BIRD SPECIES DETECTION USING VGG-16 ALGORITHM

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ABSTRACT:

Birds play a crucial role in ecosystems, underscoring the importance of being able to identify them in the wild. As some bird species become increasingly rare, accurately classifying them poses a significant challenge. Ornithologists, tasked with monitoring bird activity, require efficient reporting methods. Although traditional bird books have been helpful for birdwatchers and researchers, manually identifying bird species is not practical. Instead, image-based methods use technologies like OpenCV and CNNs to identify birds from pictures. Deep learning approaches offer promising avenues for accurate bird identification. The Project proposes a robust deep learning **BCC.h5** model by using VGG(visual Geometry Group)-16 which is a deep convolution neural network for easily **identifying bird species**. The accuracy of our model is **95%**. By integrating bird data alongside species identification, users gain access to extensive insights into recognized avian species, enriching their comprehension of **bird diversity and behaviors**. Moreover, the incorporation of **bird vocalizations** introduces an immersive element to the project, enabling users to interact with the auditory facets of bird recognition.

Keywords: Bird Image Detection, VGG-16, Streamlit, Deep Learning, API's.

1. INTRODUCTION

Identifying bird species in today's environment poses significant challenges, often leading to uncertainty. Birds serve as vital indicators of environmental health, swiftly responding to atmospheric changes by seeking out specific organisms, such as insects, for sustenance. However, the process of collecting and aggregating bird information demands substantial human effort and financial resources. In response to this, there is a pressing need for a robust system capable of large-scale bird information processing. Such a system would serve as a valuable resource for scholars, government agencies, and other stakeholders.Various methods, including image, audio, or video, have employed for bird identification. In 2013, the IEEE International Machine Learning Workshop for Signal Processing (MLSP) initiated a challenge focused on identifying bird species. While audio processing techniques offer the advantage of detecting birds through recorded audio signals, the task becomes considerably more complex due to environmental factors such as mixed sounds from insects and other real-world objects. Given that people are generally more adept at recognizing images than audio or video data, utilizing images for bird classification is often preferred.

Bird experts, known as **ornithologists**, face the challenge of identifying birds. To do this, they need to understand various factors like climate, genetics, where the birds live, and how they impact the environment. Usually, they use a system created by Linnaeus that categorizes birds based on features like their group, family, and species. Even with modern technology, identifying bird species is still a tough but crucial job for ornithologists and researchers.

2. LITERATURE SURVEY

In 2012, **Aditya Bhandari, Ameya Joshi, and Rohit Patki** conducted a study using the Caltech UCSD 200 bird species dataset. Their methodology revolved around utilizing the Python library Scikit and experimenting with various algorithms, including Naive Bayes, Support Vector Machines (SVM), and KNN. Through their analysis, they discovered that Logistic Regression paired with Mturks as the feature extraction technique yielded the highest accuracy. The accuracy achieved by the Logistic Regression method with Mturks feature extraction outperformed other modules such as SVM or SVM combined with CNN-learning methods. However, in comparison to the Logistic Regression-learning method, the accuracy was marginally lower. Specifically, the proposed model attained an accuracy rate of 53%.

In 2013, researchers **Andreia Marini, Jacques Facon, and Alessandro L. Koerich** worked on a project. They used a dataset called Caltech UCSD-200. Their method started by separating the birds from the background in images using colors. Then they split the images into parts and created histograms for each part. To make things faster, they reduced the number of bins in the histograms. These histogram bins were used as features by a computer program to tell different bird species apart. In the end, their system could correctly identify birds about **75%** of the time.

In 2013, **Saundarya Junjur, Punam Avhad, and Deepika Tendulkar** employed a Deep Learning algorithm utilizing CNN architecture. Their approach involved transforming uploaded images into grayscale before applying the algorithm. The primary objective was to identify bird species based on input images. They utilized the Caltech-UCSD dataset containing 200 different bird species.The architecture they designed comprised five convolution layers, one activation layer, one pooling layer, and one dense layer. Through this configuration, they achieved an accuracy of approximately 83.3% in predicting the names of birds given their images. This highlights the efficacy of utilizing deep learning techniques, particularly CNNs, in accurately classifying bird species based on visual data.

In 2015, **Suleyman A. Al-Showarah and Sohyb T. Al-qbailat** employed an Artificial Neural Network (ANN) algorithm for their study. Various operations, including combining, finding the maximum, minimum, and average values between the features f6 and g7, were performed. The classifiers produced promising results, with the ANN achieving a classification accuracy of approximately 70.9908%. The recall rate was noted at 0.71%, and the f-measure stood at 0.708. This study demonstrated the effectiveness of the **ANN** algorithm in achieving a high accuracy rate of image identification, reaching approximately 70.9908%.

In 2017**, Amit Tambade and Bhandare** developed an application leveraging Deep Convolution Neural Network (DCNN) and Unsupervised Learning algorithms. They utilized Google Colab for dataset preparation. The architecture of their system comprised five convolution layers, one activation layer, one pooling layer, and one dense layer. The application yielded impressive results, with accuracy ranging between 80% to 90%. Notably, the implementation made use of the TensorStream library, highlighting its effectiveness in achieving high accuracy rates in image classification tasks.

In **2021**, some researchers created a special computer model. They made it specifically to recognize the **27 unique birds** found only in Taiwan. They used a type of computer network called a **skipped CNN**. This network design helps prevent a common problem in deep learning where the signal gets lost as it moves through the layers. Their model was successful in telling apart these special birds from pictures with an impressive **95% accuracy.**

In **2012**, a researcher named **Nadimpalli** studied how to find birds in pictures. They tried different methods like looking for movement, matching templates, and using the Viola-Jones Algorithm. Out of all these methods, the Viola-Jones Algorithm was the best. It could correctly identify birds about **87%** of the time, and it didn't make many mistakes.

In **2011**, some researchers focused on figuring out which birds were singing based on their recorded songs. They used a mix of computer tricks and learning methods. One of the tools they used was called **MARSYAS**. Their work was successful in telling apart different bird species by listening to their songs.

Back in **2012**, researchers **Peter Jancovic and Munevver Kokuer** came up with a new way to figure out which birds were singing based on their recorded sounds. They used a mix of computer tricks and learning methods. One of the tools they used was called a **hybrid deep neural network hidden Markov model (DNNHMM)**.

Back in **2019**, a researcher named **G.M. Nyaga** made a special computer system. This system was designed to figure out which birds were in pictures taken in **Kenya**. They used a type of computer program called a **machine learning algorithm**.

3. PROPOSED METHODOLOGY

The proposed model is to identify the **information , type and Voice of bird** . Figure 1 illustrates the architecture of proposed model.

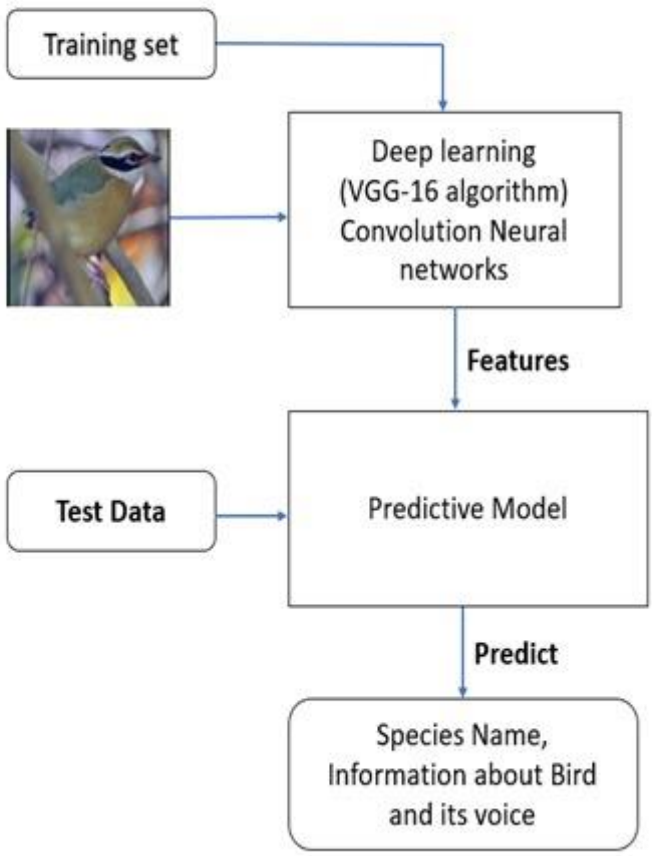

Fig-1: Model Architecture

1. Dataset Loading and Preprocessing: Loading the dataset involves importing data from a source, which could be files,, or APIs, into memory. Preprocessing includes tasks like cleaning data, handling missing values, normalization, and feature engineering to prepare the data for modelling.

2. Dataset Splitting: The process of splitting the dataset into training and testing subsets is essential for evaluating the performance of the model. Typically, a portion of the dataset, 80%, is used for training, while the rest is kept aside for testing.

3. Generating Model using VGG-16 Algorithm: Convolutional neural networks with the VGG-16 architecture are well-known for being straightforward and efficient in image classification applications. The model architecture is composed of 16 convolutional layers, max-pooling layers, and fully linked layers at the top.

4. Creating User Interface (UI) using Streamlit Library: Streamlit is a Python library used for building interactive web applications with minimal effort. With Streamlit, we can create UI elements such as sliders, buttons, and text inputs to interact with the underlying data and models.

5. Integrating API: Integrating an API allows for communication between different components of the application, such as the user interface, backend services, and the model. APIs define a set of rules and protocols for building and interacting with software applications, enabling seamless data exchange and functionality.

4. RESULTS AND DECLARATIONS

After Preprocessing the data and extracting features, the dataset divided into train and test set portion. Figure 2 describes about the loss of training and validation.

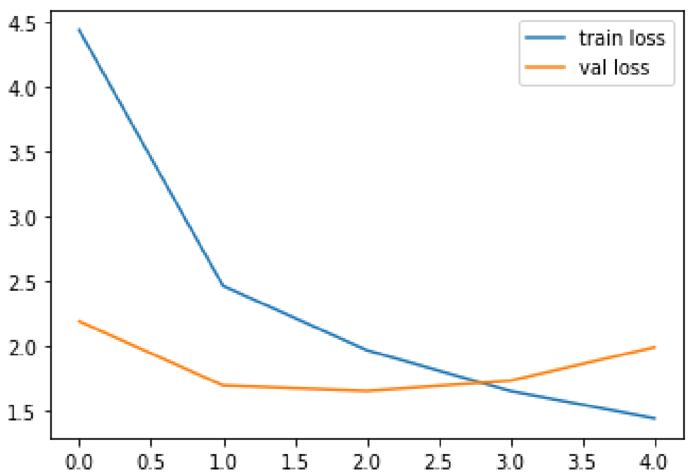

Fig 2: Training and Validation loss

Figure 3 describes about the accuracy of model. The training accuracy should increase over epochs as the model learns from the data.

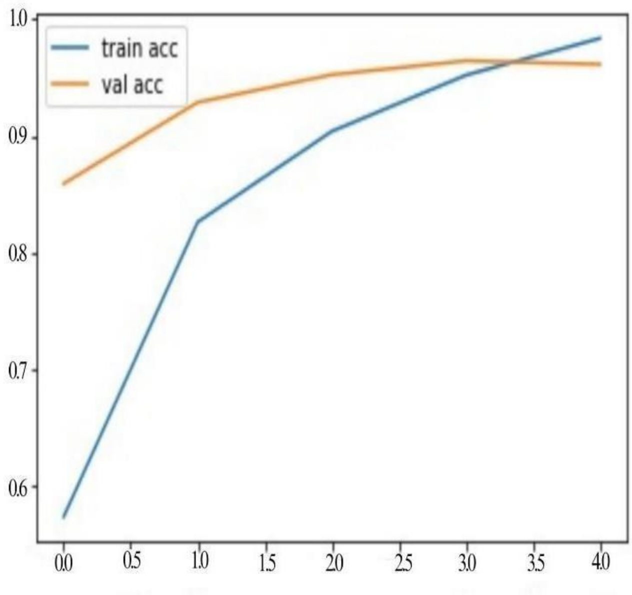

Fig 3 : Training and Validation Accuracy

Figure 4 shows the output of predicted bird image.It shows Bird image and its name.

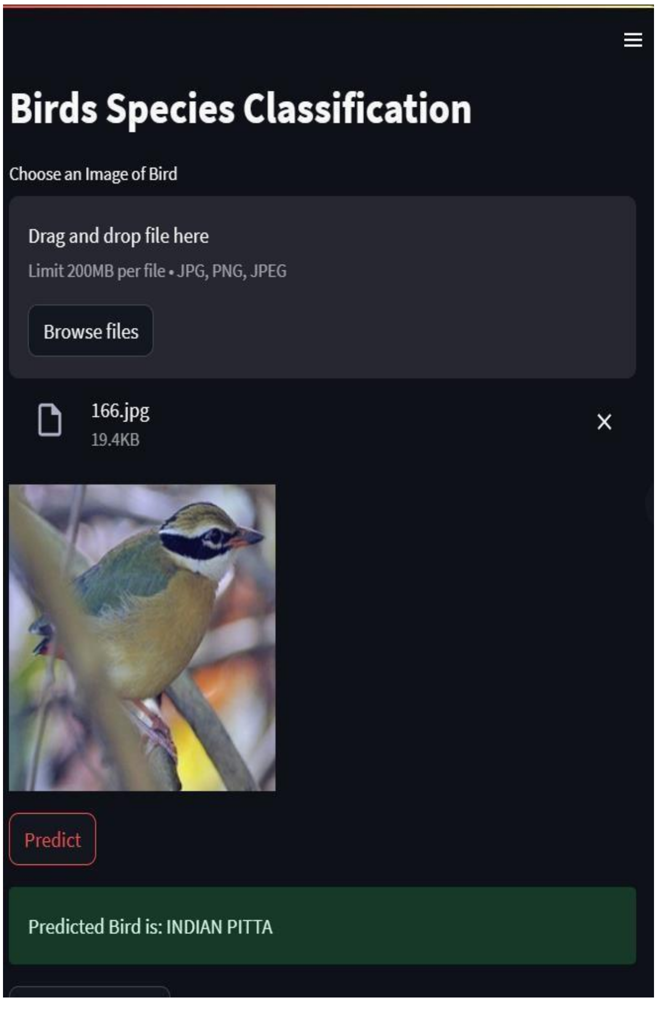

Fig 4 : Predicted Output Interface

Figure 5 shows the complete information of bird like location, Colour and behaviour of bird.

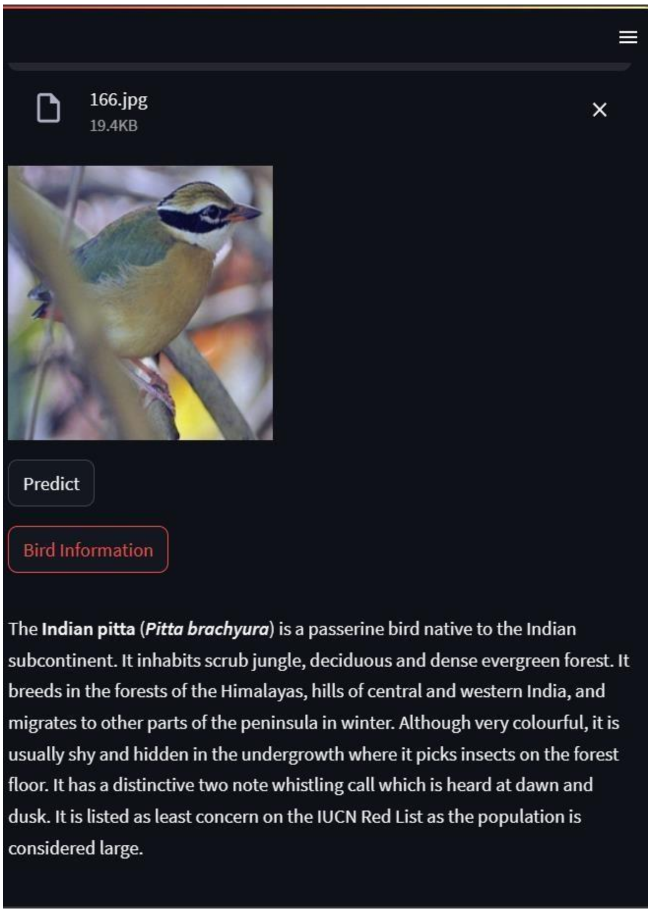

Fig 5: Bird Information Interface

CONCLUSION

In conclusion, the utilization of the VGG-16 algorithm in bird species detection has proven to be remarkably effective, boasting an impressive accuracy rate of 95%. The proposed model marks a significant stride in the realm of computer vision, showcasing the potential of deep learning techniques to contribute to biodiversity conservation efforts and ecological research.

Beyond its high accuracy, the model offers additional features that enhance its utility and appeal. By incorporating bird information alongside species detection, users can access comprehensive details about identified birds, enriching their understanding of avian diversity and behavior. Furthermore, the inclusion of bird vocalizations adds an immersive dimension to the project, allowing users to engage with the auditory aspects of bird identification.

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