DETECTION OF TRASH IN SEA USING DEEP LEARNING

P. M. Kavitha [1], M Anitha[2], Shraddha Padhiari[3], K. Anitha[4]

[1]Assistant Professor, Department of Computer Applications, SRM Institute of Science and Technology, Ramapuram, Chennai. pmkavimca@gmail.com
[2]Assistant Professor, Department of Computer Science and Engineering, P.B.College of Engineering, Chennai . galina.anitha@gmail.com
[3] BCA Third Year, Department of Computer Applications, SRM Institute of Science and Technology, Ramapuram, Chennai. shradz97@gmail.com
[2] BCA Third Year, Department of Computer Applications, SRM Institute of Science and Technology, Ramapuram Campus, Chennai, aniarav0305@gmail.com

ABSTRACT

Pollution in sea is one of the most agonizing issues of this generation. With that being said, water has the ability to absorb harmful chemicals that are released by debris thrown into water bodies. This can cause unimaginable effects on humans as well as sea animals. Therefore, it is vital for every one of us to take a step towards resolving this issue. Of course, there are some people who have taken a step to reduce and remove debris in sea. These measures involve manual work which may not be highly-effective as some of the debris tend to sink in water making it hard to detect.

Hence, we are proposing a project that can detect and classify trash present in water bodies. It is done with the help of deep learning with CNN model. With the help of these concepts, one can determine the position and type of debris present in sea.

***KEYWORDS**: Deep learning, trash detection, CNN model, dataset, accuracy, debris.*

INTRODUCTION

Trash detection in sea using deep learning focuses on detecting the volume of disposed waste material in sea-level water bodies. Marine water pollution is increasing day-by-day. It can get polluted by man-made factors such as, eradicating chemical waste for instance, pesticides that are applied to farmland enter surface water and pollute it. However, one of the most well-known and preventable way of polluting water bodies is disposal of garbage and/or plastic debris into water.

It is vital for us, human beings to take responsibility for it. As a matter of fact, several people have taken small steps towards minimizing water pollution, some of which includes manual methods, visual observations, using drones and aerial scans. These ideas

however, have their own set of disadvantages such as human errors, time consumption or limited coverage.

Therefore, we are proposing a fast and cost-effective method for a machine (which when incorporated with our code) to automatically detect the presence of trash material using deep learning. This project involves two datasets-training set and test set. The developer uploads images of waste material and classifies them into the training set. This dataset usually involves around 2000 images as input. In the training set, the machine has the ability to classify the inputs given by the user into the right category. The project focuses on identifying and classifying trash material which is done by recognizing and classifying an image. To do so, the concept of Convolutional Neural Network (CNN), a deep learning concept, comes into play.CNN works by building a network into a fully connected layer where all the neurons are connected to each other and the output is processed.

Plastics play a major role in polluting water bodies. Our code can identify plastics based on the following strategy. Generally, plastics can be classified into two types based on size i.e., macro plastics and micro plastics. Macro plastics are those plastics that are easily visible to the naked eye due to its large size. It also has high density when compared to micro plastics. Due to these characteristics, they tend to float in water, making it easy to detect them. With the help of image processing feature in the project, the device once placed in water, scans the image of this plastic to see if it matches any of the images in its dataset. When it does, it maps out the exact location and outlines the shape of the plastic. This is how macro plastics are detected. As for micro plastics, they are smaller in size and tend to sink in to the water. This causes major harm to the living species in the sea. The concept of CNN plays a major role in detecting trash.

By implementing this method, the accuracy and efficiency of detecting plastics increases enormously. Similarly, the machine identifies other trash materials. It is crucial for intelligent systems to take over the job of manual, time-consuming jobs. The project makes use of latest technologies such as machine learning and image processing to solve an alarming issue.

Source: Google images

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IMPORTANCE OF TRASH DETECTION IN SEA

People tend to dispose domestic refuse in water bodies, thinking it as a easier and efficient way to get rid of waste material from their property. But, they fail to think much about the aftermath of disposing trash into water bodies. According to recent surveys, about 80% of water is polluted due to domestic sewage. Due to the accumulation of these materials both humans, as well as sea creatures are immensely affected. Contaminated water makes us ill. Unsafe water sickens about 1 billion people every year. Low income communities are affected tremendously as they are located closest to the most polluting industries.

Domestic waste can be classified as hazardous and non-hazardous. Non-hazardous materials include food scraps, paper and bottles that can be re-cycled or composted. Whereas, hazardous materials include batteries and household cleaners. These materials should be handled in a safe manner to ensure that they are disposed properly.

Billions of pounds of garbage end up in the oceans every year. Plastics require several years to decompose. Therefore, when they are thrown into water bodies, the plastic products spread throughout the ocean along with its toxins. The marine organisms absorb these toxins unknowingly. The contaminated fish that contain toxins such as lead, mercury and/or cadmium are ingested by humans who can lead to serious health problems such as cancer and problems of the immune system. Marine animals such as seabirds, turtles and dolphins face the danger of entangling in the plastic bags and other dangerous debris. When they consume these toxic items, it can lead to internal blockages and death.

In this situation, it is important for all of us to take small steps towards minimizing water pollution caused by man-made factors for the well-being of sea creatures and man-kind.

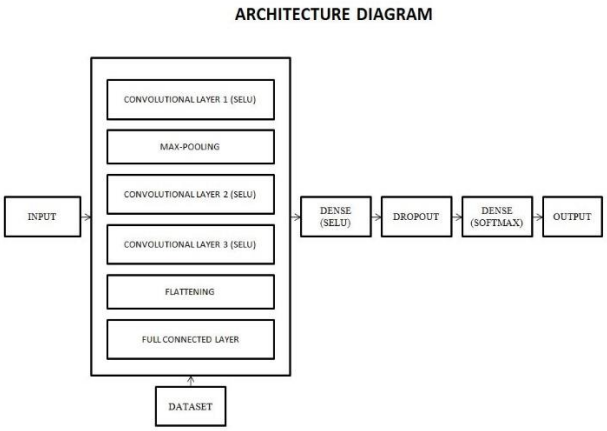
IMPLEMENTATION OF CNN MODEL

Deep learning models are capable of focusing on the right features by themselves, requiring little guidance from the developer. Deep learning is implemented with deep networks, i.e., a neural network with multiple hidden layers. Initially, the input is given to the “input layer” where the number of neurons is equal to the number of features in our data. Then, the data from the input layer is fed to the “hidden layer” where the number of hidden layers is dependent on our model and data size. The output from each layer is obtained by performing matrix multiplication of the input value to its assigned weights. The output of every layer is then added to find out the final result. The final result is then compared to the actual output to find out the accuracy of our model.

For instance, the existing system of our model provided 80% of accuracy. It was then worked through to get an accuracy of 98.2%.The accuracy is dependent on the weight value that is automatically assigned to the input. Weights represent the priority of the input. Therefore, the process of assigning weights to find out the output is carried on until the accuracy rate increases. This process is called back-propagation and it is performed to increase the accuracy of the machine providing expected output to the user.

The concept of CNN (Convolution Neural Networking) is used to classify images easily. It consists of several processing layers that is used to reduce an image to its key features which makes it easier for the machine to classify an image. This process involves four major processes that include: (i) convolution, (ii) max-pooling, (iii) flattening and (iv) fully connected layer.

Convolution merges two set of functions to produce a third function. In our case, convolution is performed on the input data and the respective filter to produce a feature map. Secondly, max-pooling is responsible for calculating the maximum value in each patch of the feature map. The results highlight the most present feature in the map. Then, the data is converted into a single dimensional array for inputting it to the next layer. This process is called flattening. Flattening is an essential process for problems dealing with an imaging context. Since, our machine will be detecting and classifying an object based on image processing algorithms, it is essential for us to feed a linear layer as an input to the machine. Finally, in the fully connected layer, all the inputs from one layer are connected to every activation unit of the next layer. The objective of this layer is to classify an image to its appropriate class.



The model consists of three CNN layers using the activation function 'SELU'. SELU is used in the three convolution layers and it contains two constant parameters α and λ that is obtained from the inputs.

$$\operatorname{selu}(x) = \lambda \begin{cases} x & \text{if } x > 0 \\ \alpha e^x - \alpha & \text{if } x \leqslant 0 \end{cases}$$

The dense layer is the fundamental layer in the neural network. It supplies the output of the preceding layer to the neurons. Every neuron contributes one output to the following layer. In the dense layer, we have used SELU and Softmax as our activation function. Softmax helps one result to proceed a step further to one with another result to zero.

$$\sigma(\mathbf{z})_i = \frac{e^{z_i}}{\sum_{j=1}^{K} e^{z_j}} \text{ for } i = 1, \ldots, K \text{ and } \mathbf{z} = (z_1, \ldots, z_K) \in \mathbb{R}^K$$

Dropout layer assigns dimensions to the input vector as zero along with the probability. The optimizers help in the formation of the model using weights. The model shows around 98.2 % of the accuracy.

RESULT

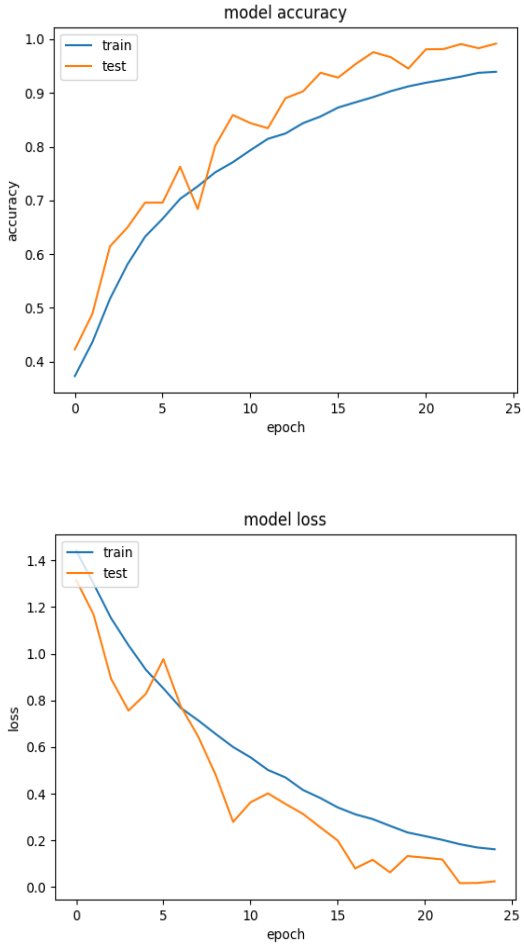


Fig.:Stimulation graphs of the model

The graphs show the training and testing of the model. The first graph depicts the model accuracy whereas the second graph represents the model loss. We can observe that there is minimal loss and the model predicts great accuracy.

CONCLUSION

Our project will help with the detection of the various types of trash in the sea. This algorithm is designed to work fast and in an effective manner. This model can be deployed on devices of various levels and architecture very easily. Detection of trash becomes very easy due to the high accuracy of the proposed model. High computational power is not required for this model. The trained model is small in size and easy to implement.

FUTURE SCOPE

This model can be made better by feeding it with more dataset. Even the detection of microplastics in the sea is possible if the correct dataset is provided to the model. The proposed algorithm can be made better if the number of layers is increased (requires more computational power for training).

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