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# BIRD SPECIES CLASSIFICATION USING DEEP LEARNING

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***Abstract:*** *Birds are the warm-blooded vertebrates constituting of class Aves, there are nearly 10 thousand living species of birds in the world with multifarious characteristics and appearances. Bird watching is often considered to be an interesting hobby by human beings in the natural environment. The human knowledge over the species isn't enough to identify a species of bird accurately, as it requires lot of expertise in the field of Ornithology. This paper presents an automated model based on the deep neural networks which automatically identifies the species of a bird given as the test data set. The model was trained and tested for 20 species of birds with the total images 7637 and 1853 images for train and test respectively and the model has shown A promising accuracy of 98% when tested with the test datasets.*

***Keywords: Convolution neural network, Artificial Intelligence, Machine Learning, Image Classification.***

## 1. INTRODUCTION

Numerous people visit bird sanctuaries to see various birds and to enjoy the beautiful variants of colors and characteristics of the birds, People barely have the knowledge about the various species and hence cannot easily distinguish the characteristics and the species name without the expertise in the field of ornithology. Bird watching is usually considered to be a good recreational activity that most of the people do practice besides their usual life style. The automatic identification and classification of birds by making use of the modern artificial intelligence and machine learning motivates the development of the proposed model. Deep Learning is a subset of machine learning comprising of various algorithms and was inspired by the human neural networks, the algorithms imitates the working of human brains in processing of the data and produces a pattern of data for decision making. This paper presents an approach of convolution neural network model for identifying the species of birds. CNN is commonly applied for analyzing the visual imagery and image Classification usually refers to taking an input of an image and classifying it to some particular class, here in we have presented a CNN based classification model which classifies the bird species given a bird image as input. The convolution neural network model is capable of extracting the variant features based on size, shape and color from the images and are hence capable of successful classification.

### 1.1 Motivation

Identification of species requires the assistance of manual bird books. So, it also requires expertise in the field to identify the species accurately. Few Species of Birds look very familiar in their appearances thus identifying the exact species by humans may be error prone.

### 1.2 Aim and Objectives

The main aim of the proposed work is to develop an automated model which has capability of identifying the species of the bird where bird image is given as a test image from the dataset The main objectives are to develop an automated model by making use of train and test-colored images of birds in order to identify/ classify the bird species to particular class of its species.

### 1.3 Proposed System

This study developed a platform that uses deep learning for image processing to identify bird species from digital images uploaded by an end-user. The proposed system could detect and differentiate uploaded images as birds. With an overall accuracy is high for the training dataset using CNN model. This study ultimately aimed to design an automatic system for differentiating among bird images with shared fundamental characteristics but minor variations in appearance.

## II. LITERATURE SURVEY

The earlier approaches for the species identification involved the bird songs where audio feature extraction was based on MARSYAS framework [1] and the classical Machine learning algorithms for classification, the visual features i.e. SIFT (Scale invariant feature transform) [2] from bird images and acoustic features both were used to train a standard SVM for classification. The fine-grained visual categorization [3] have shown great results of classification.

The trajectory features, turn based features and shape movement features and wing beat frequencies [4] were considered from the video captures of bird moments and a combined naive Bayes classifier and SVM was used. The MFCC (Mel frequency cepstral centroids) [5] formed a feature matrix for class model and SVM was used to test the samples. The mean standard deviation and skewness of the RGB planes [6] of bird images have helped in classifying the species.The ratio of distance of eye to the root of beak and the distance of width of the beak were also primarily considered for classification. An HSV model [7] (which is a combination of RGB and CMY) features were considered for color-based species identification. A transfer learning-based method with multistage learning [8] was used to mine both micro and macro level features from the bird images for classification in the recent years.

## III. METHEDOLOGY

The methodology acquired to build this model is as follows

### 3.1 Image Acquisition

Images of 20 Species of different birds were collected from the online internet sources, and were used for training and testing of the Deep neural network model.

### 3.2 Preparing the Dataset

The collected images were divided into train and test datasets i.e. 80 percent of the total images of the species were used as training data and the remaining 20 percent for the purpose of testing the trained model. The total number of train and test images with the species name is as follows (Given in the table form):

| DATASET OF BIRD SPECIES WITH THE NUMBER COUNT | | |
|---|---|---|
| SPECIES NAME | TRAIN IMAGES | TEST IMAGES |
| Black_footed_Albatross | 345 | 87 |
| Bobolink | 320 | 80 |
| Brewer_Blackbird | 332 | 84 |
| Cardinal | 307 | 77 |
| Crested_Aukle | 336 | 84 |
| Gray_Catbird | 553 | 139 |
| Groove_billed_Ani | 336 | 84 |
| Indigo_Bunting | 313 | 79 |
| Laysan_Albatross | 332 | 84 |
| Lazuli_Bunting | 358 | 90 |
| Least_Auklet | 536 | 135 |
| Painted_Bunting | 369 | 93 |
| Parakeet_Auklet | 369 | 93 |
| Red_winged_Blackbird | 388 | 98 |
| Rhinoceros_Auklet | 356 | 90 |
| Rusty_Blackbird | 474 | 119 |
| Sooty_Albatross | 374 | 94 |
| Spotted_Catbird | 320 | 80 |
| Yellow_breasted_Chat | 336 | 84 |
| Yellow_headed_Blackbird | 313 | 79 |
| Total | 7967 | 1853 |

### 3.3 Dataset Preprocessing

The collected image datasets have to be preprocessed before they can be used for training the model. All the images are first scaled to same image size ratio and by making use of the CV2 libraries the image datasets are converted to the image pixel arrays. In order to reduce the harshness, Noise and disturbances in the images the pixel values are normalized and then can be used for training the model.

### 3.4 Convolution Neural Network for Bird Species Classification

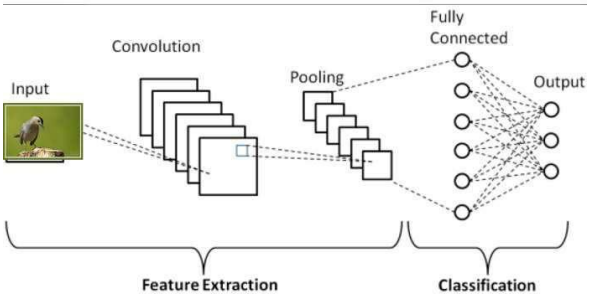


**Figure 1. The Convolution neural network model for bird's species classification.**

A convolution neural network is a Deep learning algorithm which takes input images assign importance to various contents of the images and is self-capable of differentiating one from another. The input image is nothing but the pixel values in the computer vision, The RGB image consists of three planes RED, GREEN, BLUE. The main role of convolution neural network is to reduce the image into the form which is easy to process and to effectively mine all the features that could help in best classification.

#### 3.4.1. Convolution Layer

The main purpose of the convolution layer is to extract high level features from the image. There is no limit for the number of these layers in the network, by including more layers we are capable of extraction every minute and major feature from the images such as edges, color gradients, Orientations etc. This layer makes use of kernel for generating the Convolved feature output, the kernel strides all through the image pixel values to generate a convolved feature matrix for the particular image.

#### 3.4.2. Pooling Layer

Similar to convolution layer, the pooling layer is capable of reducing the spatial size of the convolved feature matrix by performing the pooling functions over it. This layer is responsible for extracting the dominant features from the images. We have used the Max pooling function which returns the maximum value from the portion of the image covered by kernel.

#### 3.4.3. Fully Connected Layer (FC Layer)

Fully-Connected layer is a method of learning nonlinear combinations of the high-level features as represented by the output of the convolutional layer. After we have converted our input image into a suitable form for our Multi-Level Perceptron, it is necessary that we shall flatten the image into a column vector. The flattened output is fed to a feed-forward neural network and back propagation applied to every iteration of training. Over a series of epochs, the model is able to distinguish between dominating and certain low-level features in images and classify them using the SoftMax Classification technique.

## IV. RESULTS

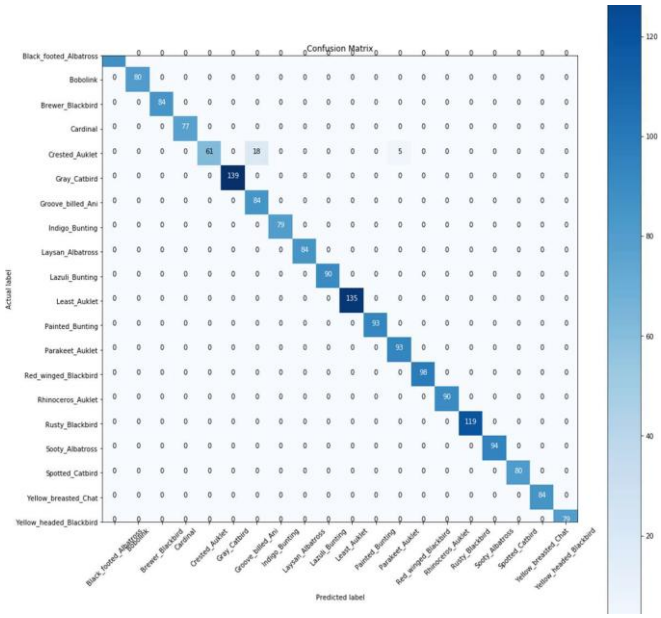


**Figure 2. The confusion matrix for the classification model.**

The develop model was successfully tested using the test image datasets and the accuracy of the model built was found to be 98.75% overall.

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

## V. CONCLUSION

This model helps building applications that helps tourist who go onto bird sanctuaries identify the bird species by just capturing a picture of a bird and uploading it as input to the model. As many species of birds have become endangered and are near to extinction many people have no knowledge about the species which are few in number, Thus application built using this model may be helpful in identifying the endangered species and help society in spreading awareness about the need of all the species for balance in the nature. As the model implies the knowledge of Deep Convolution neural networks, we can infer that the CNN is the best algorithm for analyzing the visual imagery and image Classification.

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