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BIRD SPECIES IDENTIFICATION BASED ON IMAGE FEATURE ANALYSIS

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Abstract

Species information is a critical component of preserving biodiversity. Because of the closeness of the birds' forms sceneries and image backgrounds and the viewer's lack of knowledge, distinguishing birds are amongst the most difficult roles for bird watchers. It is a demanding task that tests both humans' and systems' visual talents. Although distinct bird species have the same basic set of elements, their form and visual appeal can vary drastically. Correlation variance is high due to lighting and surrounding variations, as well as extreme diversity in stance. We present a deep learning model in this publication that is capable of the process of recognizing distinctive birds from an input picture using the Convolutional Neural Network (CNN) algorithm. By correlating the model to a trained model, this application would detect the input image and forecast the bird species. This system is proven to achieve good results in practice.

Keywords: Bird image recognition; Image classification; CNN algorithm; Deep Learning.

1. Introduction

Bird lifestyle and population dynamics have recently become a significant concern. Birds assist humans in detecting various living forms on the planet by reacting quickly to environmental changes. Nonetheless, coordinating and accumulating data on bird species takes a great deal of human effort and is a very expensive method. In this scenario, a strong is necessary to allow for large-scale data processing regarding birds while also serving as a significant infrastructure for scientists, government agencies, and other stakeholders. In this approach, bird species distinguishing proof plays an important role in determining which groupings a certain photograph of species belongs to.

Bird viewing is a leisure pastime that provides greater relaxation and happiness to people's brains. The intraclass and interclass characteristics that exist across bird species make classification a difficult undertaking. Bird species are classified into distinct groups based on their physical traits, colour, and form. Because of observer restrictions such as geography, range, and technology used to detect birds, recognizing birds with the naked human eye are based on fundamental typical aspects, and suitable categorization based on different features is sometimes seen as tiresome. A variety of techniques have become available to determine bird species. Deep learning is an emerging technique that can be used to identify birds. The convolutional neural network (CNN) is a deep learning neural network category. Convolutional neural networks represent a significant advancement in image processing and recognition.

In this paper, rather than identifying an excessive number of distinct categories, this research investigates the issue of recognizing an excessive number of classes inside a single category. Because of the extreme resemblance across classes, classifying birds present an extra hurdle. Furthermore, birds are non-rigid objects that will deform in a variety of ways, resulting in an enormous diversity within classes. Previous studies on bird categorization focused on a small number of classes or voices.

2. Related work

It was discovered, in particular, that ecologists monitor ecosystems in order to establish the variables driving population variability and to aid in the conservation and management of vulnerable and endangered species. The numerous surveys used to count bird species, as well as data gathering procedures, were briefly addressed. It wasdiscovered that a small but rising number of researchers have investigated the use of computer vision for monitoring bird species.

This part assesses reports of research available in theliterature that are linked to species monitoring and categorization. It focuses on evaluating avian methodologies utilized for these species, which are often comparable, as well as motion aspects that this research wants to examine for bird categorization.

Madhuri A. Tayal, Atharva Magrulkar, et al (2018) [1], developed a software application that is used tosimplify the bird identification process. This bird identification software takes an image as an input and gives the identity of the bird as an output. The technology used is transfer learning and MATLAB for the identification process.

Andreia Marini, Jacques Facon, et al (2013) [2], proposed a novel approach based on color features extracted from unconstrained images, applying a color segmentation algorithm in an attempt to eliminate background elements and delimit candidate regions where the bird may be present within the image. Aggregation processing was employed to reduce the number of intervals of the histograms to a fixed number of bins. In this paper, the authors experimented with the CUB-200 dataset and the results show that this technique is more accurate.

Marcelo T. Lopes, Lucas L. Gioppo et al (2011) [3],focused on the automatic identification of bird species from their audio recorded songs. Here the authors dealt with the bird species identification problem using signal processing and machine learning techniques with the MARSYAS feature set. Presented a series of experiments conducted in a database composed of bird songs from 75 species out of which problems were obtained in performance with 12 species.

Nyaga, G. M. (2019). A Mobile-based image recognition system for identifying bird species in Kenya (Doctoral dissertation, Strathmore University) [4] indicates that a Machine Learning Algorithm is used to classify images to detect bird species and predict behavioural patterns.

3. Existing System

Identification of bird species can be done using a photograph, audio, or video. An audio processing approach enables recognition by capturing the sound signatures of various birds. However, due to the mixed noises in the condition, for example, creepy crawlies, real-world items, and so on, management of such data becomes increasingly complicated. Images are typically discovered more successfully than audios or recordings. As a result, utilizing a picture rather than a voice or video to categorize birds is preferable.

Disadvantages:

a) Background noise: especially while usingdata recorded in a city.
b) Multi-label classification problem: This problem occurs when many species are singing at the same time.
c) Different types of bird songs with varyinglengths and quality of audio.
d) Inter-species variance: there might be differences in bird songs between the same species living in different regions or countries.

4. Methodology

4.1Proposed Deep Learning Algorithm:

The Convolutional Neural Network (CNN) is a deeplearning system that takes an input picture and assigns weights and distinctions to distinct features of the image, allowing it to differentiate one image from another. When compared to other classification methods, CNN requires substantially less pre- processing. CNN's architecture is quite similar to that of the pattern of neuron connectivity in the human brain, in which individual neurons respond only to stimuli in the receptive field. These receptive areas collectively overlap the entire visual area. The CNN model for bird species identification used a convolutional layer stack that included an input layer, two fully connected (FC) layers, and one final output SoftMax layer. Convolutional layers perform a convolution operation on the input and send the generated data to the next layer.

(a) Convolutional Layer: The convolution layer is the heart of CNN. The most essential factors are the number of kernels and their sizes. The more layers we incorporate, the greater the extraction capability each minute. Colour, patterns, attitudes, and textures are characteristics of the layer for this project. This uses a kernel to provide convoluted feature output and a convoluted feature matrix for the given picture.

(b) Pooling Layer*:* The pooling layer, like the convolution layer, can reduce the spatial size of the convoluted feature matrix by applying pooling functions to it. This layer is in charge of extracting the pictures' prominent characteristics. We utilized the Max pooling function, which returns the greatest value from the kernel-covered area of the picture.

(c) Fully Connected Layer (FC Layer): The outputof the Pooling or Convolutional Layer is sent into the fully-connected layer. After transforming the raw picture into a readable image, the image must beflattened into column vectors. This output is then input into the forward neural network, and iterations are performed. The model can identify and categorize the picture after numerous iterations.

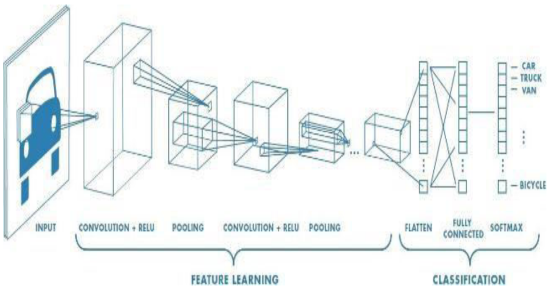

Fig. 1. CNN Architecture

4.2 Implementation

This section describes the implementation of the proposed deep learning platform for identifying bird species. The system receives the picture of the bird as input. With a collection of data, the software system has a trained model. The bird's picture is transformed to grayscale and subsequently to matrixformat.

Several alignments from the picture will be considered, and each alignment will be sent into the CNN for feature extraction. These extracted characteristics are fed into the CNN with the trained model, and the results are compared. The classifier divides the picture into distinct groups based on the comparing values. The predictive algorithm then forecasts the species of that specific bird, which is considered the final result. The network's output layer gives portions of the input picture including the bird.

4.2.1 System Design

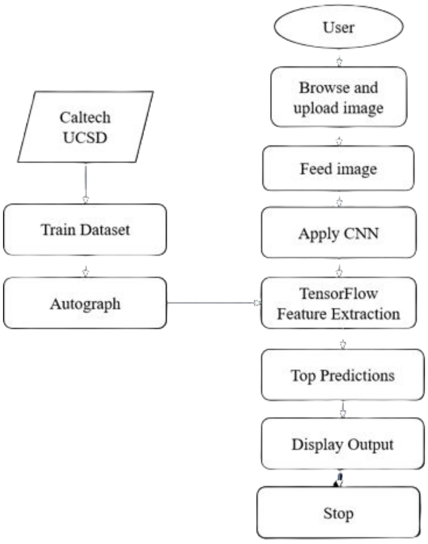

Fig. 2. Data Flow Diagram for the proposed deep learning model

Figure 2 depicts the procedure block diagram. The method shown is made up of five processes:
(a) Data Collection; (b) Image pre-processing; (c)DCNN Algorithm; (d) Identification and Analysis; (e) Evaluation.

(a) Data Collection:

Caltech-UCSD Birds 200 (CUB- 200- 2011) is a well-known bird picture dataset that contains photographs from 200 different categories. The dataset consists primarily of birds found in North America [5]. Caltech-UCSD Birds 200 includes
11,788 images and annotations, including 312 binary characteristics, 15 component locations, and 1 bounding box.

Fig. 3. CUB-200 dataset

(b) Image pre - processing:

Pre-processing created a grayscale picture dataset, which is utilized for pixel-by-pixel image identification and image size reductions. [6] These functions are then combined and sent to the classifier. This increases processing time while maintaining image quality.

(c) DCNN Algorithm:

This input file is fed to the device and forwarded to DCNN where a suitable dataset is coupled withCNN [7]. A DCNN is made up of various convolution layers. To maximize categorization accuracy, several alignments or aspects such as head, body, colour, beak, shape, and full bird pictureare evaluated.

(d) Identification and Analysis:

TensorFlow is a software library developed by Google that is open source in nature. It enables developers to monitor and alter the settings of each neuron (node) to produce the desired result [7]. TensorFlow generates an autograph by sequencing processing to improve recognition accuracy.

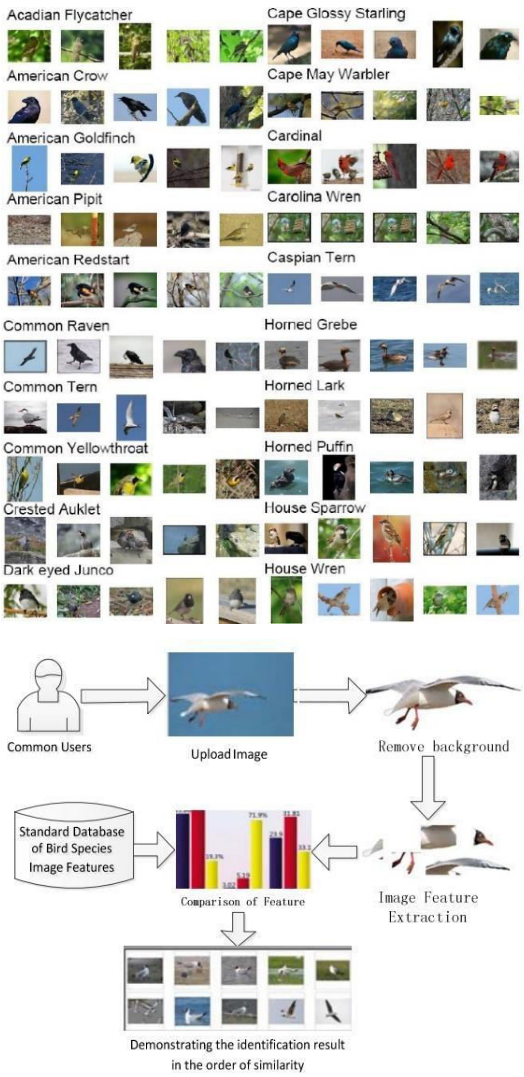

Fig. 4. Proposed System Architecture

(e) Evaluation:

During categorization, an autograph, containing nodes that eventually form a network, is generated to produce probable outcomes by comparing the input with the training dataset. This network generates a score sheet, which is built with the help of the score sheet output.

5. Results

This section explains the details of the experimentalresults of the system used to identify the bird species. The performance of our system was evaluated on 225 different species of birds. The model developed was tested using the test dataset successfully and the calculated accuracy was 89.68%. The main purpose of the project is to identify the bird species from an image and also to identify the species related to the bird in the user uploaded image.

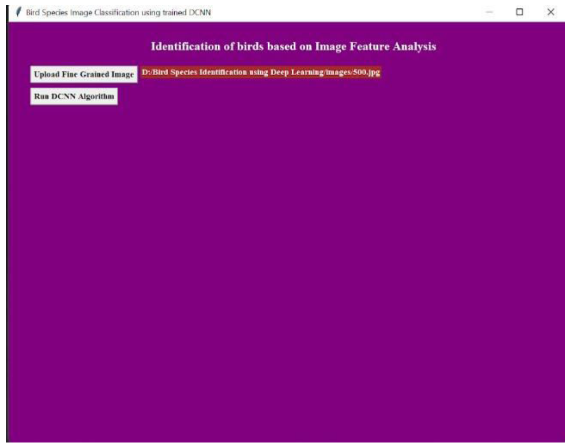

Fig. 5. The main page of the proposed system

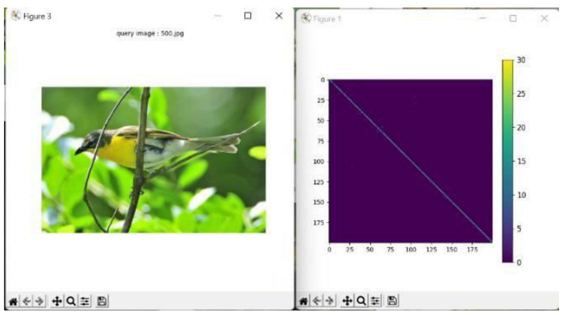

Fig. 6. Uploaded Bird Image and its Accuracy Graph

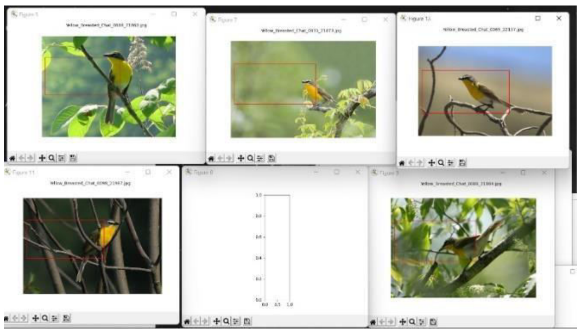

Fig. 7. Final Output

The final output of the proposed system contains the predicted species of the bird image uploaded by the user along with the images of the related birds belonging to the same family and also their accuracy graphs.

6. Conclusion

The major goal of creating this identification system is to raise knowledge about bird-watching, bird identification, and specifically birds found in India. It also addresses the need to streamline the bird identification procedure, making bird-watching more accessible. Convolutional Neural Networks is the technology employed in the experimental setup (CNN). It recognizes images using feature extraction. The approach utilized is adequate for extracting characteristics and classifying images.

The project's main goal is to identify bird species based on a photograph provided by the user. CNN was chosen because it is well-suited for developing complex algorithms and provides high numerical precision accuracy. It is also multifunctional and scientific. We were able to reach an accuracy of 89.68 percent. As the purpose satisfies, we feel this project has a broad reach. This technique may be used in wildlife research and monitoring by using in- camera traps to keep track of wildlife movement in specific habitats and behaviour of any species.

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