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FISH SPECIES DETECTION USING COMPUTER VISION

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Abstract- Recommending a way for the automated detection of fish species using computer vision is the target of this paper. High accuracy of fish classification is widely used in order to understand fish behavior for the fishermen and the fishing community by large. Endangered species in water bodies concern multiple institutions. The existing methods address classification of fish only as a classification model which is not real time because implementing real time classification through an usable application poses challenges. This method uses techniques based on Convolutional Neural Networks, Deep Learning and Image Processing to achieve maximum accuracy and it ensures a considerably user friendly system with accuracy improvements.

Keywords*- Fish Species Detection, Computer Vision, Deep Learning, Convolutional Neural Network*

I INTRODUCTION

India is the third largest fish producing country and the second largest aquaculture fish producer in the world. India contributes about 7% to the global fish production. The country is also home to more than 10% of the global fish biodiversity and is one of the 17-mega biodiversity rich countries. Around 14 million people are engaged in fisheries and its allied activities [1]. Thus fishing is an important economic activity. Counting and tracking of fish populations is one of the most essential errands for conservation as well as for the fishing industry.

Fish species recognition is a problem of multi-class classification. The following proposed method uses Convolutional Neural Networks which ensures a simpler process and a robust system even while working with a large dataset. Convolutional Neural Networks are flexible such that it can adapt to the new incoming data as the dataset matures and even when under maintenance.

Computer vision techniques provide an attractive way for building a robust and versatile fish counting system.

The data for the research was used from Robotics@QUT [2].

Building a usable mobile application in order to help the user easily and accurately detect the fish species is of immense importance. With a well-trained algorithm and user friendly interface one can make it possible.

II SURVEYED METHODOLOGY

I Dataset Curation:

Building any Machine Learning model, involves the major step of curating appropriate data. In this case it is the collection of images of the required fish species. For our study we have made use of the fish dataset from Robotics@QUT [1].

The major steps that need to be followed while curation of dataset are as follows:

1) Data Collection: Getting fish images as the raw dataset. It could be from online sources or by actually clicking pictures of various fish species.
2) Data processing: Cropping out the fish images from the whole image needs to be done. This has to be done manually in order to ensure precise images for training purposes. This step inturn will significantly increase the accuracy of the model by making clearer understanding of features

based purely on the fish without any background noise.

3) Data splitting: After having a huge dataset of thousands of images cleaned, augmented, labelled properly and sorted according to the species under consideration, we need to split it into training, testing and validation images for each species.

According to an article by Julian Depois about solutions and tips to deal with data, "The winner is not the one with the best model, it's the one with the best data."[3] Thus the ideal splitting should be as follows:

-Train the model over the training set.

-Test the model on the validation set to avoid over fitting.

-Pick the most promising model. Test it on the testing set, in order to get the true accuracy of the model.

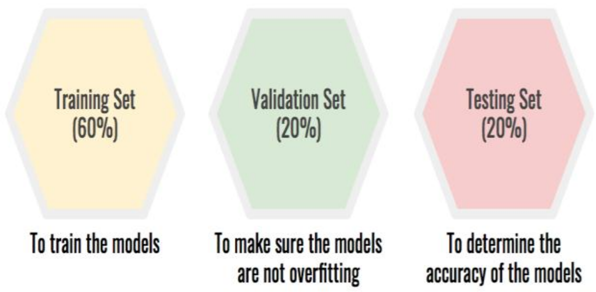

Figure 1 : Recommended splitting of data

Doing this will protect your testing set from being overfitted by the choice of the model.

Let us consider an example of training the model to detect the acanthistius cinctus fish.

Figure 2 : Raw image

Figure 2 is a raw image obtained of the fish in its natural form. It includes the required features with additional background which can pose as noisy data. Thus after manually processing the image Figure 3 is what we get.

Figure 3 : Processed image for training

Thus the new image can be used for training the model to precisely learn about this fish.

Once the images are labelled well, in order to incorporate it into the system we will have to refine the dataset as per relevant species ie. According to coastlines and create area specific repositories. Thus the same system can be reused across the globe.

Furthermore, periodic addition of new species to keep the system updated will be required as a maintenance step.

II Classification algorithm: Convolutional Neural Networks

In a variety of fields related to pattern recognition; from image processing to voice recognition, Convolutional Neural Network has had ground-breaking results. Reducing the number of parameters in ANN is the most beneficial aspect of CNN. It is due to this that has motivated the developers and researchers to make use of it for more complex problems difficult to be solved by classical ANNs. The key assumption while using CNN was that the features are spatially independent. Simply put, we assume that the appearance of features are not correlated, for example the features like eyes, fins, scales of fish can appear in any manner and are not relatively placed. Also, in CNN

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as the input propagates into deeper layers of the model, the features can be extracted as they become more conspicuous. For example, in image classification, the edge might be detected in the first layers, and then the simpler shapes in the second layers, and then the higher level features.

ANN is a computational processing system that is inspired from the working of the biological nervous system like the human brain [7]. Just like the brain consists of thousands of neurons that are interconnected and result in a layered working for human perceiving and understanding. CNNs (ConvNet) are a class of deep ANNs, which are applied to analyze visual imagery [8]. It is constituted by activation functions, some related bias and neurons that carry weight. CNN comprises input, hidden and output layers, which carry out operations that alter data in order to investigate the specific features. Convolution, activation or rectified linear unit (ReLU), and union are the three of the most common layers[6]. CNN is one of the most impressive architecture among the other ANNs.

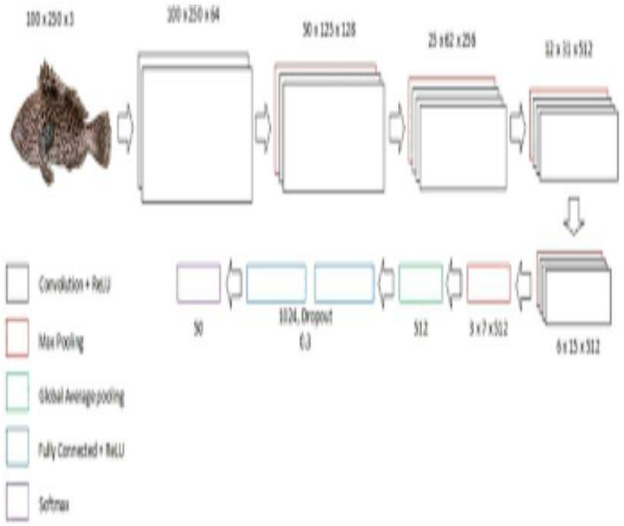

Figure 4 : Abstract view of proposed VGG16 Architecture

1) **Convolution:** Convolution exposes the input image through a series of convolutional filters, which activate the corresponding features of the image. It is done by mapping negative to zero values and maintaining positive values for the matching features.

2) **Activation:** ReLU is referred to as activation, because only the activated feature is carried forward to the next layer. Simplification is done by pooling output through non-linear down sampling. Doing this we can reduce the number of parameters that the network needs to learn. These three operations are repeated across more than tens or hundreds of layers, in which each learning layer is associated with different features. ReLU enables faster and more effective training.

3) **Union:** The next layer is responsible for the amalgamation of the previously mentioned steps. This layer is a fully connected layer that results in a K-dimension vector. Here K is the number of classes that the network can predict. This vector contains probabilities for each class of any classified image. The last layer of the CNN architecture uses a classification layer such as softmax to yield a classification output of more than two classes or sigmoid to generate output classifications of fewer than or equal to two classes.

VGG16 is one of the VGGnet models that uses 16 layers as a model architecture (Figure 4). A normal VGG16 consists of 5 convolutional blocks before connecting to a classifier. The convolutional block is connected to the three MLP layers that comprises two hidden layers and one output layer. The output layer consists of nodes that directly represent the number of classes, and softmax activation functions (for more than two classes) or sigmoid activation functions (for classes fewer than or equal to two) [5].

III Expected Implementation:

1. Create Front end for Mobile Application. To build UI accepting details of a fish image and details such as geographical location.

2. To successfully classify a fish according to their species for the input image. Maintain a record of all classification.

3. Enable the user (local fishermen) to get information about the type of fish species available and their quantity in a specific geographical area.

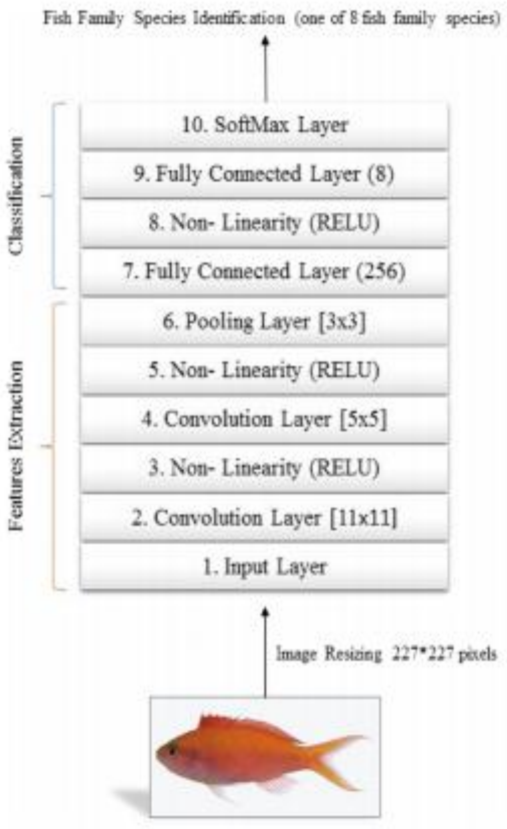

Figure 5: Detailed component architecture for the proposed deep CNN system [10]

Input: Image of a fish.

Output: Classification of the fish according to its species.

Success Condition: Species of fish identified correctly.

Failure Condition: False classification of fish species

III CONCLUSION

A curated amalgamation of appropriate data, well trained CNN model, and friendly application will result in a modern system that could be used globally for detecting fish species easily at all levels of the fishing community.

The final outcome would be a system that keeps records of each species of fish classified and also knowing about specific properties of a particular species, freshness of a fish and many more. The application developed can be used on a large scale by fishermen and consumers to classify a fish. Further on it can be expanded to predict the population of fishes in a geographical area, freshness of a fish and check if the fish is edible.

This project has a large area of application:

• Fishermen community.

• All industries related to fishery directly or indirectly.

• Organizations related to monitoring of oceans and marine life.

Applications are not limited to particular areas but can be used all over the world.

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