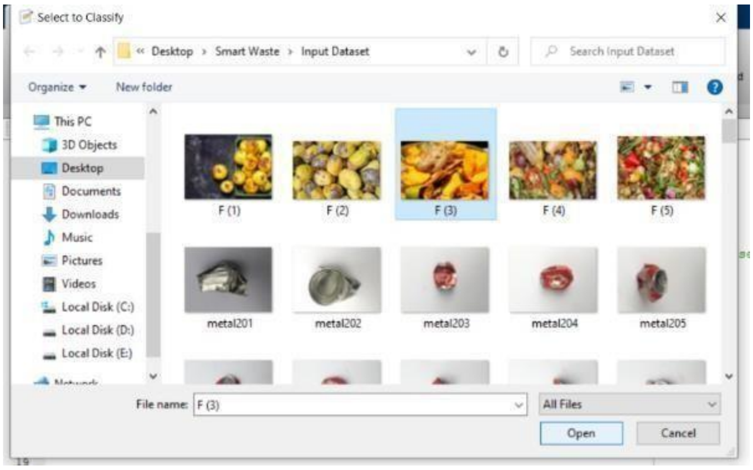
D. Hardware Components:

i. Arduino ATmega328 Microcontroller.
ii. RFID Tag and Reader.
iii. LCD Display.
iv. Servo Motor.
v. Buzzer.

E. Software Tools:

i. For Image Processing-MATLAB R2014a
ii. For Hardware Module-Arduino IDE

IV. RESULTS AND DISCUSSION



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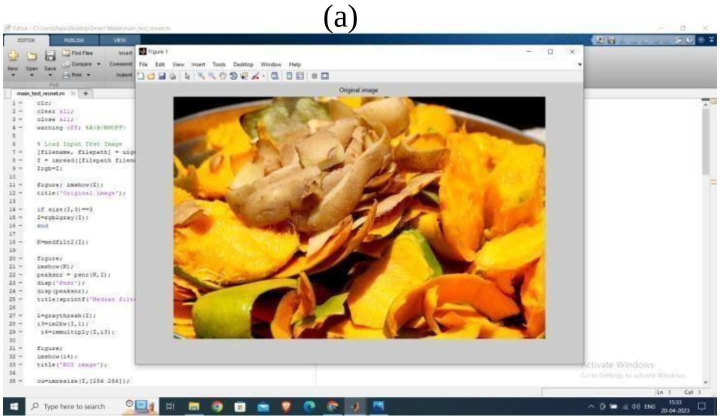

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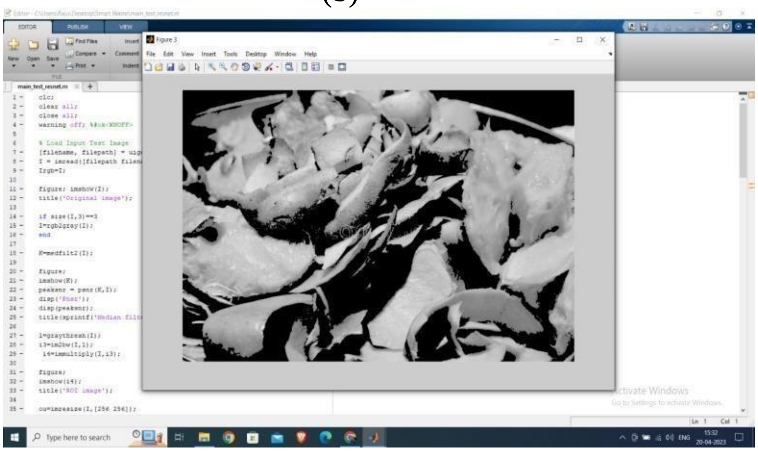

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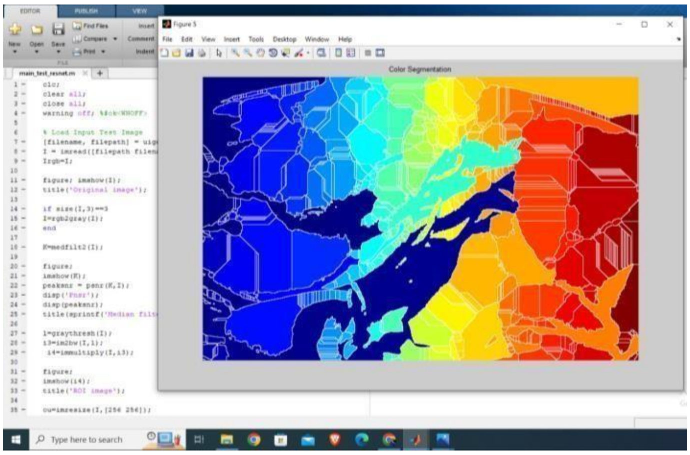

(d)

(e)

Above pictures shows how trash is classified using RESNET50. And then separated based on trash nature.

V. CONCLUSION

In conclusion, the implementation of a reverse vending machine project for the deposition of wastage has proven to be a successful and effective solution for promoting recycling and reducing environmental pollution. The use of reverse vending machines has provided a convenient and user-friendly method for individuals to deposit their recyclable materials, such as plastic bottles, cans, and other waste items, and receive incentives in return.

VI. REFERENCE

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