

Automated Waste Segregation using Machine Learning

Shravan K R¹, Shreya S Emanti², Shreyas G³, Tejas S⁴, Pushpaveni H P⁵

⁵Assistant Professor(M. Tech), ^{1,2,3,4,5}Department Of Computer Science and Engineering,
^{1,2,3,4,5}Dr. Ambedkar Institute of Technology, Bengaluru, Karnataka, India

Abstract - The current Indian government has begun various tasks for propelling sanitation and neatness. Megacities in India, for instance, Ahmedabad, Hyderabad, Bangalore, Chennai, Kolkata, Delhi, and more importantly Mumbai have a dynamic monetary development and high wastage per capita. Some issues and difficulties like the absence of gathering and isolation at source, shortage of land, dumping of e-Waste, and so on. The present waste collection framework collects a wide range of waste in an unsorted way by utilizing physical work. The separation of this waste is an extraordinarily redundant, repetitive, and inefficient endeavor, which is numerous a period perilous to the sufficiency of the authorities. In this manner, there is a requirement for a framework, which robotizes the strategy of waste separation, with the objective that the waste transfer can be executed viably and profitably. The proposed model utilizes machine learning strategies such as CNN to accurately characterize the objects into different categories. The grouped waste can be isolated into different classifications using rotating bins. The automated order along these lines helps during the time spent on sanitation. The ordered waste can be additionally arranged and handled by the businesses for recycling. This impacts the computerized transfer framework to work rapidly and productively. This model can be scaled up to a cutting-edge level with the objective that it can be utilized as a part of semi-urban and urban domains.

Key Words: Transfer Learning, Renesas Microcontroller, Waste Segregation, Deep Learning, Python, Image Processing

1. INTRODUCTION

The framework relies upon the Machine learning domain and it is to make a whole self-administering seclusion framework in semi-urban and urban areas. The field of Machine learning is stressed over the subject of how to create computer programs that consequently improve with inclusion. Lately, numerous effective machine-learning applications have been created, going from information mining programs that figure out how to recognize beguiling charge card exchanges, to data separating frameworks that take in customers' examining tendencies, to automatic vehicles that figure out how to drive on open interstates [1]. Waste arranging can happen physically at the family and assembled through some gathering plans, or consequently separated by mechanical natural treatment frameworks.

Waste segregating is the procedure by which waste is separated into various components. Dry waste incorporates paper, plastic, glass, metal, cloth, and wood. Wet waste, commonly implies natural waste for the most part produced by eating foundations and is overwhelming in weight because of soggy. Waste can similarly be isolated on-premise of biodegradable or non-biodegradable waste. Waste is accumulated at its source in each zone and segregated. Populace blast, combined with an enhanced lifestyle of people, brings about expanded age of strong squanders in urban and furthermore rural locales of the country. In India like each and every other division, there is a stepped capability between solid waste from urban and nation zones. In CNN innovation is utilized to order the protest from the identified articles gathered from the movement identifier [2]. As it is very difficult to build and train a new CNN model with less data, we can use the method of transfer learning where we select a neural network which is already trained on the similar dataset and train it on our dataset so that the previously learned features by the neural network will be transferred to the new model which results in higher accuracy even for small datasets [3][4][5]. This paper portrays computer vision and example acknowledgment method using the descriptor and the correlation with the picture acknowledgment by utilizing profound learning.

"Automatic Garbage Collector Robot Model" this investigation paper intends to layout and makes AGATOR[6] (Automatic Garbage Collector), a rotor robot displays as programmed city worker to counter aggregation of junk in the stream which has no stream reasonably and proficiently. Two well-known learning algorithms are utilized namely deep learning using CNN and Support Vector Machines(SVM). Convolution Neural Networks has had a great impact on pattern recognition. The proposed idea is to make an autonomous system that segregates the waste. The system segregates the waste utilizing CNN algorithm in machine learning [7][8]. The algorithm detects and classifies the waste as indicated by the dataset provided to CNN [9][10]. The algorithm accordingly classifies the waste as different categories of waste. As mentioned the given system utilizes microcontrollers and sensors to segregate the waste

directly whereas we look forward to first classify the waste and reduce the use of bigger hardware components. The result is then processed to the hardware components of the system where Renesas microcontroller is being used to dump the waste in the bins [11].

2. BLOCK DIAGRAM

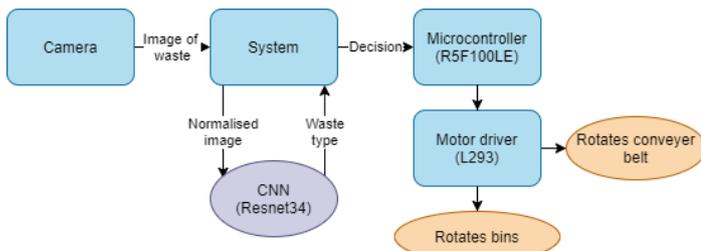


Figure 1: Block Diagram of the model

3. WORKING

Our prediction model is trained to categories 5 types of waste i.e., paper, cardboard, glass, plastic and metal. Hardware components includes camera used to take picture of the waste item to be segregated, processor to predict the type and send appropriate signal to the microcontroller which moves the conveyer belt and the bins such that the waste item is segregated properly.

First a picture of the waste object which needs to be categorized is taken. This image is sent to the processor where the image is sent to a CNN network which is trained to categories the input image into paper, cardboard, glass, plastic or metal. The CNN network will give predictions of the image for all these 5 categories ranging from 0-1. Whichever category get high prediction, that category is the predicted category of the input image. According to this prediction, appropriate signal is sent to a microcontroller. This will control the movement and rotation of conveyer belt and the bins. In our model we have three bins two of which are assigned to different type of waste (for example, plastic and paper) which can be changed at any time and the remaining bin will be marked as other. If the signal received by the microcontroller specifies waste type which is allotted to any bin, the bins will rotate such that the bin allotted to the predicted waste type is in front of the conveyer belt otherwise, the bin allotted for 'other' category will be moved in front of the conveyer belt such that the object is segregated into its respective bin.



Figure 2 Bins for segregating waste

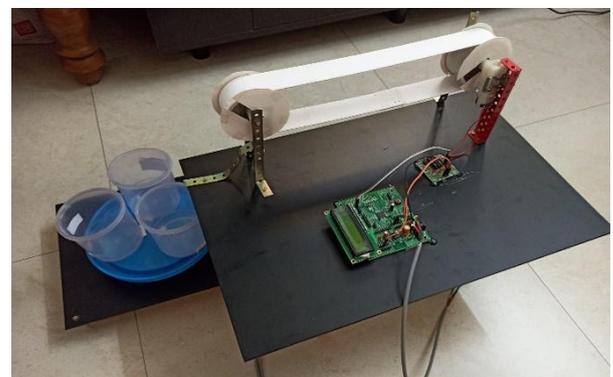


Figure 3 Automated waste segregation model

4. SOFTWARE SPECIFICATIONS

➤ Python

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It utilizes English catchphrases frequently whereas other languages use punctuation. It also has fewer syntactical constructions compared to other languages. There are a lot of situations where it is the best data science tool for the job. It is immaculate when data analysis tasks involve integration with web applications or when there is a need to fuse statistical code into the production database. The undeniable programming nature of Python makes it an ideal language for implementing algorithms. Its packages are rooted in specific data science jobs. Packages like NumPy, SciPy, and pandas produce great outcomes for data analysis jobs. While there is a requirement for illustrations, Python's matplotlib rises as a decent package, and for machine learning tasks, scikit-learn turns into the perfect substitute [12][13][14].

➤ CubeSuite+

The CubeSuite+ integrated development environment provides effortless, security, and convenience of use in developing software through iterative cycles of editing, building, and debugging. The basic software tools can be used for developing software for Renesas MCUs immediately after the initial installation. CS+ is also amicable with Renesas hardware tools including the E2 and E1 on-chip debugging emulators (sold separately), which facilitates advanced debugging. Abundant extensions and functions for client support guarantee a reliable environment for all users [15].

5. HARDWARE COMPONENTS

- Renesas Microcontroller - R5F100LE
- L293 Motor Driver
- LCD
- DC Motor (12 Volt)
- USB to TTL Converter – PP210
- Power Supply Adapter (12V, 1A)

6. RESULTS

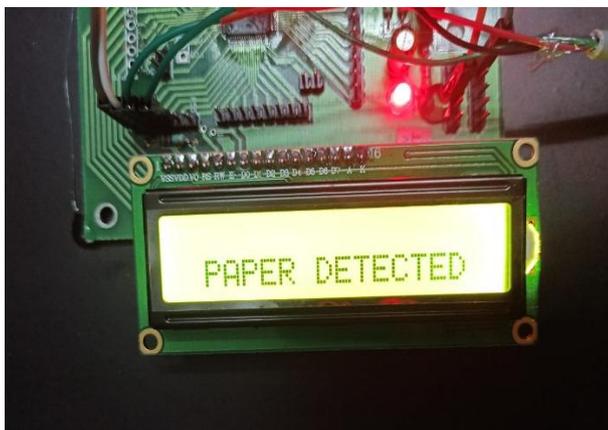


Figure 4 LED displaying type of waste



Figure 5 Waste segregated in its respective bin

As shown in the images, when the model detects a particular type of waste, LED will display respective message and then the object will be dumped into the bin by conveyer belt. We can also see that from the below confusion matrix, accuracy of the model is very good as most of the predictions on the validating set are true which means there is a high probability that the model will perform well in production environment also.

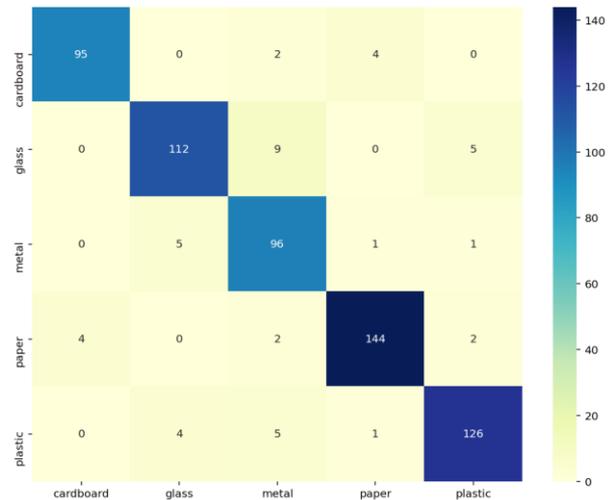


Figure 6 Confusion matrix

7. ADVANTAGES

- As this model segregates waste automatically without any human intervention, this method can be very useful in handling toxic waste which can pose a huge risk on human life.
- Using this method in the initial stage of garbage collection will help in recycling most of the garbage which is collected and reduces the large collection of garbage in landfills.
- As the model gets new images every day, it can be used to train the model hence accuracy of the system increases day by day.

8. CONCLUSIONS

This paper aims to provide an easy and cost-effective solution in handling problems in waste management. It uses a powerful CNN network to categorize different wastes. As the model will be learning every day with new data, it can commit less errors compared to segregation done by human hands.

Our model can detect five categories of waste through image processing then microcontroller controls the bin and conveyer belt movements and the waste will be dumped in

its respective bin without any human intervention. Hence the model can work on its own all day which can help in clearing out large dump yards faster.

This paper gives a solution for situations where large quantities of waste with different types are to be segregated and the objects can be categorized by look only. In situations like these, an automated waste segregator can do the work without any effort and with high efficiency and accuracy and human effort can be diverted into more difficult segregation tasks which can help in getting control of the waste we produce and properly handle them.

ACKNOWLEDGEMENT

This research was permitted and encouraged by our Institution, Dr. Ambedkar Institute of Technology. We thank all the people responsible for the same. We further thank our HOD, Dr. Siddaraju, who has provided valuable insight that greatly assisted the research. We would also like to show our immense gratitude to our respective families for their constant support through their affection and care during the research period.

REFERENCES

- [1] Dymitr PIETROW and Jan MATUSZEWSKI Military University of Technology, Warsaw 00-908, Poland, 2018 - "OBJECTS DETECTION AND RECOGNITION SYSTEM USING ARTIFICIAL NEURAL NETWORKS AND DRONES"
- [2] Mahbub Hussain, Jordan J. Bird, Diego R. Faria, 2018 - "A STUDY ON CNN TRANSFER LEARNING FOR IMAGE CLASSIFICATION"
- [3] Manali Shaha, Meenakshi Pawar, 2018, - "TRANSFER LEARNING FOR IMAGE CLASSIFICATION"
- [4] J.Talukdar, S.Gupta, P.S. Rajpura, R.S.Hegde, 2018 - "TRANSFER LEARNING FOR OBJECT DETECTION USING STATE-OF-THE-ART DEEP NEURAL NETWORKS"
- [5] Karl Weiss, Taghi Khoshgoftaar, DingDing Wang, 2016 - "A SURVEY OF TRANSFER LEARNING"
- [6] Osiany Nurlansa, Dewi Anisa Istiqomah, and Mahendra Astu Sanggha Pawitra, Member, IACSIT, 2014 - "AGATOR (AUTOMATIC GARBAGE COLLECTOR) AS AUTOMATIC GARBAGE COLLECTOR ROBOT MODEL"
- [7] Yushi Chen, Member, IEEE, Hanlu Jiang, Chunyang Li, Xiuping Jia, Senior Member, IEEE, and Pedram Ghamisi, Member, IEEE - "DEEP FEATURE EXTRACTION AND CLASSIFICATION OF HYPERSPECTRAL IMAGES BASED ON CONVOLUTIONAL NEURAL NETWORKS"
- [8] Jitendra Malik, Berkeley Serge Belongie, Berkeley Thomas Leung, Berkeley Jianbo Shi from University of California, Berkeley - " CONTOUR AND TEXTURE ANALYSIS FOR IMAGE SEGMENTATION "
- [9] <https://github.com/collindching/Waste-Sorter>
- [10] <https://www.kaggle.com/asdasdasdas/garbage-classification>
- [11] M.K.Pushpa , Aayushi Gupta , Shariq Mohammed Shaikh , Stuti Jha , Suchitra V Associate Professor, Department of Electronics and Instrumentation Engineering, MSRIT, Bengaluru, India, 2015 - "MICROCONTROLLER BASED AUTOMATIC WASTE SEGREGATOR"
- [12] <https://towardsdatascience.com/transfer-learning-from-pre-trained-models-f2393f124751>
- [13] <https://towardsdatascience.com/object-detection-and-tracking-in-pytorch-b3cf1a696a98>
- [14] <https://towardsdatascience.com/an-introduction-to-computer-vision-using-transfer-learning-in-fast-ai-aircraft-classification-a2685d266ac>
- [15] <https://www.renesas.com/us/en/products/software-tools/tools/ide/csplus.html>