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Bird Species Identification UsingDeep Learning Techniques

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Abstract:
Identification of bird species is an important task in biodiversity preservation and ecosystem maintenance. Birds also help in various activities like agriculture, landscape formation, coral reef formation, etc. Identification and observation of the bird species is a vital task in ecology. Due to the development inthe field of machine learning, the automatic classification of bird species has been made simple. The advancements in technology led to the development of various bird species classification systems. Mostly, a web application or mobileapplication will be developed to display the result of the classification model. This paper presents the implementation details of bird species identification using a Convolutional Neural Network.

Keywords. Bird species classification, Feature extraction, Deep learning, Convolution Neural Network (CNN).

1. Introduction

In recent years, deep learning techniques, like convolutional neural networks (CNNs), have caught the attention of environmental researchers. Deep learning techniques and methods are implemented in the field of ecology and research to successfully identify the animal, bird, or plant species from images. A lot of importance is given to bird species classification because of its attention in the field of computer vision and for its promising applications in environmental studies. The identification of bird species is a challenging task in the research field as it may sometimes lead to uncertainty due to various appearances of birds, backgrounds, and environmental changes. Recent development in the deep learning field made the classification of bird species more flexible.

Birds play an essential role in the ecosystem by directly influencing food production, human health, and ecology balance. Various kinds of challenges have been faced by ornithologists for decades regarding the identification of bird species. Ornithologists study the characteristics and attributes of birds and distinguish them by their living within the atmosphere, and their ecological influence. on bird species have led to the development of applications that can be used in tourism, sanctuaries, and additionally by bird watchers.

Several bird species in the world are critically endangered, vulnerable, and near threatened. The development of bird species classification system can help the authorities to keep track of birds in a particular area by observing each species of bird. In recent years, studies In our work, the dataset is collected using internet resources. Before using the dataset for the classification, the images will be preprocessed. The CNN algorithm is used for the classification. The preprocessed images will be used for feature extraction and classification. The model will be trained and tested to produce a favorable outcome.

2. Prior work

[1] In these nine features of color-based maremeasures of mean, standard deviation, and skewness of red, green, and blue (RGB) planes are found in bird images. SVM algorithm was implemented for feature extraction and classification. A fast detection model known as SDD

was used for predicting the locations of the multiple category objects in an image. The stochastic gradient descent (SGD) algorithm was used to train the SVM classifiers. In [3], a CNN-based architecture had been proposed for bird species classification. Histogram of Oriented Gradient (HOG) had been utilized for feature extractionand the LeNet model was chosen for the classification process. [4] This paper proposed a Machine Learning approach to identify Bangladesh birds. The VGG-16 network was applied for feature extraction and SVM was applied for the classification of bird species. AMobileNet model [5] was proposed for the classification of Indian species. A transfer learning technique was used to retrain the MobileNet model.[6] A bird species classification model using a deep convolution neural network was proposed. SoftMax layer was used in CNN to improve the performance of the system.

A Deep Convolutional Neural network [7] was used and parallel processing was carried out using GPU technology and theGoogleNet framework had been applied to identify the bird images. In this [8], a novel deep learning model was proposed to classify bird species along with another deep learning model using pre-trainedResNet architecture. The end-to-end deep network for fine-grained visual categorization [9] called Collaborative Convolutional Network (CoCoNet) was proposed and the implementation and performance of the model were based on the Indian bird's dataset.[10] A transfer learning-based method using InceptionResNet-v2 was developed to detect and classify bird species. Swapping of misclassified data between training and validation datasets and fivefold cross-validation was performed. An Artificial Neural Network was proposed after selecting a combination of features from shape, color, and texture features [11]. The classification was done by using Multilayer Perceptron (MLP). [12]Here, a multi-scale Convoluted Neural Network with Dataaugmentation Techniques was used to train the system and a skip connection method was used to improve feature extraction.

3. Algorithm

This paper discusses the implementation of CNN to identify bird species. A convolutional neural network (CNN) is a class of deep learning algorithms that utilize machines to take in input images, assign weights and biases to various aspects and
objects in the image, and identify patterns in the image.CNN's consist of the input layer, which is a grayscale image; the output layer, which is a binary or multi-class label; and the hidden layers, which are convolution layers, ReLU layers, pooling layers,and a fully connected neural network.In the field of image processing, CNN is a powerful algorithm. These algorithms are currently the best available for automatingthe processing of images. Images are made up of RGB combinations.
Three Layers of CNN:
Convolutional layer: An input neuron is connected to each hidden layer in a neural network.In CNN, only a small portion of input neurons are connected to the hidden neurons.

Pooling Layer: Feature map dimensions are reduced by this layer.There will be multiple activation & pooling layers within the hidden layer of the CNN.
Fully-connected layer: Layers that are fully connected from the last few layers in a network. The output from the final pooling or convolutional layer is flattened and fed into the fully connected layers.

4. Dataset

First, the dataset was collected from the resources available on the internet. There are six different bird species or classes with more than 100 images per class. The bird species are American Goldfinch, Barn Owl, Carmine Bee-eater, Downy Woodpecker, Emperor Penguin,

and Flamingo. The model will be trained on this dataset.

Figure 1. Bird Images

5. Preprocessing

Image pre-processing involves working with images at the lowest level of abstraction possible. These operations do not increase the level of information in the image, but rather decrease it if entropy is a measure of information. In addition to cleaning image data for model input, image preprocessing can also decrease model training time and increase model inference speed. If input images are exceptionally large, reducing these images will dramatically improve model training time. It reduces distortions or enhances certain features for further processing, although geometric transformations (e.g. rotation, scaling, translation) are often necessary.

6. Implementation

After preprocessing the images, that is after splitting the images into training and validation datasets. Next, a network architecture for the model will be created. The different types of layers are used according to their features namely

1. Conv_2d: It is used to create a convolutional kernel that is convolved with the input layer to produce the output tensor

2. Max_pooling2d: It is a downsampling technique that takes out the maximum value over the window defined by pool size.

3. Flatten: It flattens the input and creates a 1D output.

4. Dense: Dense layer produces the output as the dot product of input and kernel.

5. In the last, a softmax layer will be used as the activation function because it is a multi-class classification problem.

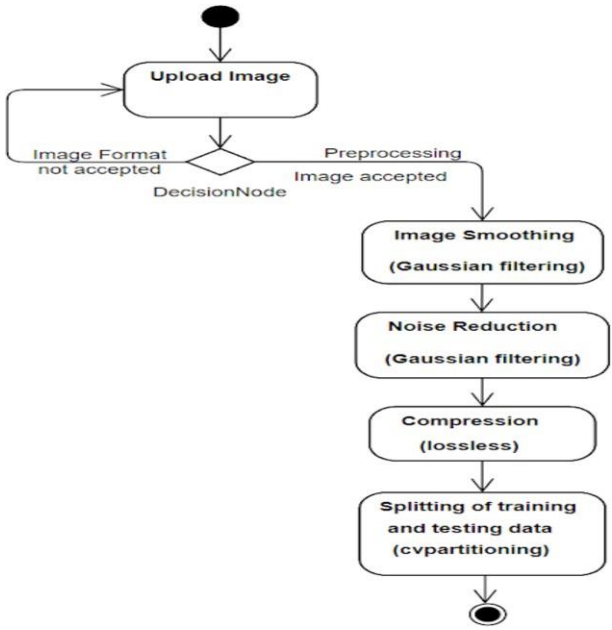

Figure 2. **Flowchart**

Now the model will be trained on 50 epochs and a batch size of 128. During eachepoch, the model performance can be determined by the training and validation accuracy. Next, the accuracy of the model for the training history and the loss of the model for the training history will be plotted.The prediction and the original label of the image will be displayed using the argmax() function. At last, a web application will be developed to display the result of the model.

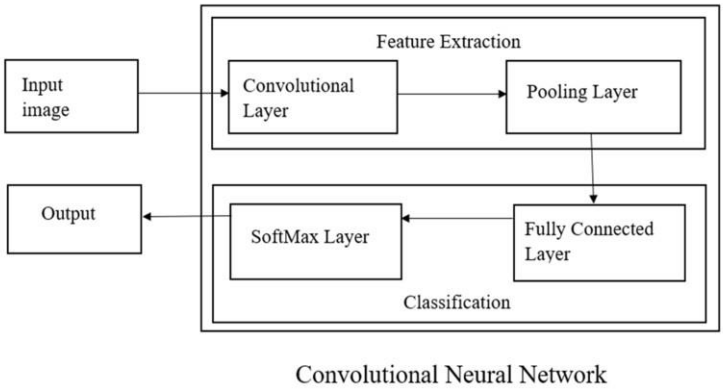

Figure 3. **Implementation process**

7. Result

A bird image will be given as input to the model and the species of the bird will be displayed along with the image.

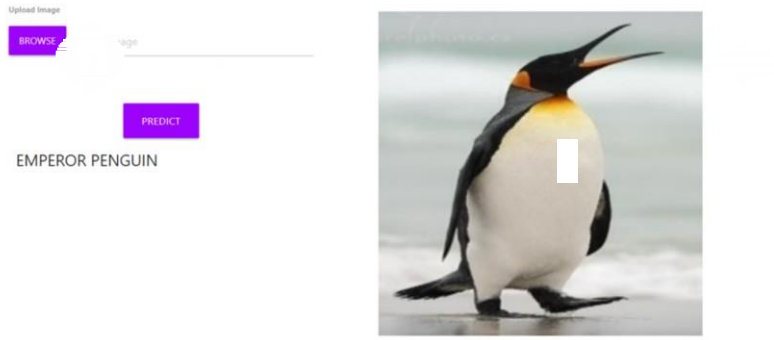

Figure 4. Output Screenshot

The following graph shows the model accuracy and was plotted with epochs along the x-axis and accuracy rate along the y-axis.

8. Conclusion and Future work

Identifying bird species from an image input by the user is the main goal of the project. The Convolutional Neural Network was used as it provides good numerical precision accuracy. The accuracy was about 87%-92%. Wildlife researchers can use this to keep track of wildlife movement and behavior in specific habitats. Various deep learning techniques can be applied in the future to enhance the accuracy and performance of the model. The future work also includes developing a mobile application for more convenient use. Also, this can be implemented in real-time monitoring of bird species in sanctuaries.

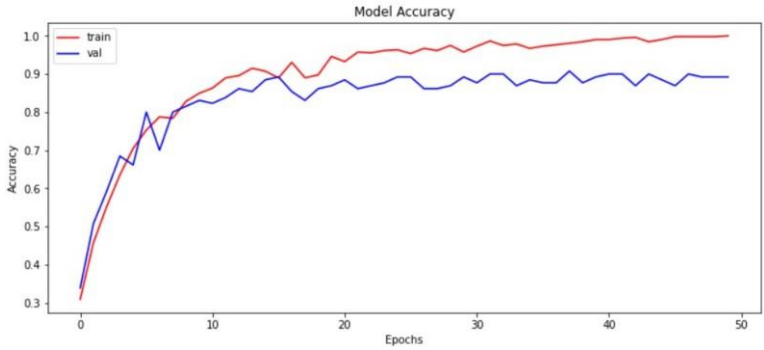

Figure 5. Accuracy Graph

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