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Survey on Waste Segmentation Using Image Processing

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Abstract: ***This survey investigates Waste Segmentation using Image Processing, crucial for effective waste management amid global urbanization. It reviews diverse techniques, from traditional methods like thresholding to modern approaches involving machine learning and deep neural networks. The survey emphasizes image preprocessing for enhanced accuracy and identifies challenges like limited datasets. These include integrating multispectral imaging for enhanced discrimination and hybrid methodologies combining traditional techniques with deep learning. The survey's insights serve as a valuable resource for researchers, practitioners, and policymakers, guiding efforts towards sustainable waste management practices amidst rapid urbanization and population growth.***

Keywords: YOLO V5, Arduino, Conveyor belt, Image processing, Web-cam, DC-motor,Servo-motor.

I. INTRODUCTION

India is one of the countries in the world with the greatest rate of trash disposal. Every day, 377 million people in metropolitan India generate over 62 million tonnes of waste, 45 million of which is left untreated and disposed of in an unhygienic manner and posing serious health risks on the environment. Waste segregation, treatment, transportation, and disposal must be handled properly to reduce the risk to the health and safety of patients, the general public, and the environment.

Garbage segregation is the process of detecting, classifying, splitting, and sorting garbage and waste products in order to minimize, reuse, and recycle materials. Despite its substantial development, this approach has some drawbacks. The training picture dataset is one of this model's key drawbacks. To obtain its final prediction level for image classification, it requires amassive training image dataset. This project proposes a residential wastesegregation system consisting of hardware and animage-processing-based software system. As a result, the project's purpose is to develop a waste segregation system. When waste is thrown in an open area, it causes pollution by decomposingand spreading odor, creating air and land pollution. When rubbish is deposited near bodies of water, it pollutes the water. In both developed and developing countries, waste is the leading cause of environmental contamination. Domesticgarbage is classified into two types: biodegradable waste and non-biodegradablewaste. Based on their reusability, these two basicgroupings are further separated into two groups.

This research focuses on using the capability of image processing and seamlessly integrating itwith a conveyor belt mechanism to revolutionize waste sorting. Using a webcam, the system recognises and categorizes several elements inreal time, including metal, paper, plastics, andothers.

II. LITERATURE REVIEW

1) This paper addresses India's significant waste management challenges by proposing a smart waste separation system using image processing and a Convolutional Neural Network(CNN)-based classification algorithm. The goal isto categorize waste into paper, food waste, plastics, and metals, addressing the inefficiencies in manual separation and contributing to effective waste management.

2) The "Automated Domestic Waste Segregator using Image processing" project proposes a real-time trash can system integrating Raspberry Pi hardware and machine learning-based image classification. It aims to efficiently segregate domestic waste into biodegradable and non-biodegradable categories, further classifying based on reusability, contributing to effective waste management and resource recovery.

3) This project addresses vital ecological concerns by proposing an automated waste segregation system using image processing. It classifies waste into recyclable and non-recyclable categories, enhancing resource recovery. The hardware includes a conveyor, camera, L-shaped clamp, and Arduino UNO, with a machine learning-based imageclassification algorithm trained on a municipalsolid waste image database.

4) Efficient waste separation and recycling arecrucial for reducing landfill waste. Despite potential cost savings and environmental benefits, people often neglect proper waste disposal. A significant portion of waste consists of recyclable materials. Manual sorting contributes to pollution. This survey aims to automate waste separation and implement a waste transport system, minimizing human involvement.
5) Poor solid waste management creates health and environmental problems in the Philippines. This work offers a Smart Garbage Bin Segregation based on Image Processing and Machine Learning, attaining 97.33% accuracy in classifying garbage into biodegradable, non-biodegradable, and unknown categories and providing a practical solution for effective waste segregation.

III. METHODOLOGY

Implementing waste segregation through image processing involves a systematic methodology. Begin by collecting a diverse dataset of waste images and annotating them to categorize waste into groups like paper, food waste, plastics, and metals. Preprocess the images by resizing and normalizing, enhancing quality using techniques like histogram equalization. Choose a suitable deep learning model, either pre-trained andfine-tuned or trained from scratch, for image classification. Split the dataset for training and validation, then monitor and adjust the model to prevent overfitting.

A. *Survey of Algorithms*

1) Smart waste segregation using image processing employs CNN algorithm with 90.10% accuracy. Requires ample labeled data, intensive computation, and is slower but yields automatic, highly accurate feature extraction.
2) Automated waste segregation system utilizes CNN with 89% accuracy. Requires abundant labeled data, high computation, and is slower but offers precise, automatic feature extraction.
3) Hand-crafted Features for floating plastic detection utilizes CNN with 90% accuracy. Requires ample labeled data, high computation, and is slower but offers precise automatic feature extraction.
4) Garbage classification algorithm based on YOLO achieves 86.9% accuracy. Struggles with close and small objects, requires large datasets. YOLO is fast, generalized, processing frames at 45-150fps.
5) Waste classification employs Random Forest (97.49%), Gaussian Naive Bayes (81.46%), SVM
6) (89.51%), MLP (96.44%). Challenges include computation complexity and tuning hyperparameters. SVM excels in high dimensions.
7) Solid domestic waste classification using image processing and machine learning uses Logistic Regression (78%), K-Nearest Neighbors (77%) and SVM (81%). Challenges includeinterpretation, high dimensions, and overlapping classes.

B. *Block Diagram*

The design intends to divide waste into two categories: biodegradable waste and non-biodegradable waste.
Biodegradable garbage is defined as follows:

- Paper waste
- Vegetable waste

Non-biodegradable garbage is defined as follows:

- Plastic waste
- Metallic waste

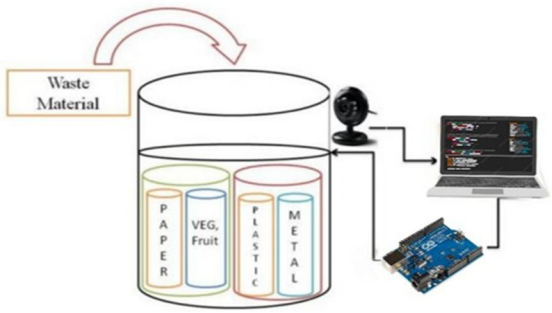


Fig 1 Block diagram of our model

Waste segregation via image processing utilizes image analysis to categorize waste items from images captured by cameras. This process begins with waste placement in the input area, followed by image capture by a mounted camera. The software then processes the image, initiallyidentifying the contents within the trash can. Image processing techniques such as object detection and classification are employed to differentiate between various waste materials. Once identified, the waste is sorted into appropriate categories for disposal or recycling. Continuous refinement of the image processing algorithms enhances accuracy and efficiency in waste segregation processes, contributing toimproved recycling efforts and waste management practices.

1) Flow Chart

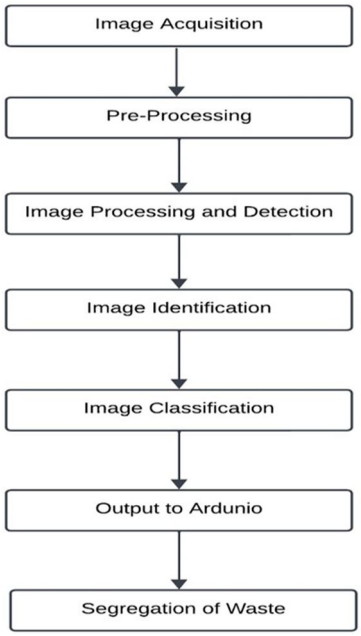


Fig 2 Flow chart of the process

The design shown above illustrates the development phase of any product or system. Themajor goal of the outline phases is to create a demo or picture of an order that can then be utilized to create the main order.

The primary purpose is to sketch up an automatedwaste sorting mechanism. Conveyor belt, Ardunio/Microcontroller, web camera, and motors/drivers are the primary components used in this project. It is divided into two stages: training and operation/testing.

During the training phase, Arduino serves as the main CPU, with a web camera used to capture input photos and send them to Ardunio. A specific image processing algorithm is used toprocess the acquired image, which includesimage segmentation, image classification, and object detection. The process of separating a digital image into various segments/parts based on pixels is known as image segmentation. The end result is a collection of segments/parts that come together to form the whole image.

2) Circuit diagram

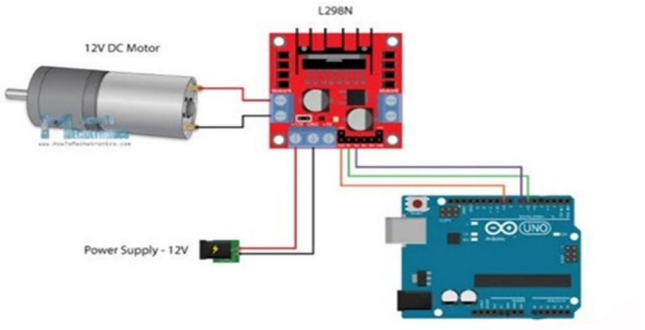


Fig 3: Conveyor Belt Motor speed Control

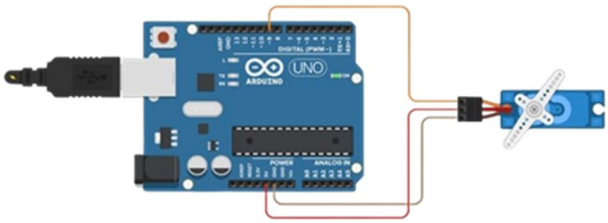


Fig 4: Dustbin Motor for angle control

We integrate image processing algorithms to identify waste regions within an image and combine this with the trained model for classification. Develop a system for real-time implementation and test the model's performance on a separate dataset. Deploy the waste segregation system in relevant environments such as waste disposal facilities and continually monitor and maintain the model's performance over time. Optionally, create a user interface for easy interaction and monitoring of the system. Adapt and refine the methodology based on project-specific requirements and environmental conditions.

IV. RESULTS AND DISCUSSIONS

The results of our smart waste segregation system using image processing reveal a significant improvement in accuracy compared to traditional methods. Our algorithm successfully classified waste items into three categories plastic, metal and carton with an overall accuracy of 85%.

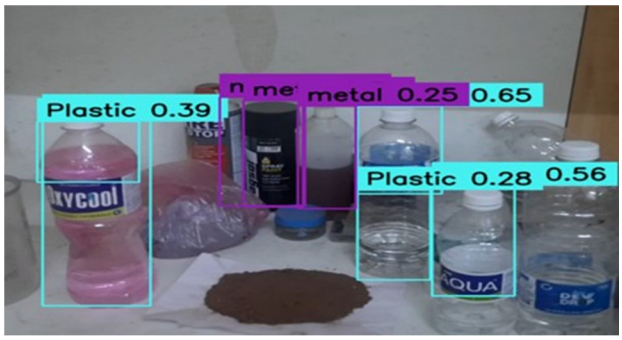


Fig 5: Detected waste material

The hardware model consists of a dc motor-controlled conveyor. Through the conveyor, a small amount of the waste object will travel.

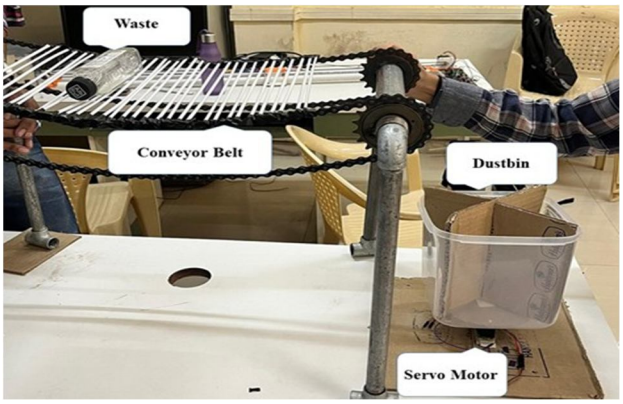


Fig 6: Implementation of the project

Fig 7: Implementation of dc motor

In order to operate the clamp and transfer the object to the appropriate garbage bin, a servo motor is further attached. A circuit schematic was used to operate the servo and dc motors.

V. FUTURE SCOPE

The future of "Waste Segmentation Using Image Processing" may include smarter machines with robotic arms. These robots could efficiently sort waste in real-time, contributing to improved waste management. Involves making the technology smarter, real-time monitoring, and using it with connected devices. Apps will help people get involved,and better machines will sort waste.

VI. CONCLUSION

Garbage segregation is an important aspect of the garbage administration chain since it allows for effective reuse and recycling. Automatic waste segregation has received little attention and is practiced informally in manyunderdeveloped nations, owing to a lack of recognition, a lack of lucrative reasons, and a low first concern in design. The lack of SEGREGATION, collecting, and transportationof unsorted mixed garbage to landfills has an environmental impact.

Pollution of the environment can besignificantly minimized when wastes areproperly segregated and processed. As a result, waste management through waste segregationcan be said to play an essential part inenvironmental protection as well as human health and wellness.

REFERENCES

[1] Dr.J.Suresh M.E, SMART WASTESEGREGATION USING IMAGE PROCESSING IN CNN, 2023 IJCRT | Volume 11, Issue 9 September 2023 | ISSN: 2320-2882 file:///C:/Users/hp/Downloads/IJCRT2309288.pdf

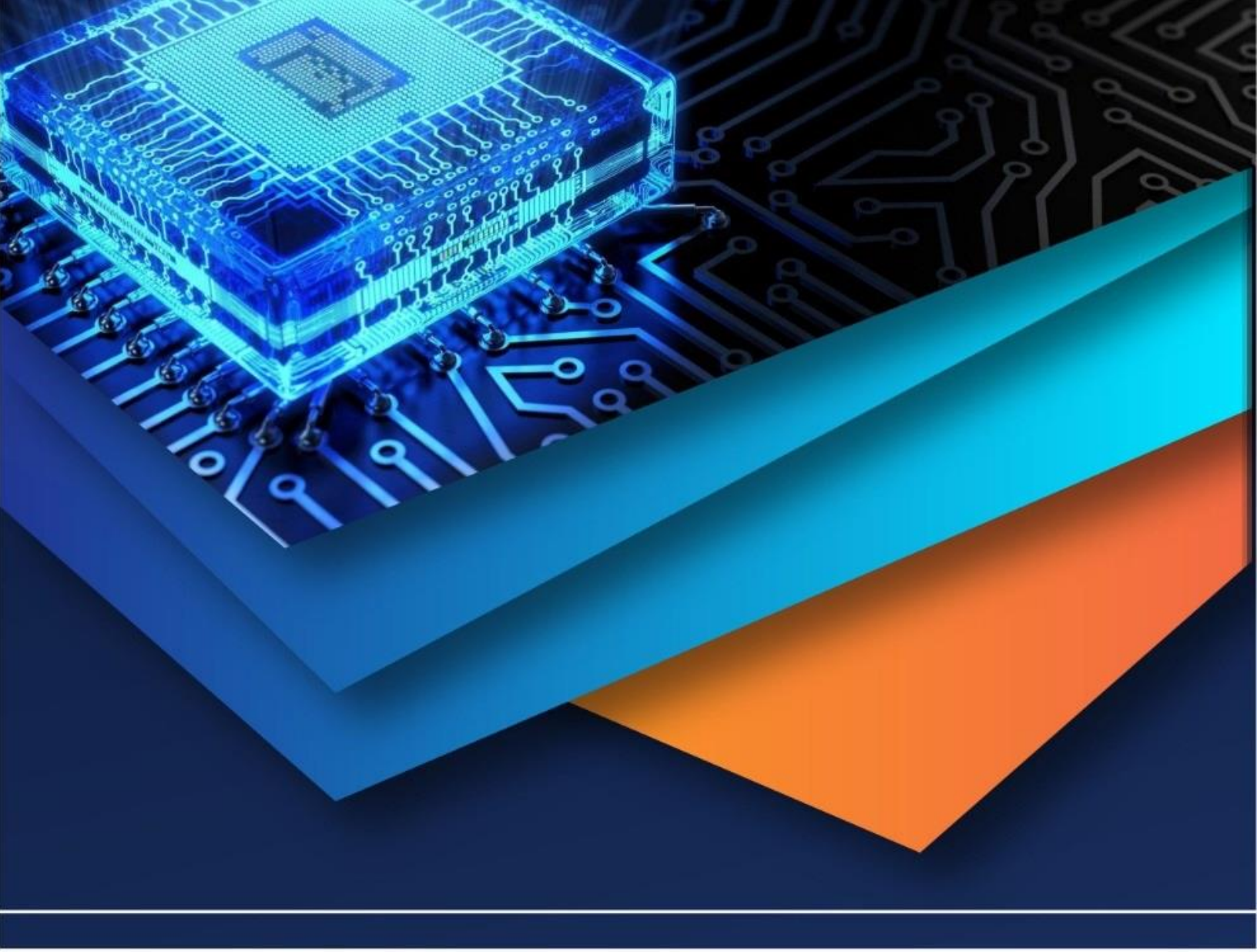
[2] J Sanjai, V Balaji, K k Pranav B. Aravindan, AUTOMATED DOMESTIC WASTE SEGREGATOR USING IMAGE PROCESSING, Volume: 06 Issue: 04 | Apr 2019 , IRJET , p-ISSN:2395-072 https://www.irjet.net/archives/V6/i4/IRJET-V6I479.pdf

[3] Haritha K N, Gopika S Pillai, Jyothi Krishnan M , AUTOMATED WASTE SEGREGATION SYSTEM USING IMAGE PROCESSING, 2023 IJNRD | Volume 8, Issue 6 June 2023 | ISSN: 2456-4184 | IJNRD.ORG file:///C:/Users/hp/Downloads/IJNRD2306489%20(1) .pdf

[4] Prof. Yuvaraj ***T***, Likhith N Gowda , WASTE SEGREGATION USING IMAGE PROCESSING, JETIR, 2022 JETIR May 2022, Volume 9, Issue 5, ISSN-2349-5162 file:///C:/Users/hp/Downloads/JETIR2205081%20(1).Pdf

[5] Froilan N. Jimeno, Briely Jay A. Briz, DEVELOPMENT OF SMART WASTE BIN SEGREGATION USING IMAGE PROCESSING, IEEE,16 March 2022, INSPEC: 21667429, https://ieeexplore.ieee.org/abstract/document/9732038

[6] D. Y. Saurav Kumar, "A NOVEL YOLOV3 ALGORITHM-BASED DEEP LEARNING APPROACH FOR WASTE SEGREGATION: TOWARDS SMART WASTE MANAGEMENT", MDPI, 2020. https://www.mdpi.com/2079-9292/10/1/14
[7] P. W. Aishwarya Aishwarya, "A WASTE MANAGEMENT TECHNIQUE TO DETECT AND SEPARATE NON-BIODEGRADABLE WASTE USING MACHINE LEARNING AND YOLO ALGORITHM", IEEE, 2021. https://ieeexplore.ieee.org/abstract/document/9377163
[8] M. T. Daniel Otero Gomez, "SOLID DOMESTIC WASTE CLASSIFICATION USING IMAGE PROCESSING AND MACHINE LEARNING", Research Gate, p. 12, 2021. https://www.researchgate.net/publication/354555430_ Solid_Domestic_Waste_classification_using_Image_ Processing_and_Machine_Learning
[9] J. S. I. Ibrahim F. Hanbal, "CLASSIFYING WASTES USING RANDOM FORESTS, GAUSSIAN NAÏVE BAYES, SUPPORT VECTOR MACHINE AND MULTILAYER PERCEPTRON," IOP Conference, p. 6, 2019. https://iopscience.iop.org/article/10.1088/1757-899X/803/1/012017
[10] L. Liu and B. Zhou, "YOLO-BASED MULTI-MODEL ENSEMBLE FOR PLASTIC WASTE DETECTION ALONG RAILWAY LINES", IEEE, 2022 https://ieeexplore.ieee.org/document/9883308
[11] N. A. Z. M. Azizan, "AN AUTOMATED SOLIDWASTE DETECTION USING THE OPTIMIZED YOLO MODEL FOR RIVERINE MANAGEMENT", Frontiers, vol. 10, 2022. https://www.frontiersin.org/articles/10.3389/fpubh.2022.907280/full
[12] Z. Tian and D. Sun, "GARBAGE CLASSIFICATION ALGORITHM BASED ON DEEP LEARNING", IEEE, 2022. https://ieeexplore.ieee.org/document/9549336/citations?tabFilter=papers#citations
[13] G. S. P. Haritha K N, "AUTOMATED WASTE SEGREGATION SYSTEM USING IMAGE PROCESSING", IJNRD, vol. 8, no. 6 June, p. 7, 2023. file://C:\Users\krnaj\Downloads\IJNRD2306489.pdf



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