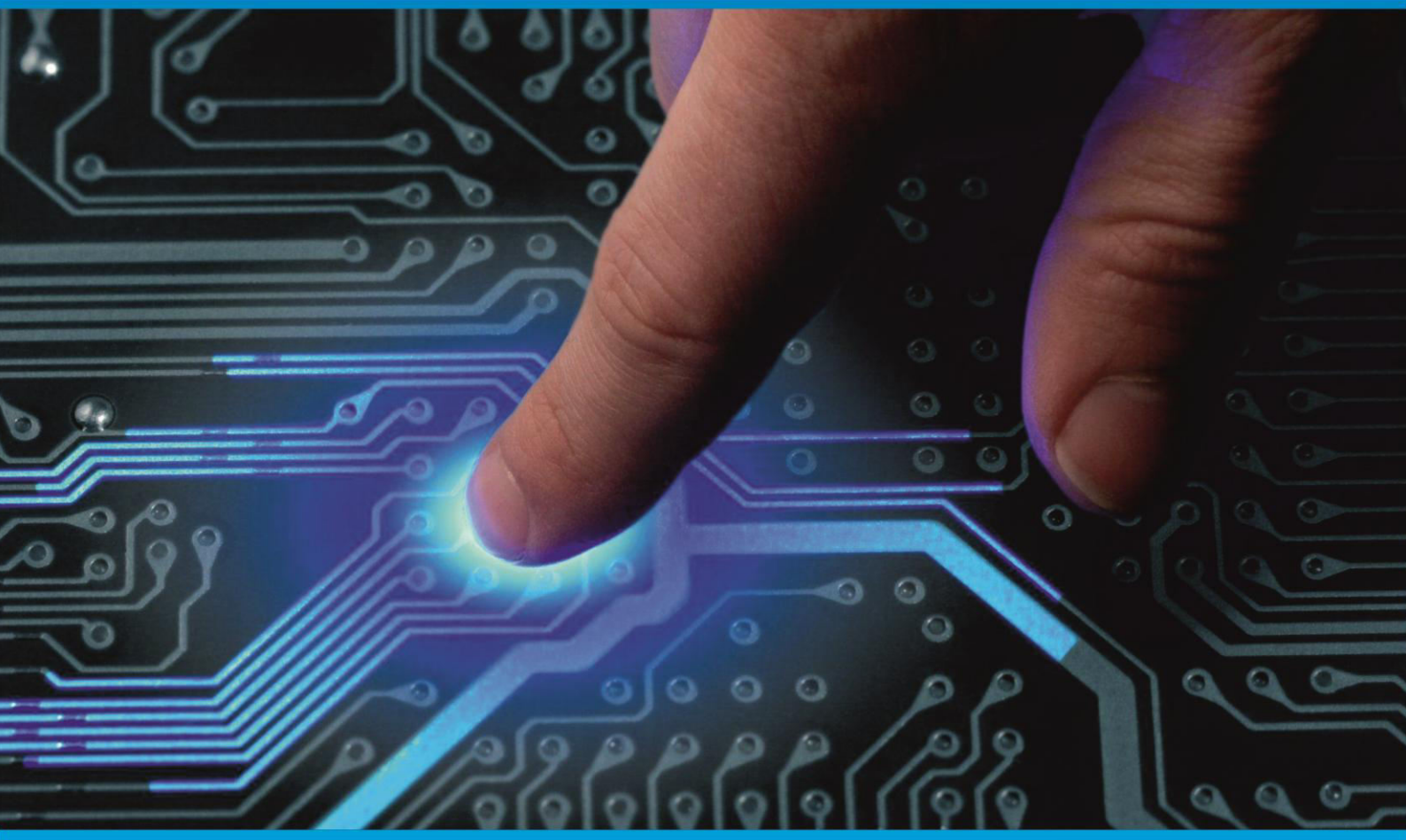
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



# INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

## IN COMPUTER & COMMUNICATION ENGINEERING

Volume 9, Issue 4, April 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.488

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.488 |

|| Volume 9, Issue 4, April 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0904160|

# A Survey on Smart Trash Management System Using Raspberry Pie and Tensorflow

**Amulya K[1], Anirudh R[2], Likhitha K R[3], Skandha Guru Dutt N[4], Lavanya M C[5]**

UG Student's, Department of Computer Science and Engineering, Vidya Vardhaka College of Engineering, Mysore, Karnataka, India[1,2,3,4]

Assistant Professor, Department of Computer Science and Engineering, Vidya Vardhaka College of Engineering, Mysore, Karnataka, India[5]

**ABSTRACT**: This paper critically examines the attitude of urban dwellers to waste disposal and management. One hundred and fifty copies of questionnaire were administered to residents in the area. Information such as the various classes of waste, frequency of waste disposal and methods of waste evacuation were obtained from the questionnaire. The research paper surveys the current institutional Solid Waste Management (SWM) with reference of students and staff at VidyaVardhaka College of Engineering, Mysore, Karnataka. The data formation done through questionnaire format of different waste generators. Total 200 residents were interviewed by our team and the results of the data collection were interpreted with the help of Red Wing students. The survey indicated that majority of the surrounding are very much concerned about the poor condition of the environment due to the inappropriate and improper SWM in and around institution.The existing systems in India are unable to handle the volumes of waste generated by an increasingly urban population, and this directly effects the healthy surroundings and public hygiene.Therefore, there is also numerous opportunities for a proper management and segregation of wastes at source and so the utilization of specialized waste processing facilities to separate recyclable materials is a fundamental role in the economy. Hence a smart Garbage System would be an honest solution for this problem.

**KEYWORDS**: Raspberry Pi, Raspberry Pi Camera module, CNN, Matplotlib, Keras.

## I. INTRODUCTION

One cannot imagine a sensible city without anefficientwaste segregation and disposal system. The refuse collection process could be a major aspect for the service providers. The usual way of manually collecting and monitoringof garbage in waste bins could be a complicated, unmanageabletask and requires more human intervention, time, and effort which isn't compatible with the current technologies. Irregular waste management may be a root cause for several of the human problems like contamination, infection has harsh effects on the healthy living community. In order toresolve these problems, we are proposing the concept of a **smart trash managementsystem** that helps within the auto-management of waste so as to keep up a clean environment.

## II. LITERATURE SURVEY

Numerous approaches are available which have proposed the different ideas working and processes involved in the canteen management system. All of them differ in the technology used to build the system. The major and unique contributions are briefed below:

A. *Efficient Waste Classification System with the aid of Deep Learning Convolutional Neural Network:*
The preliminary stage, artificial expansionof thebulk of a datasets which are training sets by introducingmodified versions of representations in the training set were performed upon tiny images. This was done due to the various orientations of the garbage elements. A number of methodscontainsimage translation, random image scaling and image shearing. With this method, it maximizes the size of dataset. The model evolved and supported by ResNet-50 model and was pre-trained on Image-Net representation with a dimension of 256 x 256 and classified into thousands of classes. The CNN layerdeforms the image that's inputted employing the filters of window sizes of three x3, this was used because what differentiates the objects are domestic and minute qualities. SVM is employed to further classify the information supported different categories.

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B. *Smart trash net for recyclability distinction:*Using computer vision, it could able to predict the category of recycling of an object based on images of it. Due tominute size of each imagethe data augmentation techniques were performed. Image transformations were chosen to account for the different orientations of recycled material and to maximize the data collected. This was also contributed by performing normalization as well as mathematical subtraction. The accuracy obtained is 63%.For the neural network, "Trash Net", the architecture similar to Alex Net but smaller in filter quantity and size is used.

C. *Standardize Model Comparisons on Waste Classification for Recyclability:*Convolutional neural networks (CNN) might be a specialized state of the multilayer neural networks and is supposed to detect geometric shapes in image processing. There are 6 classes during this data set like glass, paper, cardboard, plastic, metal, and garbage. The set created employing a white background consists of 512x384 size images. During this analysis, we used 1/2 the knowledge set for testing data without using any data augmentation method. The proposed method uses AlexNet, GoogleNet, ResNet, VGG-16, and SquezeeNet as a fine-tuned model. As an ending, SVM showed the easiest accuracy compared to the softmax Accuracy of obtained:97.86%.

D. *Smart Trash Net: Waste Localization and Classification:* For a given image of a jumbled waste, the aim is to categorize the various pieces of the waste into three categories: landfill, recycling, and paper. This project utilizes Faster R-CNN to induce region proposals and classify objects. An RPN(Region Proposal Network) could be a fully convolutional network that simultaneously predicts object bounds and objectness scores at each position. The RPN is trained end-to-end to get high-quality region proposals, which are employed by Fast R-CNN for detection.

E. *Intelligent Waste Sorting Using Deep Neural Networks:*TrashNet dataset is used for this classification where the dataset has 6 categories. The categories of recycled objects. There are several models and methods used in this research such as MobileNet, Deep residual Networks and Inception- ResNet, DenseNet, RecycleNet. Inception-ResNet-V2 is a CNN that is trained on more than a million images from the imageNet. Besides this, they have also compared the consequences of various optimization methodologies such as Adam, Adadelta and data augmentation strategies. In this research, major experiments were carried out using Tensorflow back end with Keras library on the Google Collaboratory. Overall, they have attained 95% of test accuracy. Future work involves refining of novel architecture such as RecycleNet for the pupose of deformation and natural adversarial examples.

F. *Implementation of Image Processing on Raspberry Pi:*The image processing algorithm to reinforce a picture in numerous enhancement degree using the raspberry pi. In this research, there are 3 steps of image processing, they are input, processor and output. In the first step i.e is input, camera captures images. And the it is sent to specific system to focus on a image pixel, this gives a output. The system hardware design involves several devices such as Raspberry Pi Model B,Camerainterface,SD card, Mouse, Keyboard and VGA display. Methodolgy starts with Installing raspberry pi OS to the SD card then it connects the components to the hardware and switch on the supply. Network settings should be checked before the process starts and then it enables the camera captures the image. Finally it runs the code and process ends.

G. *Deep Learning-based Smart Garbage Classifier for Effective Waste Management:*This research involves Convolutional Neural Network (CNN) which takes out the image properties in the dataset to separate the waste. Pickling of an image concept is used in this project. Pickling of an image is python objects converted into a byte stream to store in a file.Methodology starts with Convolutional Neural Network normalizing the data, action takes on the three convolutional layer, then passing two hidden layers. Dataset used here is TrashNet. The dataset has 6 classes total of 2527 images. In this research, the training and accuracy were 99.12% and 76.19%.

H. *Design of a Convolutional Neural Network Based Smart Waste Disposal System:*Automatic target detection involves two input pathways for collection of waste. One is used for organic waste and other for non-organic waste. Integrated weight sensor is used as input for organic waste.
Automatic calculation of the value is done for the specific material. On the other side, Webcam can capture the Non organic recyclable objects which is showed in the live footage. AlexNet is used for the detection of the objects which is a pre-trained network model. ATD recognizes the objects and put a label in which, price is decided. It is done when new objects are found.

I. *Smart City Management System using IoT with Deep Learning:*This project involves convolutional neural networks. Also, it involves IoT enabled devices and Object Detection. In this research, Smartphone controls lighting of Smart Home and lights are switched off automatically when the room is vacant for long time. Environmental

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Conditions are controlled by Humidity and temperature sensors. Also Flame sensors are inserted, it senses if there is a fire outbreak and sends a signal to sound alarms and alert to Smart Home owner's mobile phone in case of a critical condition.This system keeps track of filled waste bins that can be used by Municipality.To capture the images Pi camera used as a CCTV on the streets with location at the regular interval.
The training and testing accuracy obtained was 94% and 87% approximately.

*J. WasNet: Neural Network-based Garbage Collection Management System:* In this project,they haveused trained deep learning models and several algorithms to develop the end-to-end system. Raspberry has been used to carry a light-weight model and also it transmits the signals which are identified to hardware control turntable to throw objects into the corresponding box. Simultaneously, it transmits the appropriate details to the database. Tensor Flow lite has been used in the Andriod side for android sample applications for modifications and parts of the program has been added. Overall, it builds a lightweight neural network and a machine which collects garbage and then sort and recycle it.

## III. METHODOLOGY

We are using a Raspberry pi camera to capture the images. Later the captured images are sent to the Raspberry pi for further procedures. In the preprocessing stage, data augmentation is performed to enhance the features of images. We are using Resnet34 architecture which is 34 layers deep with a 3*3 filter as it helps in extracting essential and more features from the input images. The dataset will be obtained from the Trashnet project. For the image classification, we are using a multiclass-SVM model. Coming to segregation, this whole model will be built and trained on the Raspberry pi model using Tensorflow Lite. Disposing of waste is done with the help of Motor drivers which are connected through GPIO pins. Based on the output of the classification model, the item/waste placed will be segregated with the help of motors.

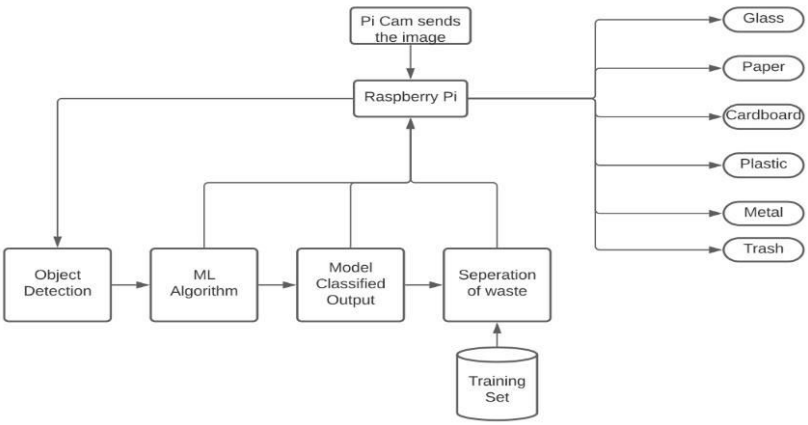


Fig 1-Flowchart of the proposed methodology

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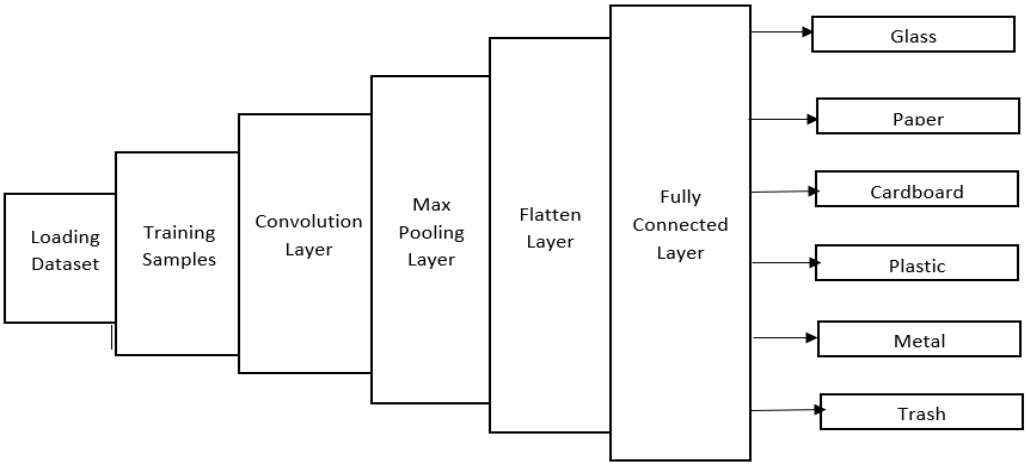


Fig 2-Flow of the project

## IV. PROPOSED WORK

[A]Pi Cam

We are using a Raspberry pi camera to capture the images(images of waste) initially. The Picamera module is a portable and lightweight camera that supports RaspberryPi. It communicates with Raspberry Pi using the MIPI interface protocol. It is normally used in machine learning, image processing, and also in surveillance projects. Later the Captured image is sent to the Raspberry pi for further process.

[B]Data Augmentation

Data Augmentation will be performed on the images obtained in the pre-processing stage because the size of the images obtained from the dataset might be small. This technique is used because to enhance the different representation of the garbagematerials. Some of these techniques includes image randomizing, image translation, random image scaling and shearing of image. With this technique, we can able to maximize the dataset size and also by increasing the efficiency of the training.

[C]Dataset

The dataset for this project will be obtained from TrashNet. The dataset has six classes and with around 2527 images:

- 502 Glass
- 595 Paper
- 403 Cardboard
- 482 Plastic
- 411 Metal
- 137 Trash

The size of the dataset will be increased by adding our own images and also with the Data Augmentation technique.

[D]Resnet34

A residual neural network is a CNN which includes lots of layering. In particular, resnet34 is a Convolution neural network with 34 layers that have been pre-trained on the ImageNet database. A pre-trained CNN will perform much more efiicient on new image classification tasks because of transfer learning. It is capable of describing more complex featureson training data.This architecture helps us in extracting the essential features from the input images.As the

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training goes down the layers, the challenging features will be extracted, with the help of the Softmaxmethod. The features extracted will be passed to theSVM model which is Multi-class. SVM takes care of the classificationbased on the features extracted.

[E]SVM

We will be choosing a Support Vector Machine as our classification algorithm to distinguish the image to put in a specific category as it is a supervised algorithm. The materialsare segregated based on the separation ofhyperplane for each of the multidimensional inputdata.The weight of the network will bemaintained fixed for the overall procedure. A fully connected layer from the Resnet34 architecture will bereplaced and removed by SVM as it is trained and used for the classification.

[F]Segregation

The Raspberry Pi is an open-source computer that runs Linux. In our model, we will be using the raspberry pi for the separation of waste.
We will be building the TensorFlow model in the raspberry pi and the whole classification will be processed and carried on through the raspberry pi.
Disposing of waste materials will be done with help of Motor drivers and stepper motors. The output from the TensorFlow model will be collected from the raspberry pi. Based on the output, the item placed will be segregated with the help of motors. Below is the circuit diagram for the proposed model using the L2N8 Motor Driver.

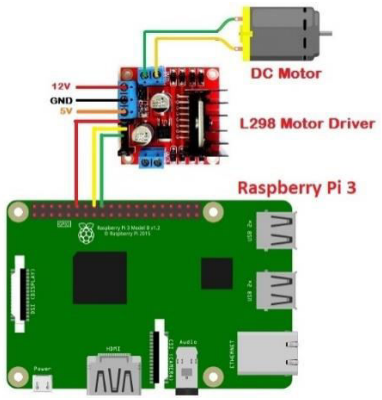


Fig 3-.Raspberry Pi with L298 Motor Driver

## V. CONCLUSION

The use of intelligent automation techniques in separation of waste materials and products is likely to be better. The unmanned Waste management system is a step aheadcompared to the existing system to make the manual segregation of waste easier. The Automated system possesses the ability to segregate glass, metal and plastics etc. Through this way we can keep our ecosystem clean and hygiene so that our upcomingera lives a disease free life.

## ACKNOWLEDGMENT

We express our gratitude towards the guidance and insights provided by our facultymembers and mentors who steered us throughout the process during research and assisted us in achieving desired goal.

## REFERENCES

1. O lugbojaAdedeji, Zenghui Wang- “Intelligent Waste Classification System Using Deep Learning Convolutional Neural Network” SMPM(2019).
2. GaryThung, Mindy Yang- “Classification of Trash for Recyclability Staus”-Stanford University.

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3. UmutOzkaya, LeventSeyfi- "Fine-Tuning Models Comparisons on Garbage Classification for Recyclability"- 2nd InternationalSymposium on Innovative Approaches in Scientific Studies Conference.
4. C enkBircanoglu, MeltemAtay,FuatBeser, OzgunGenc, MerveAyyuceKızrak- "RecycleNet-Intelligent Waste Sorting Using DeepNeural Networks" -C onference paper(2018).
5. O luwasanya Awe, RobelMengistu , Vikram Sreedhar- "Smart Trash Net: Waste Localization and Classification" Corpus ID:36189518.
6. K .S.Shilpashree , Lokesha.H , HadimaniShivkumar – "Implementation of Image Processing on Raspberry Pi"- International Journal of Advanced Research in Computer and Communication Engineering(2015).
7. DeepthiMurty T S , Nischitha C , R Pavithra , Noumana begum , NandiniM- "Simple Object Detection Using Raspberry Pi"-Maharastra(2020).
8. Sidharth R, Rohit P, Vishagan S, Karthika R, Ganesan M- "Deep Learning based Smart Garbage Classifier for Effective Waste Mnagement".
9. M d. SamiulHaque Sunny, Debopriya Roy Dipta, Shifat Hossain- "Design of a Convolutional Neural Network Based Smart Waste Disposal system".
10. S hubhamJain,AmanJatin, Shalini Bhaskar- "Smart City Management System using IoT with Deep Learning".
11. Zhihu Lang, Dan Li – "WasNet: A Neural Network-based Garbage Collection Management System".

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ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

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