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AUTOMATED WASTE MANAGEMENT SYSTEM

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Abstract - *many areas are facing problems in waste management due to the huge growth of population in cities, causing huge amount of waste generation. Increases in time and more and manpower is required so as to sort waste using the normal process. Sorting waste are often drained various methods and forms. Analyzing and classifying the rubbish using image processing will be a really productive thanks to process waste materials. This project may be attempt of making a waste segregation mechanism with minimal cost and with minimal human intervention of household level with the help of convolution neural network (CNN) algorithm. The model identifies the waste as either biodegradable or non- biodegradable and segregate waste into separate bins. The classification and segregation happen in real time which helps to scale back overall human efforts and reduces cost of overall process.*

1. INTRODUCTION

Segregation of waste materials is important for a sustainable society. Initially, segregation required use of hands for separating waste. This became tedious once the number of wastes increased as population increased. there's a desire for something which could automatically sort the waste. this can be efficient since the workers don't sort the waste fully. Waste segregation implies segregating waste into dry and wet. Dry waste contains wood, plastic, metal and glass. Wet waste, commonly alludes to natural waste for the foremost part produced by eating foundations and are overwhelming in weight thanks to sogginess. Waste can likewise be isolated on premise of biodegradable or non-biodegradable. during this paper, Convolutional Neural Network (CNN) is proposed for classification of common wastes into six different waste types. Using CNN together with the dataset which are regularly updated, the system will be used at a minimum level which can help separate the waste materials. the thought is to spot the item before of the bin, run it through the dataset available to the system and so open the dustbin for the desired garbage object.

2. CNN

A Convolutional Neural Organization is a Profound Learning calculation which can take in info picture, relegate significance to different articles in the picture and ready to separate between pictures. CNNs are utilized for picture characterization and acknowledgment on account of its high precision. The CNN follows a various leveled model which chips away at building an organization, similar to a pipe, lastly gives out a completely associated layer where every one of the neurons are associated with one another and the result is handled. A convolutional neural organization is a sort of fake neural organization utilized in picture acknowledgment and handling that is explicitly intended to deal with pixel information. A neural organization is an arrangement of equipment as well as programming designed after the activity of neurons in the human mind.

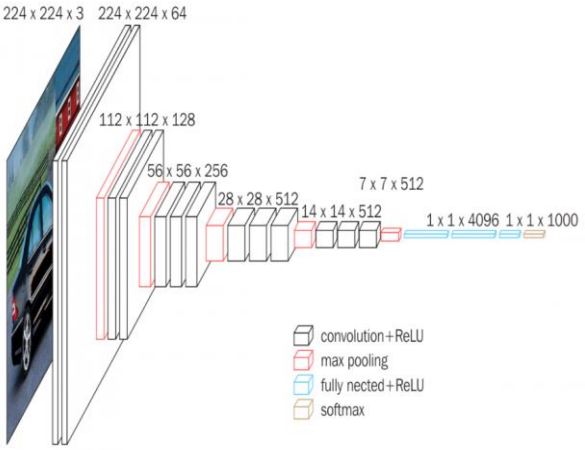

Fig -1: Architecture of Vgg16

VGG16 could be a convolution neural net architecture which was wont to win ILSVR competition in 2014. it's considered to be one in every of the superb vision model architecture till date. most unusual thing about V0tuiGG16 is that rather than having an oversized number of hyper-parameters they focused on having convolution layers of 3x3 filter with a stride 1 and always used same padding and maxpool layer of 2x2 filter of stride 2. within the end it's 2 FC followed by a SoftMax for output. The 16 in VGG16 refers thereto has 16 layers that have weights. This network may be a pretty large network and it's about 138 million parameters.

2.1 Data Augmentation and pre-processing

Picture characterization research datasets are normally exceptionally huge. Regularly, arbitrary trimming of rescaled pictures alongside irregular level flipping and irregular RGB tone and brilliance shifts are utilized. Various plans exist for rescaling and trimming the photos Multi-crop assessment during test time is moreover frequently utilized, albeit computationally costlier and with restricted execution improvement. Point of the irregular rescaling and trimming is to discover the significant highlights of each article at various scales and positions. Keras doesn't carry out those information increase strategies out of the crate, however they will effectively execute through the pre-handling capacity of the ImageDataGenerator modules. Different capacities on pictures at least expensive pace of reflection whose objective is to help the photos dataset that overcome undesired distortion or increment some picture data significant for next handling is thought as Imagepre-handling. Pre-handling's important job is to initiate the least complex outcome. Under this, we can perform different activities which are as per the following: group size, rescale, marks, picture size, shear-range, zoom-range, and so forth

2.2 Dataset

Dataset carries with it different classes, it's classified into differing kinds like Glass, Paper, Metal, Plastic, Cardboard. it's important to coach the model to urge best accuracy. Initially, it's labeled and sequential of images have taken place. Further, it's divided into three categories: training, testing and validation of dataset.

2.3 Training Data

In ML, a regular objective is to check and foster calculations that gain from past accomplishments and make different forecasts on a dataset. The model is begun from fitting of a preparation dataset that is a model acclimated fit the boundaries of the model. Preparing Set is gone through various layers of the Convolutional Neural Organization.

2.4 Testing Data

Test information is that the information that is used in the trial of a product. Explicitly recognized information is perceived as test information. Test information are regularly produced via computerization apparatuses and that we might create test information by analyzers. Principally in relapse testing information test is utilized in light of the fact that similar information might be utilized over and over.

3. Literature Review

The accompanying table shows the efficient survey of the writing, a calculation utilized by the investigations introduced and their precision.

Table -1: Algorithm used and their analysis

Sr No.	Paper	Year	Source	algorithm	dataset	Accuracy
1.	Implementation of smartbin using cnn	2018	IRJET	CNN	-	85-90%
2.	Deep learning based smart garbage classifier for waste Management	2020	IEEE	CNN	Trashnet	76%
3.	waste segregation using deep learning	2021	IOP Conference	CNN	Gary thung and mindy yang's	94.9%
4.	Optimization of cnn based garbage classification model	2020	CSAE	-	-	94.38%
5.	Waste classification using cnn	2020	-	CNN	-	92.5%
6.	An intelligent system for waste materials segregation using iot and deep learning	2021	ICCCEBS	R-CNN/ OpenCV	-	-
7.	A distributed architecture for smart recycling using machine learning	2020	Future internet	CNN	-	96.57%

8.	Automatic waste segregation system using cnn	2020	Journal of critical Review	CNN	-	92%
9.	Waste segregation using machine learning	2018	IJRASET	CNN	-	-
10.	Trash classification: classifying garbage using deep learning	2020	Researchgate	CNN	Gary thung yand/ Trashnet	80%/89%
11.	Waste segregation using artificial intelligence	2019	IJSTR	CNN	-	75%
12.	Smart Waste Segregation using ML Techniques	2020	IJITEE	-	-	92.9%
13.	An automatic classification method for environmrnt	2016	IEEE	-	-	-
14.	A methodical and intuitive image classifier for trash categorization based on deep learning	2021	ISSN	CNN	ImageNet	95%
15.	Segregation of plastic and non-plastic using deep learning	2019	Reasearchgate	CNN/ OpenCV	-	95.3%
16.	Smart Garbage Segregation & Management System Using iot and ML	2019	IEEE	SURF and KNN	-	99%
17.	Capsule Neural Networks and Visualization for Segregation of Plastic &Non-Plastic Wastes	2019	IEEE	CNN(Capsule-net)	-	96.35
18.	A Deep Learning Approach for Real-Time Garbage's Detection and Cleanliness Assessment	2020	IRJET	R-CNN	-	93%
19.	Hybrid approach of garbage classification using computer vision and cnn	2021	IJEAST	CNN/VGG16	Gvernment based dataset	82%/75%
20.	Garbage recognition and classification system based on convolutional neural network VGG16	2020	AEMCSE	VGG16	-	-

In paper [1], Convolution neural network algorithm is used for the identification of waste. The given system was able to achieve an accuracy of 84% which may increase by increasing the number of given images in the dataset. Also, we can add sensors in order to track the waste levels in the bin.

In paper [2], model is able to classify the given waste in one of the categories ranging from plastic, paper, cardboard and metals efficiently and cost effectively using the convolutional neural networks algorithm. The model recorded a training and testing accuracy of 99.12% and 76.19% respectively for 100 epochs.

In paper [3], the model is able to classify the given waste from a series of six waste classification categories using 4 pre trained CNN models and the maximum training accuracy achieved after scraping the preprocessed images was 94.9% by the DenseNet169 model. However, the most misclassified or misunderstood category was 'glass'. So more clear images of glass need to be added to the existing model for more accurate prediction.

In paper [4], In the given study a new algorithm for waste classification is proposed namely DECR-Net which achieves an accuracy of 94.38% by optimization. The algorithm optimizes the use of convolutional neural networks algorithm for the visual image analysis. Although the accuracy of the new proposed algorithm is quite robust, but the speed is not good enough than its predecessors.

In paper [5], a method for the classification of waste into 6 different categories namely glass, metal, paper, plastic, cardboard is proposed. The given model uses a multi layered convolutional neural network algorithm for the classification process. The model is able to achieve a 92.5% accuracy in identifying the correct waste types.

In paper [6], the model uses convolutional neural networks to classify the given objects into bio degradable and non-bio degradable categories which is further supported by the OpenCV python library. However, objects susceptible to different dimensions, shapes and invariances are limited for training and testing.

In paper [7], a new cloud-based classification algorithm is proposed for automated machines in recycling factories. The algorithm used is a preprocessed model of CNN called MobileNet model which is able to classify five different types of waste. The proposed model was able to achieve an accuracy of 96.57% by utilizing a cloud server.

In paper [8], a waste segregation mechanism is created which will use deep learning, image recognition and internet of things. The model uses the conventional neural network algorithm for classifying the waste into bio degradable and non-bio degradable categories. The proposed model gives an accuracy of 92%. The classification and segregation happen in real time which helps to reduce overall human efforts and reduces the overall cost of the process.

In paper [19], various methods and approaches of image classification like simple CNN, RestNet50, VGG16, etc are compared in order to find out which approach is the most accurate for the prediction and classification processes. After the results of all the analysis, we conclude that the RestNet50 gives us the best performance amongst all the analyzed approaches.

In paper [20], the conventional neural network model VGG16 is used for the identification and classification of domestic garbage along with the python OpenCV library for the identification and preprocessing of the given images. The model then classifies the garbage into recyclable garbage, hazardous garbage, kitchen waste and other garbage. The model is able to achieve an accuracy of 75.6% after testing which meets the needs of daily use.

4. CONCLUSION

This framework separates squander consequently using no sensors, but the energy of machine choosing the method for seeing on which waste will be organized as degradable or non-degradable. since the framework works freely, there's no need of human intervention to oversee or to attempt to any horrid task from now forward. The framework is restricted to the articles which show up as though metals however don't appear to be metals. In future, the framework might be moved up to the higher location of waste by utilizing progressed calculations of machine learning.

REFERENCES

[1] Sachin Hulyalkar, Rajas Deshpande, Karan Makode, Siddhant Kajale, IMPLEMENTATION OF SMARTBIN USING CONVOLUTIONAL NEURAL NETWORKS(IRJET), volume: 05 Issue: 04 | Apr-2018.

[2] Sidharth R, Rohit P, Vishagan S, Karthika R, Ganesan M, Deep Learning based Smart Garbage Classifier for Effective Waste Management, IEEE Conference Record # 48766; IEEE Xplore.

[3] Sai Susanth G, Jenila Livingston L M, Agnel Livingston L G, Garbage Waste Segregation Using Deep Learning Techniques, IOP Conf. Series: Materials Science and Engineering RIACT 2020.

[4] Fei Song, Ying Zhang, Jing Zhang, Optimization of CNN-based Garbage Classification Model, CSAE2020, October 2020, Sanya, China Fei Song et al.

[5] Fatin Amanina Azis, Hazwani Suhaimi, Pg Emeroylariffion Abas, Waste Classification using Convolutional Neural Network.

[6] V R Azhaguramyaa, J Janet, Vijay Varshini Lakshmi Narayanan, Sabari R S, Santhosh Kumar K, An Intelligent System for Waste Materials Segregation Using IoT and Deep Learning, Journal of Physics: Conference Series ICCCEBS 2021.

[7] Dimitris Ziouzios, Dimitris Tsiktsiris, Nikolaos Baras and Minas Dasygenis, A Distributed Architecture for Smart Recycling Using Machine Learning, Future Internet 2020, 12, 141.

[8] M. Prabu, Anirban Pal, Vineet Loyer, Sougata Dey, AUTOMATIC WASTE SEGREGATION SYSTEM USING CONVOLUTIONAL NEURAL NETWORKS, JOURNAL OF CRITICAL REVIEWS ISSN- 2394-5125 VOL 7, ISSUE 16, 2020.

[9] Yesha Desai, Asmita Dalvi, Pruthviraj Jadhav, Abhilasha Baphna, Waste Segregation Using Machine Learning, International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887 Volume 6 Issue III, March 2018- Available at www.ijraset.com.

[10] Ishika Mittal, Anjali Tiwari, Bhoomika Rana and Pratibha Singh, Trash Classification: Classifying garbage using Deep Learning, JES Vol 11, Issue 7,July/2020.

[11] Sindhu Rajendran, Vidhya Shree, Rajat Keshri, Rohit S, Rachana S, Waste Segregation Using Artificial Intelligence, Waste Segregation Using Artificial Intelligence.

[12] Dhruv Nrupesh Patel, Ashwin Sasi, Anand Chembarpu, Chandrashekar Dasari, Usha C S, Smart Waste Segregation using ML Techniques, International Journal of Innovative Technology and Exploring Engineering (IJITEE) Volume-9 Issue-11, September 2020.

[13] S.Sudha, M.Vidhyalakshmi, K.Pavithra, K.Sangeetha, V.Swaathi, An Automatic classification method for environment, 2016 IEEE International Conference on Technological Innovatio.

[14] ALilly Raamesh, S. Kalarani, T.V. Narmadha, N. Hemapriya, A Methodical and Intuitive Image Classifier for Trash Categorization Based On Deep Learning, International Journal of Modern Agriculture, Volume 10, No.2, 2021.

[15] Sreelakshmi K, Vinayakumar R and Soman KP, Deep-Segregation of Plastic (DSP): Segregation of plastic and non-plastic using deep learning.

[16] Shamin.N, P.Mohamed Fathimal, Raghavendran.R, Kamalesh Prakash, Smart Garbage Segregation & Management System Using Internet of Things(IoT) & Machine Learning(ML), IEEE 20 June 2019.

[17] Sreelakshmi K, Akarsh S, Vinayakumar R, Soman K.P, Capsule Neural Networks and Visualization for Segregation of Plastic and Non-Plastic Wastes, IEEE 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS).

[18] Ashok S, Arun Kumar HN, Niranjan J, Shekar A, Arun Kumar DR, A Deep Learning Approach for Real-Time Garbage's Detection and Cleanliness Assessment, International Research Journal of Engineering and Technology (IRJET) Volume: 07 Issue: 08 | Aug 2020.

[19] Anish Tatke, Madhura Patil, Anuj Khot, Parul JadhavDr Vishwanath Karad, Hybrid approach of garbage classification using computer vision and cnn, International Journal of Engineering Applied Sciences and Technology, 2021 Vol. 5.

[20] Wang Hao, Garbage recognition and classification system based on convolutional neural network VGG16, 2020 3rd conference on AEMCSE, Wuhan, 430070, China.