International Journal for Modern Trends in Science and Technology, 7(12): 212-214, 2021

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0712041
Available online at: http://www.ijmtst.com/vol7issue12.html

Image Classifier for Segregation of Waste

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To Cite this Article
Tanushree Ghai, Saumya Nasa, M.L. Sharma and K.C. Tripathi. Image Classifier for Segregation of Waste. *International Journal for Modern Trends in Science and Technology* 2021, *7* pp. 212-214. https://doi.org/10.46501/IJMTST0712041

Article Info
Received: 12 November 2021; Accepted: 06 December 2021; Published: 14 December 2021

ABSTRACT

With the upcoming new advancements, availability of cheaper goods, and rising demands, the world is also seeing a rise in the generated waste material. Around 62 Million tonnes of waste is generated in India annually, and approximately 68 percent of that goes into collection and only a small 28 percent goes into waste treatment. It is projected that the volume of waste would increase from 64 - 72 million tonnes at present to 125 million tonnes in 2031[1]. Untreated waste is a huge threat to the environment. Solid waste disposed of unhygienically or left untreated, can accumulate and add to environmental degradation. The resources of the world are fast depleting, which further strengthens the case about how essential it is to preach and follow the three R's of Waste management - Reduce, Reuse, Recycle. It is imperative that the segregation, transport, management, and disposal of the trash is well planned and effectively executed. Still recycling is being done at later stages, that too by manual processes hence inefficient. A majority of consumers also find it difficult to distinguish between different materials and their ability to be recycled.

The objective of this study is to develop a system that can identify the type of item and its category as recyclable. The model would be built using different deep learning and transfer learning techniques. The study is concluded with a comparison of the performance of the two models used.

KEYWORDS: Recycling, Deep Learning, Image Classification, Transfer Learning, ResNet, VGG

INTRODUCTION

India being a diverse nation, with a rapidly increasing population, and having constant developments through industrialization, advancements in technology, and rising demands, there is a rise in the waste being generated every now and then. Hence the increase in solid waste generated in cities of India from 48 million tonnes in 1997 and expected to reach 300 million tonnes by 2047[2]. Careless disposal of waste simply does not solve the problem, instead, its ill effects are increasing manifold, by affecting the natural ecosystems, hence causing environmental degradation, health hazards, pollution, and unhygienic surroundings. The municipal corporations in India hold the responsibility of waste collection, and separate bins for biodegradable and inert wastes are provided. But when it comes to mixed wastes, they are dumped and often open burned. Above than 90 per cent of the waste in India is being dumped unsatisfactorily. [3]

The recycling process as of now is carried out at a very later stage and that too manually. The existing system has a few stakeholders working towards these issues, yet the system requires improvement. Therefore it is very important to identify the drawbacks of our current waste management system and come up with strategies that can help increase the efficiency of the

existing mechanism. It would be necessary to design our waste disposal systems using the boom of digitization and bring these technological advancements to our benefit.

By the means of image classification techniques, we can identify and hence help segregate the different waste items into different recycling categories [4].

METHODOLOGY

A. Data

The trash image dataset in use was created by Gary Thung, Mindy Yang.[4] and was downloaded from their github repository. The dataset consists of images of different categories, namely 'cardboard', 'glass', 'metal', 'trash', 'paper', 'plastic'. The dataset consists of around 500 images of the aforementioned classes, hence accounting for 2527 images.

B. Implementation of VGG16

Transfer learning models make use of learnings from previous models and utilize this knowledge for the purpose of training new models or carrying out new tasks.[5] VGG16(Visual Geometry Group) is a model trained on the ImageNet dataset. This dataset comprises more than fourteen million images, belonging to thousands of classes. The architecture of vgg16 has 16 layers, and that involves the type of layers - convolutional, pooling, and fully connected layers. There are 2 convolutional, followed by pooling, again 2 convolutional and one pooling, followed by blocks of three convolutional followed by pooling, and finally 3 fully connected layers. [6]

The activation function used here is softmax and followed by the 5 blocks of convolution and pooling layers, a dense layer or fully connected layer is added.

C. Implementation of RESNET 34

It is a convolutional neural network, with many layers, 34 layers in the case of resnet-34(Residual Neural Network), and again it is pre-trained on the ImageNet Dataset, hence this is also an application of Transfer Learning. The problem that resnet solves is that very deep learning models, in reality, perform in a worse manner than shallow networks. This is largely because as layers increase, during back propagation, there could be a vanishing gradient problem. Hence resnet uses an identity shortcut connection and skips one or more layers [7],[8]. In its architecture there are 1 max pooling layer, 32 convolutional layers and 1 average pooling layer.

RESULTS AND DISCUSSIONS

A.Evaluating VGG16

Upon making predictions on the test data, the following accuracy and loss v/s the number of epochs plots are obtained. An accuracy of 64.45% was obtained when 25 epochs were taken into consideration.

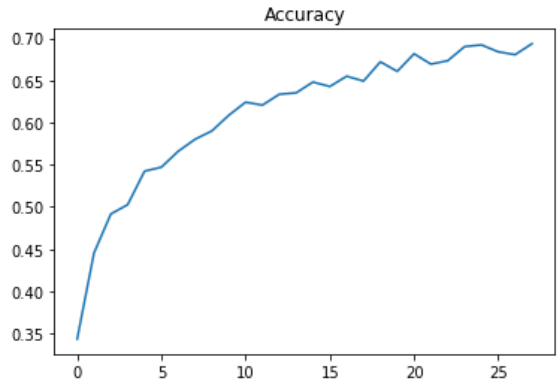

fig1: vgg16 evaluation - accuracy v/s number of epochs

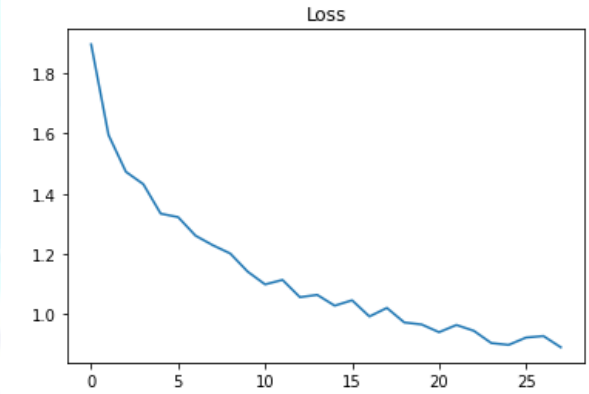

fig2: vgg16 evaluation - loss v/s number of epochs

B. Evaluating RESNET 34

The confusion matrix below demonstrates that the model has most confused metal for glass, and plastic as glass. An accuracy of 92.1 % was obtained when the model was trained over a set of 20 epochs. Maximum accuracy was obtained for the class 'paper', i.e. 96.64% of the actual paper was classified as paper during the predictions.

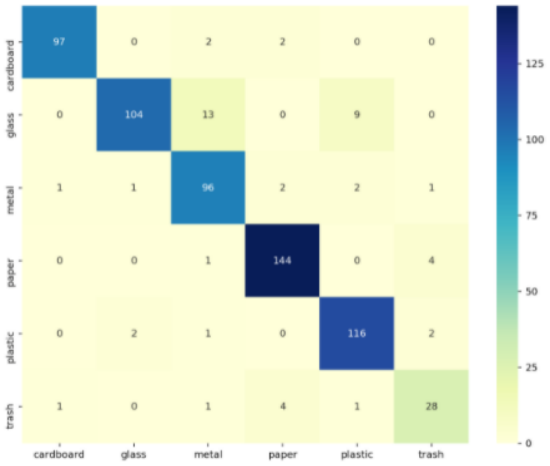

fig3: confusion matrix for RESNET 34 Test data evaluation

CONCLUSION AND FUTURE SCOPE

The objective of this study was to develop a model that can classify an image into one of the six categories - 'glass', 'paper', 'cardboard', 'metal', 'plastic', 'trash'. We are able to come up with a transfer learning model that gives realistic classification of the waste images into different classes of recyclable items. We observed that due to the usage of pre-trained deep learning models, we were able to achieve better accuracy in classifying unseen data. This study has been performed meticulously and hence provides accurate results which can be further taken forward from here. This study can be taken forward by adding more classes of data. Also, more advanced models could be taken up for further improving the accuracy.This model can find use in developing optical sorting systems which can be used on both household levels and large scale waste management areas, to make the recycling process efficient.

REFERENCES

[1] Ahluwalia, Isher Judge; Patel, Utkarsh. 2018. "Solid Waste Management in India: An Assessment of Resource Recovery and Environmental Impact." Indian Council for Research on International Economic Relations.

[2] Raveesh Agarwal, Mona Chaudhary, Jayveer Singh, "Waste Management Initiatives in India for Human Well Being." ESJ edition ISSN: 1857 – 7881 (Print) e - ISSN 1857- 7431

[3] Sunil Kumar, Stephen R. Smith, Geoff Fowler, Costas Velis, S. Jyoti Kumar, Shashi Arya, Rena, Rakesh Kumar and Christopher Cheeseman "Challenges and opportunities associated with waste management in India"

[4] Yang, M. and Thung, G. (2016). Classification of Trash for Recyclability Status, CS229, Project Report, 2016

[5] SrikanthTammina, "Transfer learning using VGG-16 with Deep Convolutional Neural Network for Classifying Images" . IJSRP, vol. 10, 143-150(2019)

[6] Karen Simonyan, Andrew Zisserman "Very Deep Convolutional Networks for Large-Scale Image Recognition" - arXiv preprint arXiv:1409.1556, 2014.

[7] K. He, X. Zhang, S. Ren, and J. Sun. "Identity Mappings in Deep Residual Networks". arXiv preprint arXiv:1603.05027v3,2016.

[8] K. He, X. Zhang, S. Ren and J. Sun. "Deep Residual Learning for Image Recognition", 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2016, pp. 770-778, doi: 10.1109/CVPR.2016.90.