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BIRD SPECIES IDENTIFICATION USING DEEP LEARNING

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ABSTRACT—
Identifying bird species from images is a tough job for humans, but it's crucial for things like wildlife conservation and studying the environment. This new method, called "Bird Species Identification using Deep Learning," makes it a lot easier. It uses a special kind of computer program called the Xception architecture, which is really smart at recognizing things. The whole thing was made using Python, a programming language. We trained the program to be super good at telling different birds apart. And it's really accurate too! When we tested it, it got it right about 99% of the time, both during training and testing. We used a huge bunch of bird pictures—about 89,885 of them, covering 524 different bird species to teach the computer. This made sure it learned about all kinds of bird features, so even if it sees a new bird, it can still figure out what it is. By using deep learning and the Xception Architecture, we have made a big leap forward in recognizing bird species. It's much better than the old ways and opens up lots of new possibilities for studying birds and computer vision.

KEYWORDS:
Bird Species, Image Based, Deep Learning, Xception, Bird Species Identification.

I. INTRODUCTION

Birds are diverse group of mammals that have captured human fascination for centuries. Belonging to the class Aves, they are known for their unique adaptations for flight, including feathers, hollow bones, and a strong yet lightweight beak[1]. With over 10,000 known species found across every continent except Antarctica, birds have successfully inhabited a wide range of environments, from dense rainforests to arid deserts and towering mountain peaks.

Bird species display an incredible variety of colors, sizes, shapes, and behaviors, which makes them a source of wonder and inspiration for scientists, birdwatchers, and nature enthusiasts alike. Each species possesses distinct physical and behavioral traits that allow them to thrive in their specific habitats and fulfill various ecological roles.

A. Deep Learning:

Deep Learning enables computational models consisting of multiple processing layers to learn representations of data with multiple levels of abstraction. These models have significantly advanced various fields such as speech recognition, visual object recognition, object detection, and many others including medicine discovery and genomics[2]. The backpropagation algorithm, which guides how a machine should adjust its internal parameters to refine the representation in each layer based on the representation in the previous layer, is utilized by deep learning to uncover intricate structures in large datasets.

Deep convolutional networks have shown significant improvements in processing images, video, speech, and audio data, while recurrent networks have shed light on sequential data[2]. Deep learning is a fascinating area that allows computational models to learn intricate representations of data through

multiple layers of abstraction. These advancements have greatly benefited various modern applications such as speech recognition, visual object recognition, and many other disciplines[4].

B. Convolutional Neural Networks:

Three 2D arrays, one for each of the three color channels, hold the pixel intensities that make up a color image. Multiple array data presentations are processed by Convolutional Neural Networks (CNNs). Various array formats are used to represent different types of information: 2D is used for images or sound spectrograms, 1D is used for signals and sequences like language, and 3D is used for films or volumetric images.Convolutional neural networks, which take advantage of the characteristics of natural signals, are based on four main principles: pooling, shared weights, local connections, and the application of several layers. A typical convolutional network's design is set up in stages.

Convolutional layers and pooling layers are typically the two primary types of layers in the early stages of convolutional neural networks (CNNs). Consider the units as being placed in a grid-like arrangement within a convolutional layer. Each unit is connected to neighboring patches in the previous layer's grid by means of a filter bank, which is a collection of weights. After being combined, these weighted values are run via a non-linear function such as ReLU[10]. distinct grids in a layer can use distinct filter banks, even though all units within a grid share the same filter bank.

Additionally, it's worth noting the remarkable success of convolutional neural networks in image recognition tasks. This success stems from their ability to effectively capture the spatial dependencies present in images. They achieve this by using small-sized filters and sliding them across the input image. This process enables the networks to learn important features like edges, corners, and textures, which are essential for accurate image classification. This breakthrough represents a significant advancement in the field of computer vision.Overall, convolutional neural networks are a powerful tool in the deep learning field. They have revolutionized image processing and computer vision tasks by effectively capturing the spatial dependencies and learning meaningful features from the data[9]. They have a lot of potential in a lot of different areas, like object detection, picture recognition, and even natural language processing (nlp), because they can analyze input in the form of arrays.

II. LITERATURE SURVEY

In our nation, no comparable work or research has been conducted to precisely detect birds. Thus, the foundation is what is happening of natural life and the utilization of computer based intelligence in untamed life Picture handling use CNNs, to recognize and distinguish various classes of pictures.xception is used to detect the bird species in this project.It is used for image detection and will provide you the high accuracy compared to other algorithms.Some researchers are working on using image processing and various algorithms to detect birds, and a few have successfully achieved this in their work.

Tayal,Madhuri et al [1] they worked on identification software utilizes Transfer Learning in MATLAB, leveraging a pre-trained AlexNet algorithm, to streamline the recognition of bird species, with a particular emphasis on those found in India. Achieving an accuracy range of 80%-85%, the software aims to facilitate bird-watching activities and simplify the process of identifying birds. Additionally, it holds potential for aiding wildlife research endeavors, such as monitoring habitat and species behavior using camera traps, thus extending its scope beyond mere bird identification.

Alter et al [3] proposed using computer vision techniques to classify bird species.They also applied softmax regression to manually observed binary attributes, utilized a multi-class SVM on HOG and RGB features from photos, and ultimately used transfer learning to classify birds with a CNN.

Atanbori et al [4] conducted bird species classification from videos using both appearance and movement features. They built a dataset containing thirteen bird classes, which includes ten distinct species and three variations based on color, for training and evaluation purposes.

Jinhai cai et al [6] They looked into how well neural networks could recognize bird species by trying out different ways of preparing the data and using different features. They created a special kind of

neural network that could understand the changing sounds of bird songs. They also came up with a way to reduce background noise in the recordings, which helped the neural network recognize bird species better. They then compared how well their special neural network did against other methods that used different kinds of features. The results of their experiments showed that their approach was very promising, suggesting it could be a really effective way to identify bird species.

Akash Kumar et al [7] introduced a way to use deep learning to figure out what kind of bird is in a picture. They did this by using something called transfer learning and training the computer in multiple stages. They used a special kind of program called Mask R-CNN, which helps locate birds in pictures, and also a mix of two other models called Inception Nets (InceptionV3 and InceptionResNetV2). Their final model did a pretty good job, getting an F1 score of 0.5567 or 55.67% on the dataset they tested it on.

Satyamraj et al [10] They came up with a way to predict bird species from images using a popular Deep Learning algorithm called Convolutional Neural Network (CNN). They built the whole CNN Model themselves, trained it, and then tested how well it worked. The program they made is now giving out results, and they found that it's really accurate. During training, it got things right about 93.19% of the time, and during testing, it was accurate about 84.91% of the time.

Every day, more and more of our population is choosing to leave behind the traditional village lifestyle and the close connection with nature. Our lives have become mechanical due to the modern way of living. Consequently, our generation lacks knowledge about birds. Some of them are unable to recognize it. Through this project, the upcoming generation will be able to easily recognize and learn the names of different bird species. It will be particularly beneficial for the children. They can expand their understanding of birds and would be quite intrigued by it. During the winter season, numerous migratory birds come. This system will have a significant impact.

III . PROPOSED METHODOLOGY

The block diagram of the proposed methodology is shown in below figure. The project's workflow can be represented by a block diagram, showcasing the various stages involved in bird species identification using Transfer Learning with a pre-trained Xception Architecture.

The block diagram starts with the input images to take the input next preprocessing techniques and then trained the training data and build the xception architecture model to predict the class or species of bird while predicting the species the testing data will be used and then the result will be displayed as name of species.

The input images in our dataset are in the form of folders which containing images of the respective species.The images high in train dataset and somewhat in valid and test dataset.And then we used different preprocessing techniques to process the images.And then we build the xception architecture train the images.Atlast we predict the species of the image we uploaded.

This block diagram illustrates the sequential flow of operations involved in the bird species identification process.

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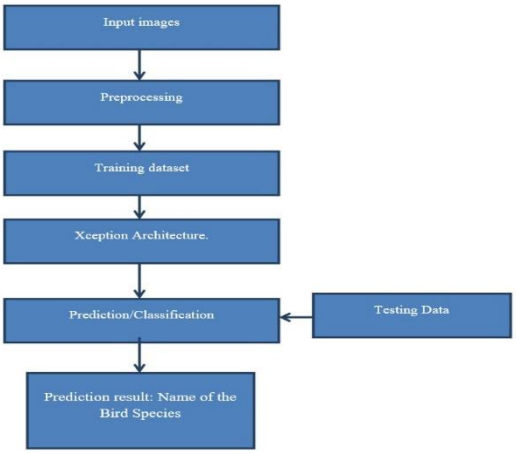

Figure 1: Block diagram of proposed methodology

A. Dataset:

The dataset has above 89,885 figures and with 524 classes.

The dataset is created to complete a figure ID proposition. There are over 89885 figures in this data file, of which 84,635 are used to train the model. 524 result classes are characterized in the model.

Figure 2: Dataset collection

The below figure shows the count of images in the each species.

```
Number of images in each class:
labels
RUFOUS TREPE                273
HOUSE FINCH                 258
D-ARNAUDS BARBET            243
OVENBIRD                    243
ASIAN GREEN BEE EATER       230
                           ...
NORTHERN RED BISHOP         140
SNOWY PLOVER                140
PATAGONIAN SIERRA FINCH     140
EURASIAN GOLDEN ORIOLE      140
RED TAILED THRUSH           140
Name: count, Length: 525, dtype: int64
```

Figure 3:Image count in each species

B. Architecture of the Model:

Xception could be a convolutional neural organize design that depends exclusively on depthwise distinguishable convolution layers.

What does it see like?

The information to begin with goes through the section stream, at that point through the center stream which is rehashed eight times, and at last through the exit stream. Note that all Convolution and SeparableConvolution layers are taken after by batch normalization.

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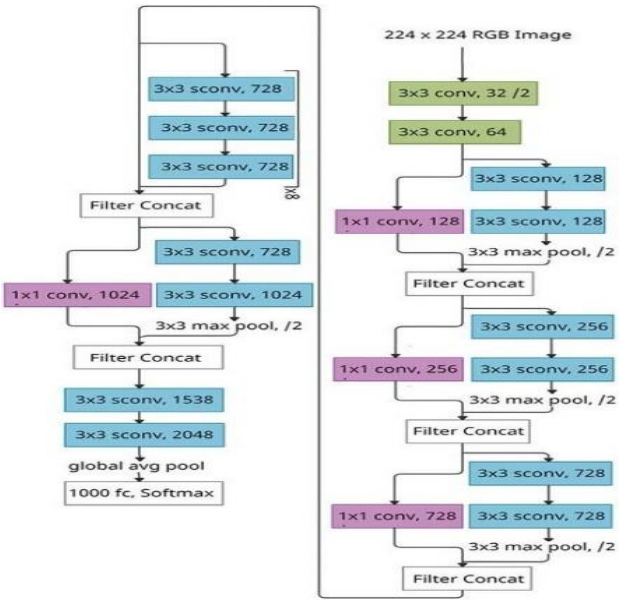

Figure 4: Model summary of the xception architecture

The Xception show may be a 71-layer profound CNN, motivated by the Initiation demonstrate from Google, and it is based on an extraordinary translation of the Beginning show. Its engineering is stacked with depthwise divisible convolutional layers.

The Xception demonstrate is an motivated form of CNN Initiation Show, an 'extreme' change. The Initiation demonstrate has deep CNN layers and more extensive CNN layers that work in the parallel side. This show has two distinctive levels, each with three convolutional layers.

The Xception model is made up of two tiers, with one tier featuring just a single layer. This layer divides the output into three parts and passes them to the next set of channels. The first tier comprises a sole convolutional layer with a 1 * 1 channel, while the other tier consists of three convolutional layers with a 3 * 3 channel. The main concept behind the Xception model is called Depthwise Separable Convolution. Unlike traditional CNN models that handle spatial and channel information separately, the Xception model combines both depthwise and pointwise convolution to improve its performance.

C. Optimizer & Learn rate of the model:

We use the Adam optimizer in this project with the rate 0.001 modernize networks network weights and make results fast to beginning learn levels.

The learning rate we used in this model is 0.001 at starting which means in freezing state of weights.After the model is created the learning rate is changed to 0.0001 because model need to learn the process and all the weights are unfreezed.

IV. PROPOSED MODEL PERFORMANCE

A. Dataset Distribution:

Here we separate the dataset into train, valid & test information from the given pictures. The whole pictures are 89885. Here 84635 information of pictures are utilized for train reason & for test reason 2625 information of pictures are utilized. After train and testing the information, a few information will be utilized for valid. CNN is the basically profound learning calculation. Here CNN and Xception is utilized for identifying the input picture. Here we utilized the three color of rgb and the categorical mode and at long last the measure of clump is 64 for prepare and testing information. We delivered the information demonstrate which give us way better execution. Our valid information contributing the distinguish fowl like our train and testing information.

B. Proposed Model Efficiency:

The model which we used got the better the efficiency and the accuracy.As the model the gave the validation accuracy and training accuracy as shown in the below figures.And also we got he training

loss and validation loss as shown in the below figure. In the below figures the red color line indicates the training and the blue color line indicates the validation.We plot the graph for the accuracy and the epochs.From the below figure we are getting to know that we used 10 epochs and in each epoch the training and validation accuracy levels are increasing and decreasing in the case of loss.

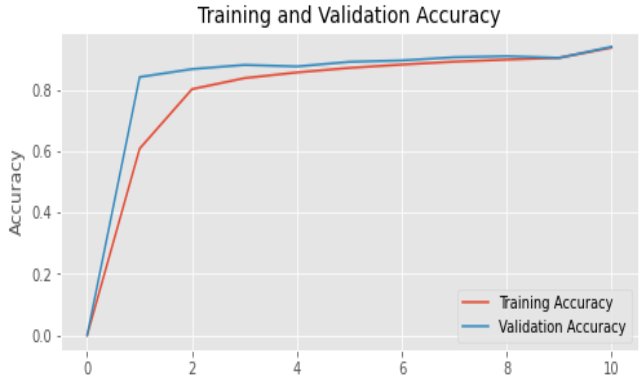

Figure 5: Train and validation accuracy

Figure 6:train and validation loss

$$ACCURACY = \frac{TP + TN}{TP + TN + FP + FN}$$

TN=”True positive”
TP=”True Negative”
FP=”False Positive”
FN=”False Negative”
Here we also calculated loss , precision which all are evaluation metrics.

$$PRECISION = \frac{True\ Positive}{True\ Positive + False\ Positive}$$

Precision is a metric that measures how often a machine learning model correctly predicts the positive class.

V. RESULT AND ANALYSIS

There are many algorithms to detect the bird species in which we use some of them like VGG16 , YOLO V3, XCEPTION models. The existing system got the below displayed accuracy.
The previous used models are the first two as above mentioned. Our proposed model is the Xception. Now the accuracy difference between the three models is little different. Those differences are

tabulated as shown below:

TABLE 1 ACCURACY OF EXISTING SYSTEM[20]

ALGORITHM	ACCURACY
VGG16	88%
YOLOV3	95.52%

TABLE 2 ACCURACY OF PROPOSED SYSTEM

ALGORITHM	ACCURACY
XCEPTION	99.10%

From the above table ,we are able to know that the VGG16 has got the 88% accuracy, and the YOLOV3 has got the 95.52% accuracy in the existing system. Our proposed model got the highest accuracy of 99.10% .From the above tables the highest accuracy rate is for the xception.

VI .CONCLUSION

In conclusion, "Bird Species Identification Using Deep Learning" offers an advanced and remarkably accurate solution for automating the recognition of bird species from images. By utilizing the capabilities of deep learning and the Xception architecture, the system has showcased exceptional performance in precisely categorizing a wide range of bird species, surpassing traditional methods in terms of accuracy, efficiency, and adaptability. This success can be attributed to the utilization of the Xception architecture, which facilitated automated feature learning and hierarchical representation of bird images. This allowed the system to capture intricate details and patterns, thereby enhancing its ability to differentiate between visually similar bird species with great precision.It benefited significantly from an extensive and diverse dataset comprising over 89,885 bird images from 524 different species. This extensive dataset enabled robust learning, generalization to unseen data, and adaptability to novel bird species and varying environmental conditions. With an impressive training accuracy of 99% and validation accuracy of 92%, along with a test accuracy of 99%, the proposed system demonstrates its capability to tackle the complex task of bird species identification effectively. These results show that deep learning techniques are very effective for sorting images and prove that the proposed system is a top-notch way to find birds.

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