IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Automatic segregate : Dry and Wet segregation using CNN(Deep Learning) with Robotic arm

Harsabardhan Barik[1], K.Tulsi[2], Saroj Devi[3], Subbulaxmi[4], Guru Prasad[5]
Assistant Professor[1], Under Graduate[2], Under Graduate[3], Under Graduate[4], Under Graduate[5]
Department of Computer Science & Engineering[1,2,3,4,5],
Dr. B. R. Ambedkar Institute of Technology, Andaman and Nicobar Island, Port Blair, India[1,2,3,4,5]

Abstract : Dry and wet segregation using CNN with robotic arm is employed to segregate the waste into dry and wet class. The aim of this research work is to segregate the trash between dry and wet using image classification technologies and deep learning algorithm for detecting trash. This research paper will facilitate your to enhance the trash management systems. Convolutional Neural Networks (CNN) are supported on the transfer learning architecture, were developed to go looking for trash objects in a picture and separate dry and wet items from the trash objects, respectively. During this research paper, we are using dataset of trashNet where we train and test the dataset of trash to classify the category between dry and wet. Using TrashNet image dataset we achieved great performance. Then the system was trained and tested on real images taken by the user within the intended usage environment. Using the image data(CNN model), the primary CNN achieved a preliminary 84.96% accuracy to spot dry and wet items on an image dataset of assorted trash items. Lastly, a robotic arm controlled by the microcontroller (Raspberry Pi) is employed to choose up the rubbish and places it within the bin. As this model segregate the waste automatically with none human intervention, this segregate model may be very useful in handling waste which might pose an enormous risk on human life.

Keyword : Automatic segregation, Image classification, neural networks, Wi-Fi Module, waste management, Robotic arm, Dry and wet segregation .

Abbreviation

CNN – Convolutional Neural Network
RPI – Raspberry Pi

I. INTRODUCTION

The purpose of the project is to segregate the trash between dry and wet. The robotic arm to segregate the waste, whenever it senses any waste object and camera captures image of the object, after processing segmentation is completed, it separates waste into Dry and wet waste. A country, city or state is loved by folks that board it when it is healthy and hygienic. But within the few era with a growing population, the people are drawn to the town or state, and hence, it is very difficult to keep up the cleanliness of a city. If we glance towards the north or south Asian countries, we are able to easily understand how challenging it's, because the increasing number of residents of a state or city increases the assembly of trash. However, first world countries have a well-established trash management system, most of the developing countries or city manage trash very poorly[1]. That's why trash management has been an important issue to contemplate in city or in state.

Overflowing of trash bins may be a common thing in most of the developing city. Also, there's a bend among people of those city to dump the waste not inside the trashbin, but outside the bin. That's a very unhygienic and awkward condition for us. There's no little question that the encompassing area of the trashbin become a breeding place for germs[2].

II. RELATED WORK

A. DEEP LEARNING ALGORITHM

Deep learning may be a machine learning technique that learns feature and task directly from the info, where data could also be images, text or sound. The subset of Artificial Intelligence is Deep Learning. The assorted applications where deep learning (CNN algorithm) plays a big role are in tasks like recognition of speech, recognizing the images, converting speech to text and visual object, weather forecast, face detection and recognition etc. Deep learning have multiple layers through the computational models in order to learn data representations with abstraction of the many layers[5]. CNN is the most appropriate image classification method within the last few years, where no handcrafted features are extracted from segmented objects[7]. But, in our model an image classifier of the stream captured via the Raspberry pi (RPI) cam. It classifies the input image employing a trained model on the neural network of edge impulse supported transfer learning technique for image.

B. IMAGE CLASSIFICATION

Image classification is one amongst the main applications of artificial intelligence(AI). Recent image classification models often depend on deep neural networks(DNN), specifically Convolutional Neural Networks (CNNs). CNNs are neural network variants that learn by performing Image Image classification is one amongst the most important applications of artificial intelligence(AI). Recent image classification models often depend on deep neural networks(DNN), specifically Convolutional Neural Networks (CNNs). CNNs are neural network variants that learn by performing convolutions and have shown stellar performance for image classification tasks. Image classification relies on supervised learning, which needs labeled data to coach networks. After the neural network is trained, it can classify images into discrete classes.

III. TECHNICAL STRUCTURE

A. Dataset

We start with the data collected by Gary Thung and Yang for "TrashNet" Dataset. Their dataset consists of 2390 images in six classes: glass, plastic, cardboard, metal, paper, and trash which is comes under "DRY"[14].The dataset by adding 175 photos of waste material and 14 photos for Fruit waste, for a total of 2579 images[14]. We followed the methods for data collection that Gary Thung and Mindy Yang outline during this project. Although Thung and Mindy Yang resized their images to 512 × 384 pixels however, we are using images data on a resolution of 96 x 96 pixels for our model[13].

IV. PROPOSED METHODOLOGY

A. Objective

The primary aim of objective of proposed work is to segregate materials such as DRY and WET.The camera will capture images of floor objects, and the images will be transferred to processing unit to process by the CNN algorithm[7].Then, the camera is placed at the middle of the robotic arm without a rotatable camera. And the waste moves further for detection with CNN to detect either it is dry or wet[5]. If it is detected dry then, robotic arm will pick the waste and place it in the dry dustbin or otherwise in the wet dustbin.

Preprocessing : Preprocessing is required to clean the image data for input model. For example, All the layers in convolutional neural networks required that all images are the same sized arrays. That is why we are using images data on a resolution of 96 x 96 .

Software Algorithm :

CNN algorithm Works on Three Layers

1) **Layer 1 : Convolutional Layer :** Convolution is the first layer to extract features from an input image. Convolution is the relationship between pixels by learning image features using small squares of input data. It is a mathematical operation that takes two inputs such as image matrix and a filter or kernel[8].

2) **Layer 2 : Pooling layer :** A pooling layer is another building block of a CNN. Its function is to progressively reduce the amount of pixel(parameter). Pooling can be divided into 3 different types :
   a) Max Pooling
   b) Average Pooling
   c) Sum Pooling
   Max pooling is the largest element from the rectified feature map. This largest element could also take the average pooling but, most comman used pooling is max pooling.Max pooling means sum of all elements in the feature map called as sum(max) pooling[9].

3) **Layer 3 : Fully Connected Layer :** It is converting the data into one dimension array for inputting it to the next layer sometimes, it is called flattening. In the below diagram, Flatten feature map matrix will be converted as fully connected layer as a vector form(x1, x2, x3, …).

With the help of fully connected layers, we combined these input features together to create a new model.

Lastly, we have an activation function such as sigmoid or softmax to classify the outputs as dry or wet etc[8].

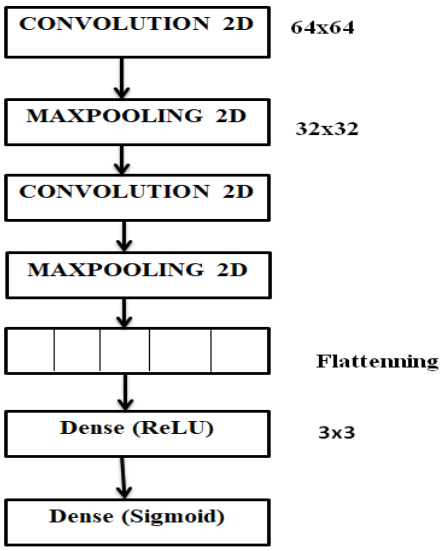

Fig 1: Design of CNN Model

Using this CNN algorithm we are able to classify the object detection between the class of DRY and WET. In this algorithm, we used Convolutional ten layer for extract features from an input image, Max Pooling is used for reducing the number of parameter, and the Stride 1, is used to move the filter one pixel at a time, and sigmoid is an activation function, we used sigmoid for binay classification model, it return the probabilities of each class and the target class will have the high probabilities, and the ReLu function is used for increase the non linearity in our image.

Support vector machine(SVM)

SVM or Support Vector Machine is **one among the simplest linear model for classification and regression problems**. Example : SVM is used for classifier of machine learning technique. It can easily solve linear problem and non-linear problems and work well for several practical problems, the though of SVM is easy, and the algorithm creates a line or a hyperplane which separates the computer file into classes such as DRY and WET.

Object Detection

For detecting the garbage from the image, we are using TrashNet for image classification, Automatic Garbage Detection Collection uses CNN for obtaining the bounding box around the image portion of garbage under test. This is where Detection collection performs the task of object detection[10]. Object detection refers to identifying instances of objects of a particular class (such as Dry or Wet) in images. The object detection CNN algorithm enables Automatic Garbage segregate to identify the places in the waste image where the object of interest i.e. garbage is resting. To make an object detection algorithm for automatic segregate garbage collection, transfer learning model is used and letting garbage in detecting the objects lying in front of the robotic arm[3]. The trained model of CNN is transferred to the Raspberry Pi microprocessor board (Raspberry pi 3B+) for carrying out the detection process for the robotic arm to pick the waste.

Trasfer learning is used to make a fast image model classifier. Automatic garbage sergregation has few limitations due to own dataset model. It cannot detect objects for which the Dataset is not trained[14]. Therefore, in the first prototype, only detects and considers DRY as a waste material.

Machine learning and covolutional neural networks into use in waste segregation was introduced by CS299 project group Gary Thung and Mindy Yang where they used a support vector system (SVM) with SIFT along with Convolutional Neural Networks (CNN) to classify images of a single object and to identify they accordingly into two different categories, DRY and WET. They achieved a 90% accuracy using SVM and 84.96% accuracy using CNN.

Robotic arm movement estimation

After completing the process of object detection, the next task is to identify the object from the base of the robotic arm, the arm will easily pick the waste into bin, which is necessary for allowing Robotic arm to pick up the garbage.

To complete this task detection collection has found the number with respect to the waste object which is used to find the classification of waste with respect to the base of the robotic arm[13]. The task was to design a code that could give the instructions in which direction the robotic arm should move in order to reach the targeted location[].

Open a RPI terminal window and enter the following commands :

```
sudo apt-get update
sudo apt-get upgrade
```

```
sudo mkdir robot
cd Downloads
sudo cp robarm.py servo*.txt /home/pi/robot
```

Open the Python code file (robarm.py), and run the python code after that we need to write one command in RPI terminal.

```
sudo apt-get install python-rpi.gpio
```

Through the help of above command and python code, Robotic arm move left, right, Up, down , forward and backward, with the help of robotic arm will pick the waste and place it in bin.

V. HARDWARE USED

A. Raspberry pi model 3B+

The Raspberry Pi 3 Model B+ is that the latest product within the Raspberry Pi 3 range, boasting a 64-bit quad core processor running at 1.4GHz, dual-band 2.4GHz[15].

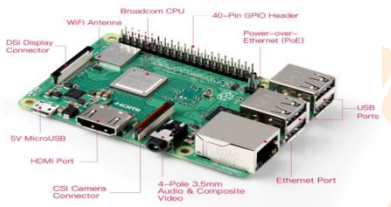

Fig 3: Raspberry pi model 3B+[16]

B. Robotic Arm

It is a mechanical arm, usually programmable with similar functions to human arm. The microcontroller controls the arm by rotating individual servo motor connecting to every joint[13]. It can perform tasks like welding, gripping, spinning etc.

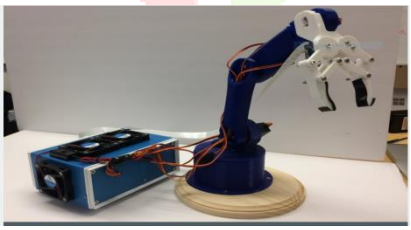

Fig 4: Robotic arm kit[13]

C. RPI Camera

The Raspberry Pi Camera v2 could be a top quality **8 megapixel Sony IMX219** image sensor bespoke add-on board for Raspberry Pi, featuring a set focus lens. It's capable of 3280 x 2464 pixel static images, and also supports 1080p30, 720p60 and 640x480p60/90 video.

Fig 5: RPI Camera

VI. DESIGN AND IMPLEMENTATION

The diagram shows the various component employed in the Segregation of waste using Smart Dustbin System is Raspberry pi board 3B+, Raspberry Pi Power Supply, RPI Camera, Two Dustbin, and for classification of image is CNN algorithm[4]. With the assistance of python code which is direct run in Television, the robotic arm will work per the python code and raspberry pi command[16].

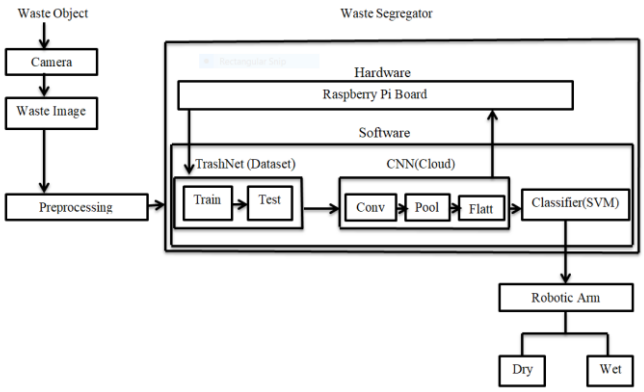

Fig 6 : Diagram of the Proposed system

VII. RESULT

This system provides a Robotic arm solution for Garbage segregation based on CNN[4]. A pick and Place mechanism is used for separation the waste. Waste separation such as wet and dry. The below figures shows the snapshots of the results obtained.

Software Implementation :

WET :

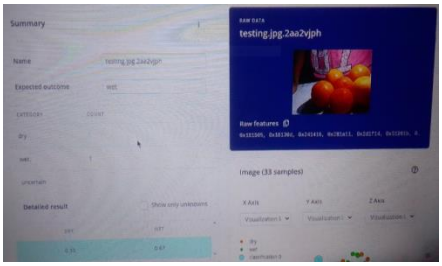

Fig 8 : Classify wet

DRY :

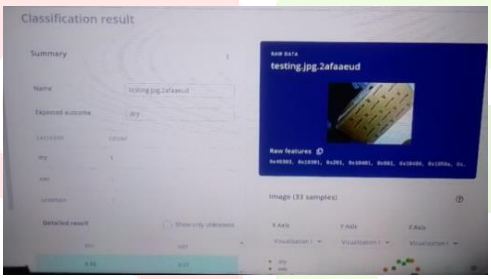

Fig 9 : Classify Dry

Hardware Implementation :

`

Fig 10 : Pick waste paper

Fig 10.1: Pick and hold the waste paper

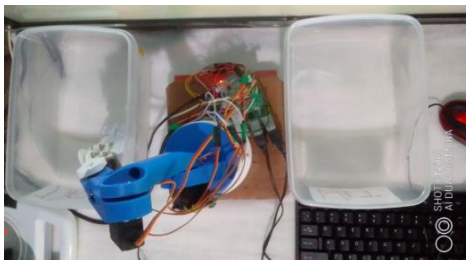

Fig 10.2 : The robotic arm place the waste paper into bin.

VIII. CONCLUSION AND FUTURE SCOPE

Automatic Waste Segregator based on Deep Learning using(CNN) the Robotic Arm performs the segregation between dry and wet waste. The waste is detected and therefore the robotic arm is employed to put the waste within the bin. This technique is more innovative because it includes an automated system and a robotic arm, making it a simpler and efficient system. This research takes a discovery in contributing towards the cleanliness of our society, thereby supporting the thought "SWACHH BHARAT ABHIYAN" proposed by our humble Prime Minister. This technique can be made more advanced and efficient by employing a crusher and deep learning and artificial intelligence within the future.

IX. REFERENCES

[1] JayashreeGhorpade-Aher,AnaghaWadkar, et al "SmartDustbin:AnefficientGarbage Management Approach for a Healthy Soceity"-2018 IEEE International Conference.

[2] Jia-Wei Lu1, Ni-Bin Chang2, Feng Zhu1, Jing Hai1, Li Liao3 ―Smart and Green Urban Solid Waste Collection System for Differentiated Collection with Integrated Sensor Networks‖ 15th International Conference on Networking, Sensing and Control (ICNSC), 2018 IEEE

[3] J.Talukdar, S.Gupta, P.S. Rajpura, R.S.Hegde, 2018 – "TRANSFER LEARNING FOR OBJECT DETECTION USING STATE-OF-THE-ART DEEP NEURAL NETWORKS"

[4] Chinmay Kolhatkar, Prachi Choudhari, Bhavesh Joshi, Dhruvin Bhuval‖ Smart E-dustbin ―2018 International Conference on Smart city and emerging technology (ICSCET).

[5] Krizhevsky, I. Sutskever, and G. E. Hinton, "ImageNet classification with deep convolutional neural networks," in Proceedings of Neural scientific discipline System Conference, Lake Tahoe, CA, USA, December 2012.

[6] Yesha Desai, Asmita Dalvi, Pruthviraj Jadhav, Abhilasha Baphna, "Waste Segregation Using Machine Learning", International Journal for Research in subject Engineering Technology (IJRASET) Volume 6 Issue III, March 2018 Trashnet, Dataset of images of trash, https://github.com/garythung/trashnet.

[7] Raghav Prabhu, "Understanding of Convolutional Neural Network (CNN)—Deep Learning", March 4, 2018.

[8] Mahbub Hussain, Jordan J. Bird, Diego R. Faria, 2018 – "A STUDY ON CNN TRANSFER LEARNING FOR IMAGE CLASSIFICATION".

[9] Manali Shaha, Meenakshi Pawar, 2018, - "TRANSFER LEARNING FOR IMAGE CLASSIFICATION".

[10] Z.-Q. Zhao, P. Zheng, S.-T. Xu, and X. Wu, ''Object detection with deep learning: A review,'' IEEE Trans. Neural Netw. Learn. Syst., vol. 30, no. 11, pp. 3212–3232, Nov. 2019.

[11] M. A. Abu, N. H. Indra, A. H. A. Rahman, N. A. Sapiee, and I. Ahmad, ''A study on image classification based on deep learning and tensorflow,'' Int. J. Eng. Res. Technol., vol. 12, pp. 563–569, Oct. 2019.

[12] Ching, Collin. "How to make an Image Classifier for Waste Sorting." Medium, March 29, 2019. https://towardsdatascience.com/how-to-build-an-image-classifier-for-waste-sorting-6d11d3c9c478.

[13] Osiany Nurlansa, Dewi Anisa Istiqomah, and Mahendra Astu Sanggha Pawitra, Member, IACSIT, 2014 -"AGATOR (AUTOMATIC GARBAGE COLLECTOR) AS AUTOMATIC GARBAGE COLLECTOR ROBOT MODEL"

[14] R. A. Aral, S. R. Keskin, M. Kaya, and M. Haciömeroglu, ''Classification of TrashNet dataset supported deep learning models,'' in Proc. IEEE Int. Conf. Big Data (Big Data), Dec. 2018, pp. 2058–2062.

[15] S. Vinoth Kumar, T. Senthil Kumaran, A. ,Krishna Kumar and Mahantesh Mathapati ―Smart Garbage Monitoring and Clearance System using Internet of things/Raspberry pi 2017 IEEE International Conference on Smart Technologies and Management for Computing, Communication, Controls, Energy and Materials (ICSTM).

[16] M. Yazici, S. Basurra, and M. Gaber, ''Edge machine learning: Enabling smart Raspberry Pi'' Big Data Cognit. Comput., vol. 2, no. 3, p. 26, Sep. 2018.