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Bird-O-Pedia An Automated Bird Classification System

Dhruv Yadav[1],Arvind Gupta[2], Atul Kumar Gupta[3], Sunny Tiwari[4], Kumud Alok[5]

[1,2,3,4]Computer CSE dept., IPEC Ghaziabad
[5]Assistant Professor CSE dept., IPEC Ghaziabad

Abstract - Classifying a bird requires lots of knowledge, as Birds exhibit different features like color, beaks, wings, eye size, tail, sound, and live-in different inhabitants. Remembering species-specific information is not easy as there are around 9000 to 10,000 species. In this paper, we proposed a system backed by the CNN model which can identify a bird from an image and can provide information about that species. Our model is trained, validated, and tested on more than 28000 images of 200 species of birds. It model provided 97.44% accuracy on the training dataset and 98.40% on the testing dataset.

Key Words: Image classification, Convolutional Neural Network, Artificial Intelligence, Machine Learning.

1.INTRODUCTION

Birds can be found singing, chirping, and flying up and down from dawn to dusk, or activities like bird watching. Sometimes we can identify them or sometimes we aren't able to do so. This problem is not only faced by a normal person but also by an ornithologist. birds exhibit different colors, beaks, wings, eye sizes, tails, sounds, and live-in inhabitants. For this, we require a record book which contains the data of different birds. Searching for that is a hectic task. Many works have been done to identify birds but they were mainly based on their voice, as we know that collecting audio data is not only difficult but also contains much noise which results in erroneous results. So, we come up with an efficient method of Deep learning with CNN based web app which not only classifies a bird image but also provides basic information about that bird. The central objective of this system is to provide bird detail by just uploading images of that bird, we can also get information about a bird by using their name from the system in case we know bird's species. In this paper, the transfer learning [8] technique was used to retrain the InceptionV3 [7] model from Keras was used on the dataset of "two hundred" different bird species. The structure of the InceptionV3 [7] model which we used as a based model is described in section 3. Processes involved from data collection, model training to application working are explained in section4. Model evaluation is described in section 5. We concluded our work in section 6

Literature Survey

Table -1: Literature Survey

Paper	Writer Name	Description
1-PakhiChini: Automatic Bird Species Identification Using Deep Learning(IEEE)(2020)	Kazi Md Ragib, Raisa Taraman Shithi, Shihab Ali Haq, Md Hasan, Kazi Mohammed Sakib, Tanjila Farah	In this paper propose a deep learning model that is capable of identifying individual birds from an input image.. Authors tend to additionally leverage pretrained ResNet models as pre-trained CNN networks with base models to encode the images. We achieved a top-5 accuracy of 97.98% on our classifications .
2- Bird Species Identification using Deep Learning on GPU Platform(IEEE)(2020)	Pralhad Gavali,J.Saira Banu	In this experiment for training purpose 500 labeled and 200 unlabeled data are used for testing. For classification, Deep Convolutional Neural Networks was used. Final results show that the DCNN algorithm can be predicted at 88.33% of bird species.
3-Learning Semantically Enhanced Feature for (FGIC) Fine-Grained Image Classification (IEEE)(2019)	Wei Luo, Hengmin Zhang, Jun Li, and Xiu-Shen WeiWei	In this paper the author achieves the sub-feature semantic by arranging feature channels of a CNN into different groups through channel permutation. Experiments verified the effectiveness of our approach and validated its comparable performance to the state-of-the-art methods with accuracy of 94%.
4- MobileNet Model for Classifying Local Birds of Bangladesh from Image Content Using Convolutional Neural Network(IEEE)(2019)	Md. Romyull Islam, Nishat Tasnim, Shaon Bhatta Shuvo	In this experiment MobileNet Model is used on a dataset of 5 species with size 100 images and at the end they get 100% accuracy in training and testing both.

5- Image based Bird Species Identification using Convolutional Neural Network(IJERT)(2020)	Satyam Raj , Saiaditya Garyali , Sanu Kumar	In this experiment used a CNN based model to classify bird species.the model achieved accuracy rate of 93.19% on training and 84.91% on testing dataset.dataset contains data of 60 species .
6- Bird Species Classification using [8] Transfer Learning with Multistage Training(IEEE)(2018)	Sourya Dipta Das and Akash Kumar	In this paper, they have introduced a Transfer learning[8] based method with multistage training. They have used both Pre-Trained Mask-RCNN and an ensemble model consisting of Inception Nets(Inceptionv3[7] net & Inception Resnetv2) to get the both localization and species of the bird from the images. And accuracy is about 55.5%.
7- Bird Species Identification using Deep Learning(IJERT)(2019)	Satyam Raj, Saiaditya Garyali, Sanu Kumar, Sushila Shidnal	This experiment has used Deep Tensorflow library , Convolutional Neural Network and Unsupervised learning algorithm to identify dataset of 200 birds (Caltech-UCSD Birds 200 [CUB-200-2011]).They provided 80% accuracy in predicting bird species identification.
8- Color-Based Bird Image Classification using Support Vector Machine(IEEE)(2020)	Rosniza roslan,Raseeda Hamzah, Nursuriati Jamil, Nur Amalina, Nazery, Nursuriati Jamil	This paper is based on extracting the color properties from the bird which to represent the species of the bird and Investigated on nine color-based features of mean, standard deviation and skewness of each plane of red, green and blue (RGB) from the bird Images ,having 100 image of each bird,it give 97.14% accuracy rate.

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2. EXISTING SYSTEM

In reference to our project "Birdopedia", we don't have such systems that exist the same. Few apps provide information by using image classification for which they require to install an application in their mobile which occupied memory space and each user is required to update their application individually." Birdopedia" is based on the mechanics of the client-server[10]. User has to simply visit the website and get the required information by using an image of a bird. this saves the user from installing the application.

3. BASE MODEL

Inception V3[7] model was introduced in 2015 ImageNet Recognition Challenge ,quartet of these model were able to achieve 2nd position in the challenge.It is able to achieve 78.1% accuracy on Imagnet dataset.The Inception V3[7] model is based on "Rethinking the Inception Architecture for Computer Vision"[arXiv:1512.00567 [cs.CV]] by Szegedy, et. al.

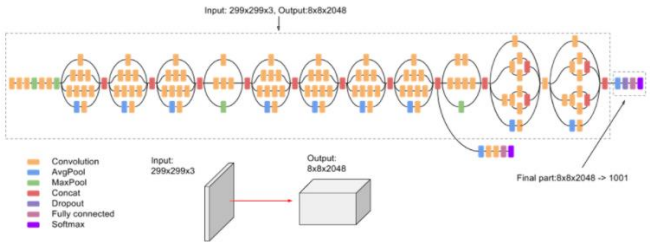

Fig -1: A high-level diagram of the model[9]

As described in the preprint, this model achieves 5.64% top-5 error while an ensemble of four of these models achieves 3.58% top-5 error on the validation set of the ImageNet whole image ILSVRC 2012 classification task. Furthermore, in the 2015 ImageNet Challenge, an ensemble of 4 of these models came in 2nd in the image classification task.In ILSVRC 2012 classification challenge InceptionV3[7] model was able to achieve 5.64% top-5 error while quartet of the model were able to achieve 3.58% top-5 error on validation set(3.5% on test set) and and 17.3% top-1 error on the validation set.
Model has used 1X1, 3X3,5X5 filter channels due to which the model grows wider in comparison to other convolutional neural network models,Having parallel filters of different help to learn at different scales.

4. METHODOLGY

Main purpose behind this experiment is to identify the images of bird and classify into a concern species and also give some relevant information about the species by considering the given objectives:-

- Bird species Identification is a major concern in ornithologists and also in our daily life when we are not sure about the species of the bird by our eyes.
- After watching the bird not only it's species is required but the watchers also want to know some information about the bird.
- By protecting bird species resources, it will provide our nation with prestige and value and also increase the beauty of our nature

A methodology block diagram is displayed in Figure:

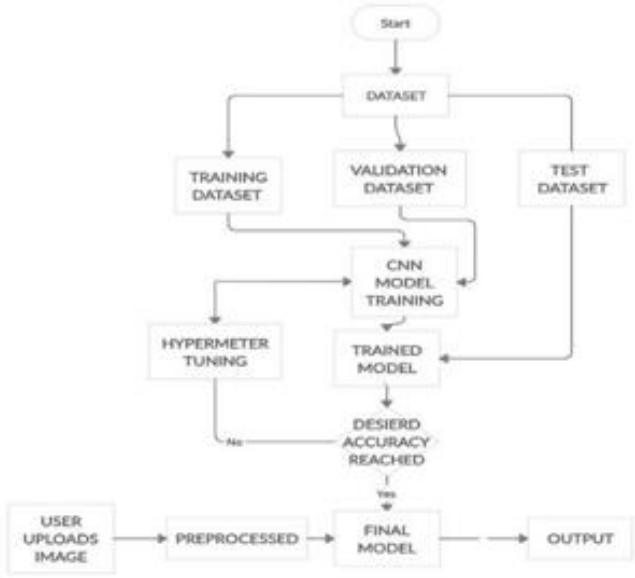

Fig -2: Methodology

1. The method shown is made up of four processes:
   A) Dataset
   B) Model Training
   C) Classification
   D) Testing
   E) User Interface

A. Dataset

Kaggle is a well-known site where data for different things is available.We have used a bird image dataset[12] with 200 category images which is present on kaggle . The dataset includes birds found In different parts of the world . Dataset is divided into training sets (contains 200 images of each), validating sets (contains 5 images per species) and testing (contains 5 images per species).

Fig -3: Dataset

B. Data Augmentation

Data augmentation is a process used to increase the amount of data by adding altered copies of already existing data or newly created modified data from existing data. To overcome model overfitting one of the steps is to increase the size of the dataset. Increasing the dataset is not possible every time so data augmentation helps us to increase the data synthetically.

C. Model Training

Dataset is divided and fed to the CNN model for the training.We have used Transfer learning[8] to increase the accuracy and reduce the training time.

(i) Transfer Learning[8]

Transfer learning[8] is the process of reusing the knowledge gained during previous training process. By using this technique, we don't require to train the starting layers of the model but the last layer of the model as they identify the minor feature required for differentiating between different classes.

D. Testing

During this phase we used a test dataset to evaluate the accuracy of the model. after rigorous training we achieved 96% on the testing dataset.

E. USER INTERFACE

a) Browse Image

Fig. -4: Browse Image

b) Output

Fig. -5: Output

5. EVALUATION

For the evaluation purpose, we have considered two parameters, which are accuracy and loss to assess model performance on a train, validate and test dataset. Where accuracy represents how accurately a model was able to predict the correct class label whereas Cross-entropy Loss Function shows how far our calculated output is from the actual output. From the Cross-entropy value, we can conclude how confident our model is in its output[11].

Despite having high accuracy, our model is facing high cross-entropy loss especially in the case of a validation dataset from which we can conclude that our model can correctly identify the class label but has low confidence in its prediction. It may be possible there are some images in the validation dataset that are accurately classified but the model has low confidence in its prediction as a result mean validation loss is high as compared to the train and test dataset loss[11].

Table 2. Evaluation Result

Dataset	Accuracy	Cross-entropy loss
Train	97.44%	0.107
Validate	94.30%	0.4939
Test	98.40%	0.0563

3. CONCLUSIONS

This study has used the InceptionV3[7] model for revealing an application that has data of 200 species and uses deep learning for data training and image processing. Images can be uploaded by the end-user from the system or by the camera as an input to perceive detailed information of birds. The current model has achieved an accuracy of 97.44% on training data and 98.40 % on testing data. This application can be adopted by tourists and regional people who want the information of bird's species present in the image.
In the future, we propose to work on more data, to classify the gender of species, create a mobile application, and Choropleth Map will present the bird's habitation more precisely. A Choropleth map also for presenting the migration routes that birds used during migration.

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