WEB – BASED APPLICATION DEVELOPMENT FOR MARINE LITTER CLASSIFICATION

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***Abstract* – The aim of this paper is to present a web application using VGG16 Transfer Learning technique of Convolutional Neural Network for waste classification. In our paper we analysed the extent to which the countries around the world contribute to marine plastic litter and we visualized the data. Later in order to understand and classify the different types of wastes that are being disposed in an incorrect manner, we classified the waste using VGG16 Transfer Learning technique of Convolutional Neural Network with ADAM optimizer and provided awareness through a web application. We thus could get a holistic view of the issue.**

Keywords – Introduction; Data visualization; CNN; VGG-16; User Interface; Results; Conclusion

I. INTRODUCTION

On a daily basis, the country produces more than 1.50 lakh metric tonne (MT) of solid waste, according to a 2019 India Today report. With almost 15,000 MT of garbage remaining exposed every day, it has become a significant reason for rising pollution levels. Marine debris – man-made objects that enter the marine environment through careless handling or disposal, intentional or unintentional release, or as a result of natural disasters and storms is one of the ocean's most pervasive, yet potentially solvable, pollution problems. It can harm ocean ecosystems, wildlife, and humans. It can injure coral reefs and bottom-dwelling species and entangle or drown ocean wildlife. Some marine animals ingest smaller plastic particles and choke or starve. Human health is also at risk, as plastics may break down into smaller pieces that may subsequently end up in our food. The economic impact of marine litter is thought to be significant. Even though there are strict policies enforced by the government for proper waste disposal, many people are still not aware and do not understand the need of the hour. While there are different types of waste that are thrown along the shoreline due to the lack of awareness about proper disposal methods, the most concern causing among them all is plastic litter. Thus, through our paper we try to study the application of deep learning in the field of environmental protection, create a general awareness and provide a small-scale waste classification solution that can later on be implemented in large scale.

(A) LITERATURE SURVEY

Different types of wastes require different management techniques and thus, correct waste segregation according to its types is needed to provide proper recycling of waste. Current existing segregation methods still relies on manual hand-picking process. One of the most frequently used deep learning methods for image classification is the Convolutional Neural Network (Ref [1]). which performs well in classifying image datasets as well as for real-time image recognition applications. AlexNet was proposed as part of ImageNet Large Scale Visual Recognition Challenge in 2012, the number of parameter optimizations strategies was increased, by making the architecture more deep (Ref [2]). However, the architecture suffers from overfitting due to its increase depth (Ref [3]). Multiple-layered Convolutional Neural Network model, specifically the

well-known Inception-v3 model has been used for classification of waste, with trained dataset obtained from online sources. Apart from its complexity due to more number of hidden layers, this model overfits and provides less accuracy in some cases (Ref [3]).

(B) EXISTING SCHEME

Current existing segregation methods still relies on manual hand-picking process. A method based on deep learning and computer vision concepts, to classify wastes using their images into six different waste types have been proposed (Ref [4]-[5]). Multiple-layered Convolutional Neural Network model, specifically the well-known Inception-v3 model has been used for classification of waste, with trained dataset obtained from online sources. Apart from its complexity due to more number of hidden layers, this model overfits and provides less accuracy in some cases.

(C) PROPOSED SCHEME

In this paper, VGG16 Transfer learning technique of CNN is used for waste segregation (Ref [6]) as it is a good neural network architecture with a simple stack of convolution, pooling and fully connected layers. It starts with two convolution layers followed by pooling, then another two convolutions followed by pooling, after that repetition of three convolution followed by pooling, and then finally three fully connected layers (Ref [7]) as given in *fig.1*. This being a pre-trained model can be loaded via the Applications interface provided by Keras. By the method of Transfer learning, this model developed for a task is used as the starting point.

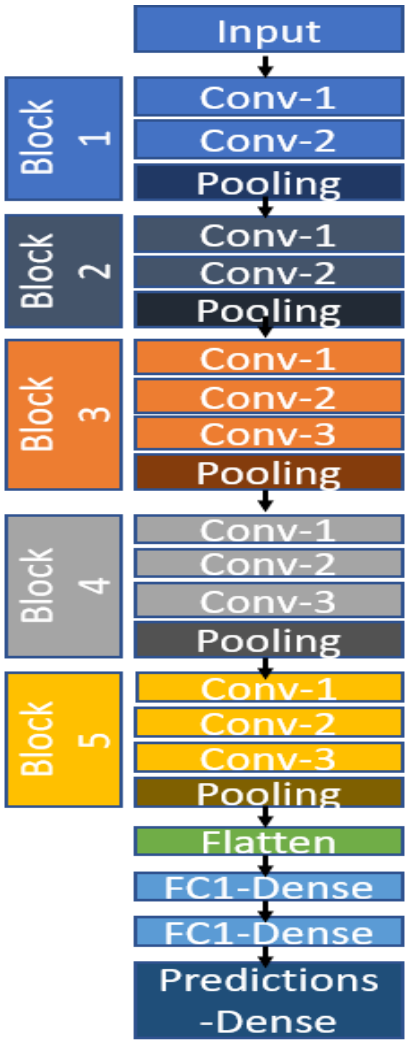
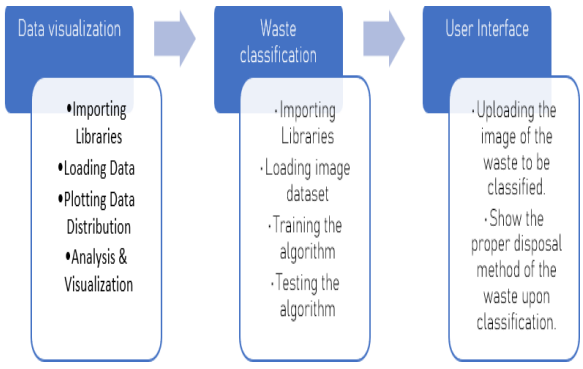


Fig.1

II. PROPOSED SYTEM



(A) AWARENESS THROUGH DATA VISUALIZATION

We downloaded a 2019 dataset from IUCN (International Union for Conservation of Nature) website (Ref [8]) that gave information about the extent to which a few countries around the world contributed to marine plastic waste. The dataset takes into account different rivers of these countries as they act as conduits of litter from inland to ocean. Analysing the datasets that inform the degree of plastic litter in various rivers from different countries would help in visualising the contribution of every country taken into account, importantly in visualising which country contributes the most. We analyzed the data by plotting the distribution as given

in *fig.2*. For our analysis we used the Python 3 language and imported libraries like numpy, seaborn, pandas and matplotlib.pyplot. This process of data visualization gives a sense of understanding and awareness about the criticality of the issue.

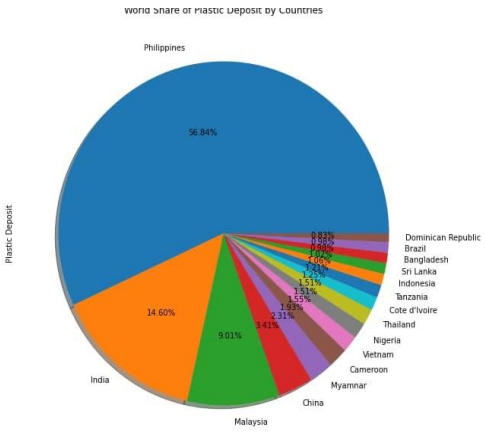


Fig.2

(B) A POTENTIAL SOLUTION THROUGH DATA (WASTE) CLASSIFICATION

Apart from just understanding the presence of plastic litter, it is necessary to classify the different categories of waste disposed along the shorelines. We downloaded a dataset consisting of around 8000 images from GitHub website (Ref [9]). All the images belong to the following 9 categories: light bulbs, paper, plastic, organic, glass, batteries, clothes, metal and e-waste. The dataset is trained using VGG16 Transfer Learning technique of Convolutional Neural Network for classification (Ref [10]). Transfer Learning technique helps neural networks to learn with limited training data available when used as a starting point for the model and also helps in avoiding over-fitting problems (Ref [11]-[12]). We tried training the algorithm using different optimizers like Adam, Adamax and Nadam available in Keras library to check which provides the better result. On feeding a test image, the algorithm correctly classifies the category of the waste.

(C) USER INTERFACE

We extended our paper by developing a web application as in *fig.3-5* that would help in waste classification. This web application can classify waste into 9 different waste classes. For frontend, web technologies like HTML (Hyper Text Markup Language) and CSS (Cascading Style Sheets) are used. Flask, which is a web framework in python is used for backend.

The web application works as follows:

- Click on the button "CLASSIFY IMAGE".
- Upload an image of any waste.
- The web application would then classify the waste to its respective category and display the name of the category.
- It would also provide the users with an insight on the particular type of waste and its proper disposal/recycling method.

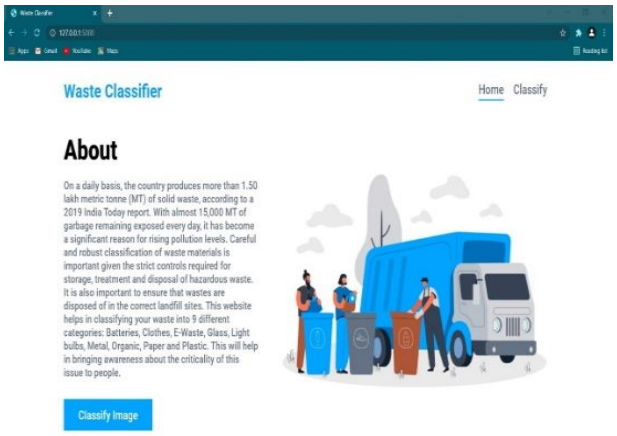


Fig.3

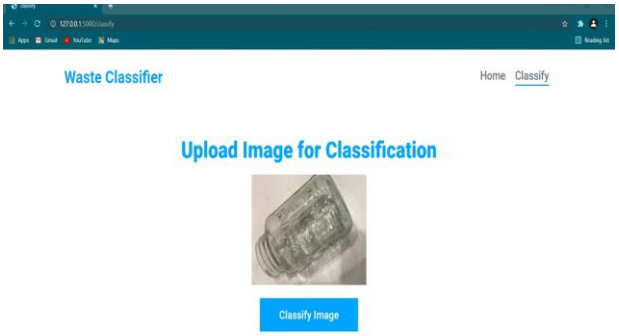


Fig.4

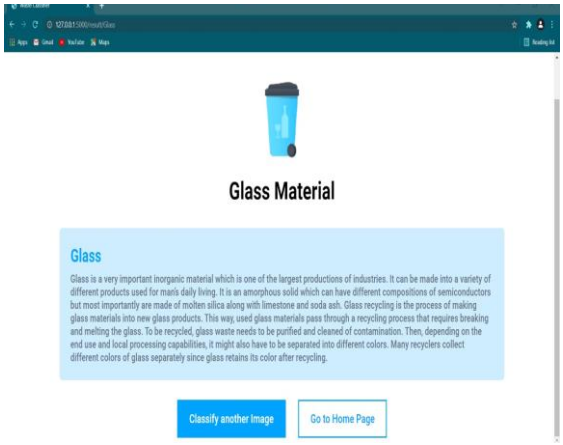


Fig.5

III. RESULTS AND DISCUSSION

Through the first step of this paper, i.e., data visualization, on analysing rivers of different countries, we were able to identify that Philippines is high in plastic deposit, with a world share of 56.84%. Its PASIG River contributes the most to this (as per 2019 dataset of IUCN). In the second step i.e., waste segregation, we were able to segregate different types of wastes using VGG16 Transfer Learning technique of CNN. On using three different optimizers available in Keras library, the results were:

(1) NADAM optimizer did not classify the images into the correct category.

(2) ADAMAX optimizer classified the images into the correct category with an accuracy of 51 percentage.

(3) ADAM optimizer classified the images into the correct category with an accuracy of 80 percentage.

IV. CONCLUSION AND FUTURE SCOPE

Given the criticality of the issue of marine litter and its dire consequences, we were motivated to envision the extent of marine waste contribution by few countries and also develop a solution that would bring understanding. We visualized a dataset from the year 2019 and studied the contribution of a few countries as the first step of our paper. We then developed a waste classification algorithm using VGG-16 as the second step of our paper and found that the ADAM optimizer performed the best with an accuracy of 80 percentage. We later developed a web application that would act as a user interface; that would help in waste classification on uploading the image of any waste and provide insight and awareness. We thus could get a holistic view of the issue.

Though this is just a small-scale implementation, it could be made large-scale and useful in the future by making the automated detection process real time. It could be installed in any drone or bot that might be used to categorically collect and dispose wastes from the shorelines in the future.

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