Abstract: This project presents a garbage classification system that uses Python, YOLOv8, and OpenCV to detect whether garbage is wet, dry, metal, or plastic through a webcam. The model is trained on a dataset of labeled images and uses transfer learning to improve its accuracy. Additionally, the system includes a feature that allows users to take images of garbage and classify them using the model. The system also includes an Arduino Uno microcontroller and a servo motor that opens the appropriate bin based on the classification output. The level of garbage can also be detected, and the data is stored in a firebase. Flask App would give the option as to garbage should be classified via image or webcam. This project could be used in waste management systems and smart cities to improve garbage sorting and reduce environmental impact.

Keyword: Waste Segregation, Yolo-v8, Firebase, Trained model

I. INTRODUCTION

The world is facing a serious challenge of waste management, with the increasing amount of waste produced every day. Proper sorting and disposal of waste can significantly reduce the negative impact of waste on the environment. To address this issue, we have developed a garbage classification system that can classify waste into wet, dry, metal, or plastic through a webcam. The system uses Python, YOLOv8, and OpenCV for image processing and classification. Additionally, the system includes a feature that allows users to take images of garbage and classify them using the model. The system also includes an Arduino Uno microcontroller and a servo motor that opens the appropriate bin based on the classification output. This project can be useful in waste management systems and smart cities to improve garbage sorting and reduce environmental impact.

II. PROPOSED SYSTEM

We have developed a garbage classification system that can classify waste into wet, dry, metal, or plastic through a webcam. The system uses Python, YOLOv8, and OpenCV for image processing and classification. Additionally, the system includes a feature that allows users to take images of garbage and classify them using the model. The system also includes an Arduino Uno microcontroller and a servo motor that opens the appropriate bin based on the classification output.

Dataset:
To train our garbage classification model, we used a dataset of images labeled with the correct class of garbage. The dataset contains images of wet and dry garbage, as well as images of metal and plastic waste. We used approximately 3000 images for training and 750 images for validation.

Model Architecture:
We used the YOLOv8 architecture for garbage classification. YOLOv8 is a deep learning model that uses a convolutional neural network (CNN) to detect objects in an image. It is an improvement over previous versions of YOLO, with a higher accuracy rate and faster processing speed.

We used the custom Dataset to train our YOLOv8 model. We used transfer learning to train our model, starting from a pre-trained YOLOv8 model on the COCO dataset.
Hardware device: - Hardware devices which are used in this project are Arduino Uno, servomotor, ultrasonic sensor, breadboard, jumper wires. After the object is being detected, the respected dustbin opens with the help of a servomotor.

Software used:- VS studio is used to make webpage, Pycharm is used to integrate the hardware components with the website. Flask is used for the classification of the image and sending the distance of ultrasonic. Firebase is used to fetch the data and display the level of the bin on the CleanCube.

III. SYSTEM IMPLEMENTATION

We implemented our garbage classification model using Python and OpenCV. We used the OpenCV library to preprocess the webcam output as well as image output and extract features for the YOLOv8 model. We also used the library to detect the location and class of the garbage in each image/webcam frame.

We then sent the classification output to an Arduino Uno microcontroller. The Arduino Uno controlled a servomotor that opened the appropriate bin based on the classification output. For example, if the garbage was classified as wet, the servomotor opened the wet garbage bin. The level of the bin would be sent to firebase and would be displayed in website.

IV. ANALYSIS AND RESULTS

Proposed system is implemented with the various technologies, the screen shots exhibit the layouts of its components.
In this project, we have developed a garbage classification system that uses computer vision and machine learning techniques to classify waste into different categories. The system provides an efficient and user-friendly solution to the problem of waste sorting, which can help reduce the negative impact of waste on the environment. We have successfully trained and tested the model on a dataset of labeled images and integrated it with an Arduino Uno microcontroller and a servo motor to open the appropriate bin based on the classification output. The system can also classify waste in images provided by users.

Our project has several strengths, including its accuracy, efficiency, and ease of use. However, there are also some limitations, such as the need for a large dataset and the potential for errors in the classification process. Nonetheless, we believe that our project can contribute significantly to the field of waste management and the environment.

There is scope for further development and improvement of the garbage classification system. Future work could include the following:

- Enhancing the accuracy of the model by incorporating more data and exploring other machine learning techniques.
- Expanding the classification categories to include other types of waste, such as hazardous waste or electronic waste.
- Integrating the system with other smart city solutions, such as waste collection and transportation systems.
- Exploring the potential for mobile applications that allow users to classify waste and track their waste disposal activities.

V. CONCLUSION AND FUTURE WORK
Conducting a comprehensive analysis of the system’s environmental impact and evaluating its effectiveness in improving waste management practices.

Overall, we believe that our project can contribute to a cleaner and healthier environment, and we hope that it can inspire further research and development in the field of waste management.

REFERENCES


