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Bird Species Identification and Prediction Analysis of Endangered Species

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Abstract - *Machine learning is an application of Artificial Intelligence that provides the system with the ability to automatically learn and improve from experience rather than explicit programming. Nowadays some bird species are being found rarely and if found classification of bird species prediction is difficult. Machine learning techniques can be used for identifying the birds using classification models. The paper highlights attributes which will reduce the risk of endangerment of such birds and predict the improvement in chances of their survival. This paper throws a light on the comprehensive survey on machine learning applications in bird identification and prediction analysis of endangered bird species.*

Key Words: Artificial-Intelligence, Endangered species, Deep Learning, Image Classification, TensorFlow.

1. INTRODUCTION

Biodiversity consists of many different species of birds and animals but people barely have any knowledge about them. There is a wide range of categories that they fall into like their colors, their chirping sound, appearance, location and many more. Thus the main aim is to identify the varieties of bird species and gain knowledge about them. Our system aims to employ the power of machine learning to help in identifying bird species through the images they capture and also analyze endangered species. The system not only detects the images of birds but also gives details like their scientific name, kingdom, location where they are mainly found, their status whether it is endangered or not, facts about the bird, ways to conserve them. Further it helps to detect the timeline of endangered species. Thus this paper presents an approach of CNN i.e. convolution neural network models for identifying birds. 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. A paper by Sefi Mekonen on "Birds as Biodiversity and Environmental Indicator" includes most of the points about identification and prediction of endangered species [29].

The idea aims to focus on predicting the time-span in which such endangered birds may go extinct and provide some valuable insight by adding other attributes to our prediction model. Also, analyze the positive effects of certain actions which can be taken by individuals or the government which can result in an increase of that remaining time span thus preventing the endangered and future birds . This will help users to gain information and knowledge about the importance of species and different small initiatives they can take in order to save biodiversity.

2. MOTIVATION

Identification of species requires the huge assistance and use of manual books. There is a huge variety of species in each bird with diverse color patterns, shapes, appearance, body organs and features. Thus, it becomes a difficult job for bird watchers and ornithologists who do scientific research study on birds to identify and study each species. Our systems aim to provide a solution to identify and do scientific study on birds along with providing all the details of each species like taxonomy, their chirping sound, geographic location, timeline, current threats and conservation actions.

3. LITERATURE SURVEY

The approach for the idea of using machine learning to analyze the patterns in biodiversity, for example using machine learning to forecast phenomena like migration, population growth, future presence etc is considered in our system. Practical applications of transfer learning methods are used to identify birds using images as input using TensorFlow. The process of detecting and identifying particular species is time-consuming and challenging.

The system Rajarshi Paul et. al. [21] proposed is about time series analysis, a machine learning approach is used for processing the time series data of birds, other features included were forecasting features like population growth, future presence and their migration. It was concluded that Polynomial interpolation is not suitable for analysis of population count. While the nearest neighbor interpolation method can be used to fill up the timeline (x-axis) of the time series carrying integer values along the y-axis. This can be useful to analyze dragonfly populations.

Madhuri Tayal [22] presents us the practical applications of using transfer learning methods to identify birds using images as input. The paper goes in detail about workings of the authors own system based on the idea using MATLAB. It was concluded

that transfer learning was suitable for bird identification when paired with technologies like MATLAB. The importance of identifying birds using image input was also realized in sectors of wildlife research and monitoring.

The system proposed by Bipin Kumar Rai [23] would recognize the input image by comparing the model with a trained model and then predict the bird species. The details would be given out as an output. Also, it will help us to build the dataset if any image captured or uploaded by the user is unavailable in the dataset then the user can add that image to the dataset.

Nyaga, G. M. (2019). A Mobile-based image recognition system for identifying bird species in Kenya (Doctoral dissertation, Strathmore University) [27] indicates that a Machine Learning Algorithm is used to classify images to detect bird species and to predict behavioral patterns. We have decided to use an image classification algorithm based on Transfer Learning which is similar to an existing model known as mobile net.

Table 1. Comparison with Existing Systems

Systems	Image Classification	Prediction Analysis	Location of a bird	Population	Ways to conserve
System 1 *[21]*	No	Yes	No	Yes	No
System 2 *[22]*	Yes	No	No	No	No
Proposed System	Yes	Yes	Yes	Yes	Yes

Table 2. Comparison with Existing Applications

Input given to the system	Output of the system 1 *[30]*	Output of the system 2 *[31]*	Output of Proposed system
Pink Robin	Pink Robin	Rufous-bresated bush-robin	99.99%, Pink Robin
Canary	Saffron Finch	Grey-fronted Green-pigeon	100% Canary (Island Canary)
Rock Dove	Rock Pigeon	Rock Dove	100%, Rock Dove

4. METHODOLOGY

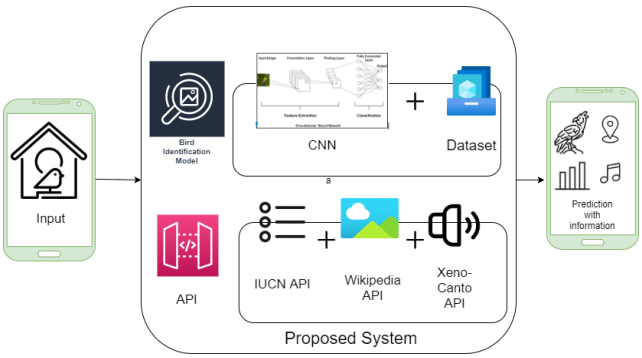

Figure 1. Methodology of Proposed System

4.1 DATA ACCUSATION

Images of 225 Species of different birds were collected from the kaggle website [28], and were used for training and testing of the Deep neural network model. Each Image has a resolution of 224 x 224.Each Bird has 5 test images and 5 valid images. Overall the dataset consists of 67132 images. We have used IUCN Red List API 2021 of Threatened Species to fetch information about birds [24]. Xeno-canto API is used on the back-end to fetch audio recordings of birds [25]. English Wikipedia API [26] is used to fetch images of birds.

4.2 PREPARING THE DATASET

The dataset found on kaggle was divided into two parts. 80 percent of the total image dataset was used for training purposes and 20 percent was used for testing the model. Source of Dataset in reference- 225 Bird Species Data set of bird species [28]. 31316 training images, 1125 test images (5 per species) and 1125 validation images (5 per species). All images are 224 X 224 X 3 color images in JPG format. Also includes a "consolidated" image set that combines the training, test, validation images into a single data set.

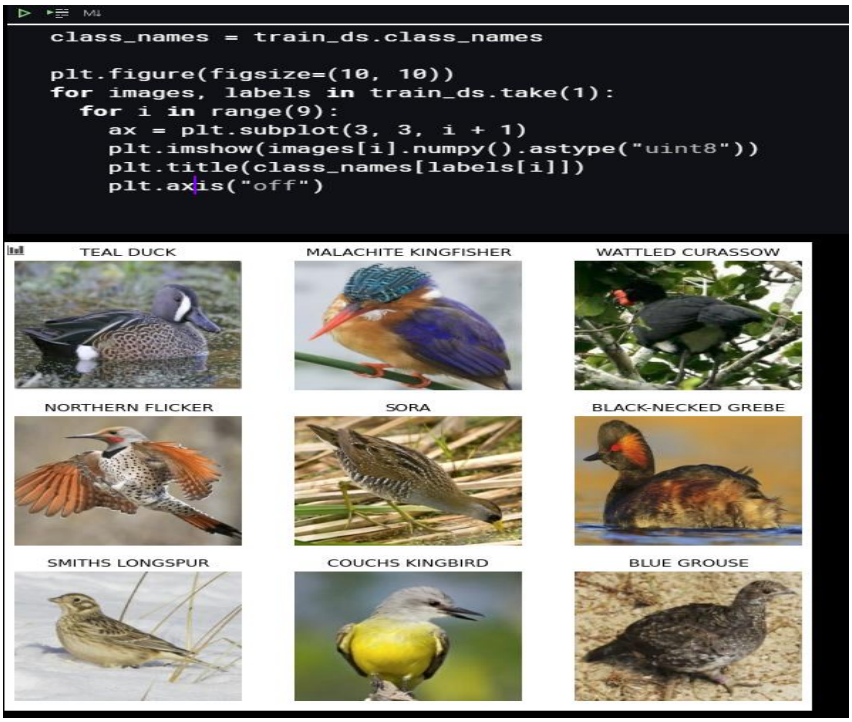

Figure 2. Preprocessing images and Sample images

4.3 DATASET PREPROCESSING

The data found on kaggel was inconsistent and incomplete having errors so data preprocessing technique was used to resolve these issues. The raw data was converted into understandable format to train the model. Data Preprocessing technique is used to convert the raw data into a clean data set. Real world data are generally incomplete, Noisy and inconsistent that's the reason data preprocessing is required. This also handles missing data if any in-case. For text preprocessing cleaning steps are Lower casing, Removal of punctuation, removal of stop words, removal of frequent words, removal of rare words, stemming and lemmatization. For image preprocessing the original images are cropped keeping only the characters and resize to 128x128 with adding the corresponding padding to maintain the aspect ratio. The stats of the produced images are also computed. Use of images allows us to avoid loading the entire dataset into memory, which may be important for running experiments at kaggle. Meanwhile the inference can be done by loading the dataset part by part without saving it as images to improve the speed.

4.4 CONVOLUTION NEURAL NETWORK FOR BIRD SPECIES CLASSIFICATION

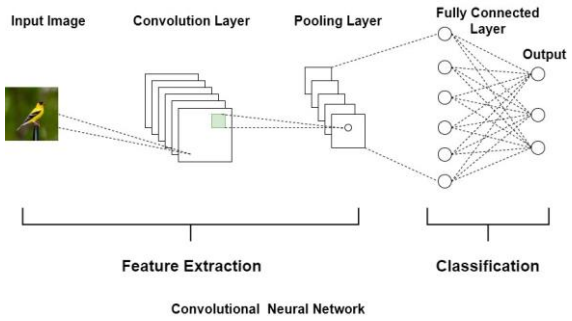

Figure 3. The Convolution Neural Network For Image Classification

Figure 2 is a representation of a Convolution Neural Network which is a Deep learning algorithm which takes an image as an input which is capable of differentiating one image from another on the basis of features. Convolution neural network's main task is to convert the image into a form which is easy to process and all the features should be mined efficiently that could help in accurate classification.

4.4.1 CONVOLUTION LAYER

The core component of CNN is convolution layer. The important parameters are the number of kernels and the size of the kernels. The more layers we include, the more capable is the extraction every minute. Features for the layer for the project are color, patterns, textures. This makes use of a kernel for giving convoluted feature output and convoluted feature matrix for the particular image.

4.4.2 POOLING LAYER

Similar to convolution layer, the pooling layer is capable of reducing the spatial size of the convoluted 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 the kernel.

4.4.3 FULLY CONNECTED LAYER (FC LAYER)

The input to the fully connected layer is the output from the Pooling or Convolutional Layer. After converting raw image to understandable image, it is required to flatten the image into column vectors. Then this output is fed to the forward neural network and iterations are used. After several iterations, the model is able to distinguish and classify the image.

5. RESULTS

The performance of our system was evaluated on 225 different species of birds. The model developed was tested using the test dataset successfully and calculated accuracy was 80%. The main purpose of the project is to identify the bird species from an image or by the name given as input by the user [Figure 5] and to provide the valuable information details about the bird and predict the analysis of endangered species is achieved successfully.

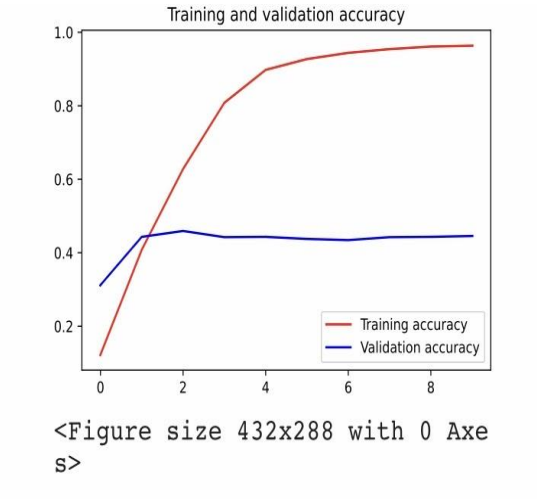

Figure 4. Accuracy graph

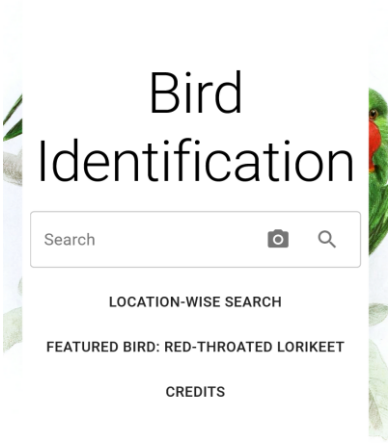

Figure 5. Home Page of Proposed System

Figure 6. Giving image as input

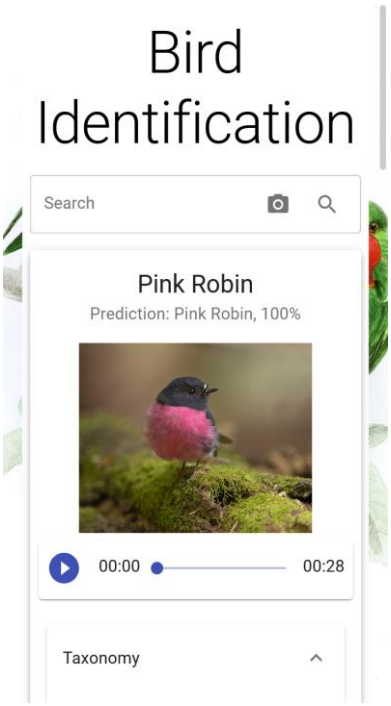

Figure 7. Output

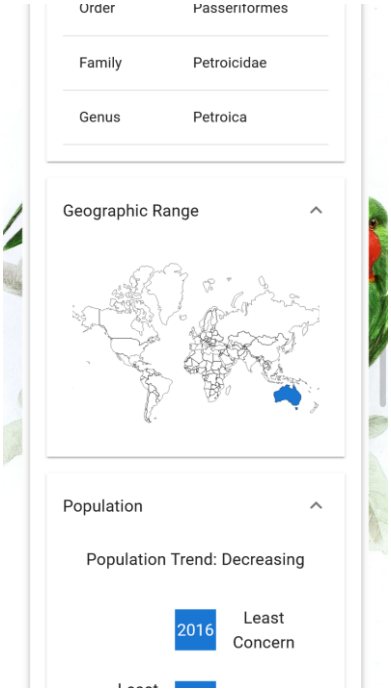

Figure 8. Output

6. APPLICATIONS

1. Users will get sufficient knowledge of information about each and every bird species present in our database. *[Figure 7]*

2. Our system is implemented in order to understand every common user without any ambiguity of bird's description.*[Figure 8]*

3. The extinct bird information is also provided with accurate reasoning.

4. This project extends a great deal of scope as the purpose meets. In wildlife research and monitoring, this concept can be implemented in camera traps to maintain the record of wildlife movement in specific habitat and behavior of any species.

7. CONCLUSION

In this thesis, we set out to improve the classification accuracy of the bird species. As many species of birds have become endangered and are near to extinction, people have no knowledge about the species which are few in number, thus application built using this model will 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 Convolutional neural networks, we can infer that the CNN is the best algorithm for analyzing the visual imagery and image Classification.

Through an analysis of the data set used we also found that the relative number of training samples for each bird species is quite uneven, which seems to lead to a favoritism, or over prediction, from the model of bird species with the most recordings, and that some bird species are harder to classify than others.

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