# Animal Breed Classification using Deep Learning

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**Abstract:** *Primates are very significant in various environment functions as well as in human evolution, cultures, and many religions in society. Out of more than 500 primate species over 60% of primate species are extinct because of various reasons such as hunting, habitat loss human activities, etc. It is our responsibility to safeguard the primate breeds once again introducing primates into their natural surroundings. In this paper, a deep Convolutional Neural Network was trained to classify various primate breeds and predict the breed of a particular test image. Animals breed dataset from the Kaggle data science community was used. The model was trained with different epochs, works with an accuracy on the training set and 0.7353 on the validation set with epochs 15. The trained model predicted the primate breeds accurately.).*

**Keywords:** deep learning, animal classification, CNN, MobileNet, image processing, image classification

## I. INTRODUCTION

In addition to humans, animals, plants and marine species have their own significance in maintaining the ecological balance on this earth. Each category of animals, plants, and other living beings has a significant number of species. Every life form on this planet has an exceptional spot in the natural way of life that adds to the environment in its own unique manner. But, unfortunately, today, a significant number of animals and birds are getting endangered. Coming to primates, more than 500 species are present and which are unnervingly similar to human beings. Nonhuman primates are of central importance to tropical biodiversity and to various climate capacities, cycles, and administrations. These primate species are playing a vital role in human evolution, livelihoods, cultures, and many religions in society. But, over 60% of primate species are undermined with eradication mostly because of human activities, habitat loss, hunting, environmental changes, illegal trades, agricultural expansion in this 21st century, and illness. This eradication emergency makes compelling preservation activities essential. There are various conceivable preservation activities for primates, similar to anti-poaching patrols, relocating animals, publicizing protection issues, and once again introducing primates into their natural surroundings. Each category of animals, plants, and other living beings has a significant number of species. Coming to primates, more than 500 species are present and which are unnervingly similar to human beings. The CNN uses a hierarchical model that tries to build a network in the shape of a funnel but finally produces a layer where all the neurons are connected to one another, processing the output as a result. A computer can learn to categories pictures. The computer transforms the pixel value of the image to an indoor version at www.ijcrt.org after training with vast image datasets representation that allows the classifier to recognize patterns in the input image. In this project, image classification is used to build a deep learning convolutional neural network backed by TensorFlow.

## II. RELATED WORK

A limited amount of research has been undertaken in the domain of Animal types recognition especially in the Primates animal area. One example here [1] Using supervised clustering based on Multi Part-Convolutional Neural Network (MP-CNN) and Expectation-Maximization (EM) clustering, they suggest a fine-grained animal breed categorization model. The proposed model uses a simple pipeline that combines deep feature extraction with CNN that has been trained on ImageNet and unsupervised data classification with EM clustering. The findings from the suggested model support the idea that deep CNNs may be trained under supervision to extract better features than most standard methods, even for unsupervised tasks, using a large and diverse dataset. [2] A total of 245 cases of aggressive

behavior issues in dogs maintained as companions were studied for data. Barking, snarling, and biting were all signs of aggression. A one to three hour home visit for each instance resulted in a description of the violent behavior sequences and the trigger circumstances under which they happened. aggressiveness motivated by fear, dominance, possessiveness, protectiveness, predation, punishment, pain, and intra-specific aggressiveness were the other eight main kinds that were seen. And in [3] The purpose of this essay is to categorize sheep according to breed. The classification of sheep breeds has been done by applying neural networks to the four main breeds. Throughout the whole work, the CNN model's accuracy was 99.97% while it was being trained, and 87.1% when it was being tested. The sheep farmer may more precisely and effectively identify the breed with the use of this classifier. And in [5] The training and testing of transfer deep learning methods in this work used a dataset of 70 dog breeds. The dataset that was utilized contains around 100 photos for each category of dog breeds and is statistically stable. Then, several deep learning techniques, including Convolutional Neural Network, VGG16, ResNet, DenseNet, etc., were used to train and evaluate the dataset that had been gathered. [6] A deep convolutional neural network was trained to identify the breed of a given test picture and classify different monkey breeds. The Kaggle data science community's dataset of 10 monkey species was employed. The primates in this dataset are ten different breeds, numbered n0 to n9. The model, which was trained using several epochs, operates with a 0.8050 accuracy on the training set and 0.7353 accuracy on the validation set using epochs 20. The primate breeds were appropriately predicted by the training model. [9] Convolutional Neural Networks (CNN), one of the deep learning techniques that can identify and categorise an item, were employed in this study. The automated extraction of picture features was modelled after the EfficientNet-B0 architecture. The working dataset supplied into the EfficientNet-B0 architecture was a collection of 2700 photos representing nine distinct cat breeds. According to the studies, the system is successful in classifying photos of different cat breeds, with the top model achieving a classification accuracy of 95%. [10] In order to identify the best model that can accurately identify the breed identification of individual animals from their images, the performance of nine different deep CNN-based models have been compared. A set of identical hyperparameters were used to train each of the nine CNN models independently on the pig and goat breed datasets. According to the results, MobileNetV2 is the best deep-CNN model for classifying goat breeds, with a prediction accuracy of 95.00%, while InceptionV3 is the best model for classifying pig breeds, with a prediction accuracy of 100.00%.
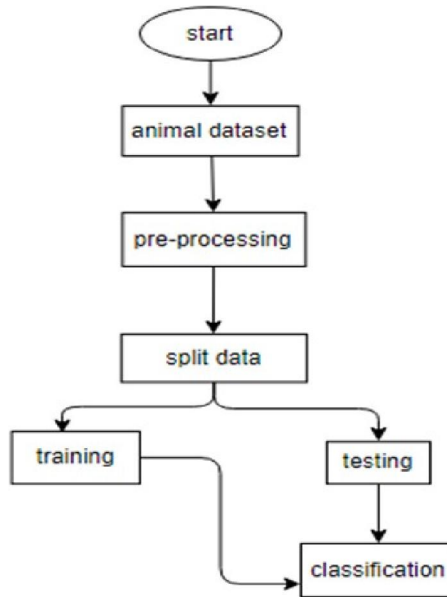
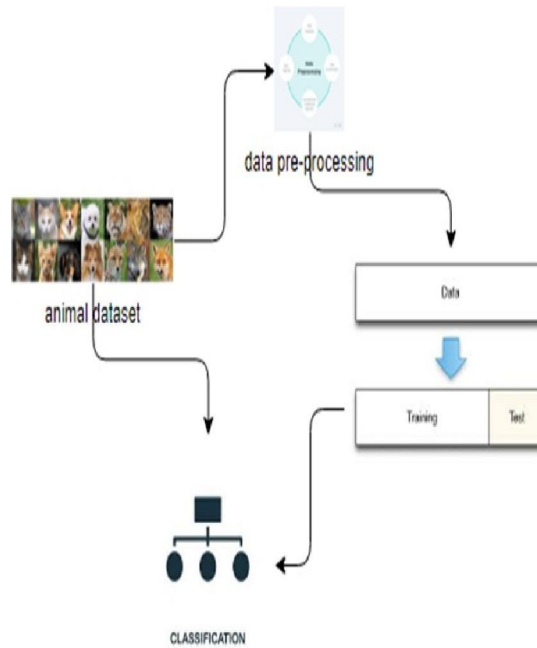## 2.1 Objectives
The main objectives of this research are
- Studying the importance of primates in social life and causes of animal species extinction in wild animals.
- Studying the state of the art models used in the animal breed classification and prediction.
- Understanding the various primate breeds from the 10 Dog species dataset.
- Training convolutional neural network for primate breed classification and prediction.
- Predicting the primate breed using the trained model on the test images.

## III. PROPOSED SYSTEM
In purposed method we are performing the classification of animal breed identification using Convolution Neural Network (CNN) of deep learning along with the Transfer learning methods. As image analysis based approaches for animal breed detection. Hence, proper classification is important for the proper animal breed that which will be possible by using our proposed method. Block diagram of proposed method is shown below.

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## IV. METHODOLOGY

**Convolutional Neural Network (ConvNet/CNN):**

A convolutional neural network consists of an input layer, hidden layers and an output layer. In any feed forward neural network, any middle layers are called hidden because The principle utilization of the Convolution activity if there should be an occurrence of a CNN is to recognize fitting highlights from the picture which goes about as a contribution to the primary layer. Convolution keeps up the spatial interrelation of the pixels This is finished by fulfillment of picture highlights utilizing miniscule squares of the picture. their inputs and outputs are masked by the activation function and final convolution. A specific kind of such a deep neural network is the convolutional network, which is commonly referred to as CNN or ConvNet. It's a deep, feed-forward artificial neural network.

Remember that feed-forward neural networks are also called multi-layer perceptions (MLPs), which are the quintessential deep learning models. which are the quintessential deep learning models.
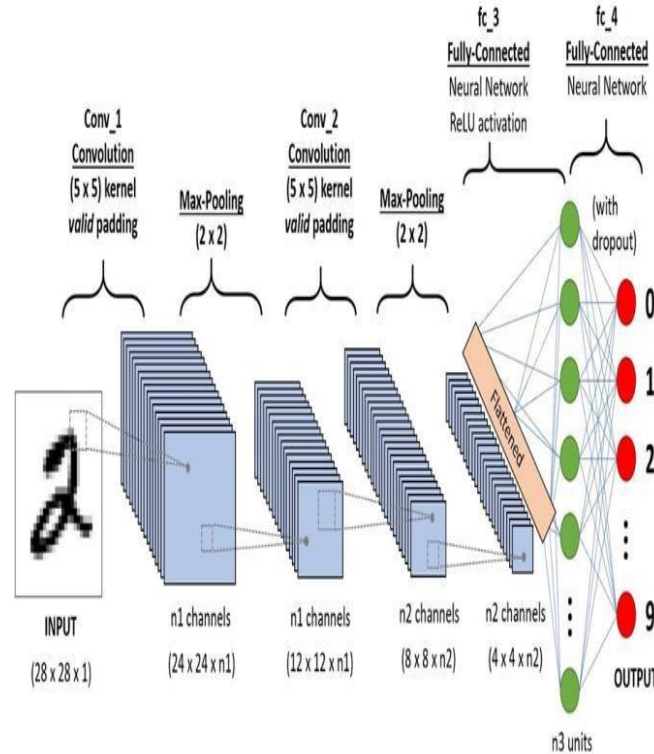


1. An image is nothing but a matrix of pixel values, right? So why not just flatten the image (e.g. 3x3 image matrix into a 9x1 vector) and feed it to a Multi-Level Perceptron for classification purposes? Uh.. not really.
2. In cases of extremely basic binary images, the method might show an average precision score while performing prediction of classes but would have little to no accuracy when it comes to complex images having pixel dependencies throughout.
3. A ConvNet is able to successfully capture the Spatial and Temporal dependencies in an image through the application of relevant filters. The architecture performs a better fitting to the image dataset due to the reduction in the number of parameters involved and reusability of weights. In other words, the network can be trained to understand the sophistication of the image better.

**MobileNet:**

MobileNet model is designed to be used in mobile applications, and it is TensorFlow's first mobile computer vision model.

MobileNet uses depthwise separable convolutions. It significantly reduces the number of parameters when compared to the network with regular convolutions with the same depth in the nets. This results in lightweight deep neural networks.

A depthwise separable convolution is made from two operations.

- Depthwise convolution.
- Pointwise convolution.

MobileNet is a class of CNN that was open-sourced by Google, and therefore, this gives us an excellent starting point for training our classifiers that are insanely small and insanely fast.

The speed and power consumption of the network is proportional to the number of MACs (Multiply- Accumulates) which is a measure of the number of fused Multiplication and Addition operations.

Table 1. MobileNet Body Architecture

| Type / Stride | Filter Shape | Input Size |
|---|---|---|
| Conv / s2 | $3 \times 3 \times 3 \times 32$ | $224 \times 224 \times 3$ |
| Conv dw / s1 | $3 \times 3 \times 32$ dw | $112 \times 112 \times 32$ |
| Conv / s1 | $1 \times 1 \times 32 \times 64$ | $112 \times 112 \times 32$ |
| Conv dw / s2 | $3 \times 3 \times 64$ dw | $112 \times 112 \times 64$ |
| Conv / s1 | $1 \times 1 \times 64 \times 128$ | $56 \times 56 \times 64$ |
| Conv dw / s1 | $3 \times 3 \times 128$ dw | $56 \times 56 \times 128$ |
| Conv / s1 | $1 \times 1 \times 128 \times 128$ | $56 \times 56 \times 128$ |
| Conv dw / s2 | $3 \times 3 \times 128$ dw | $56 \times 56 \times 128$ |
| Conv / s1 | $1 \times 1 \times 128 \times 256$ | $28 \times 28 \times 128$ |
| Conv dw / s1 | $3 \times 3 \times 256$ dw | $28 \times 28 \times 256$ |
| Conv / s1 | $1 \times 1 \times 256 \times 256$ | $28 \times 28 \times 256$ |
| Conv dw / s2 | $3 \times 3 \times 256$ dw | $28 \times 28 \times 256$ |
| Conv / s1 | $1 \times 1 \times 256 \times 512$ | $14 \times 14 \times 256$ |
| $5\times$   Conv dw / s1 | $3 \times 3 \times 512$ dw | $14 \times 14 \times 512$ |
|     Conv / s1 | $1 \times 1 \times 512 \times 512$ | $14 \times 14 \times 512$ |
| Conv dw / s2 | $3 \times 3 \times 512$ dw | $14 \times 14 \times 512$ |
| Conv / s1 | $1 \times 1 \times 512 \times 1024$ | $7 \times 7 \times 512$ |
| Conv dw / s2 | $3 \times 3 \times 1024$ dw | $7 \times 7 \times 1024$ |
| Conv / s1 | $1 \times 1 \times 1024 \times 1024$ | $7 \times 7 \times 1024$ |
| Avg Pool / s1 | Pool $7 \times 7$ | $7 \times 7 \times 1024$ |
| FC / s1 | $1024 \times 1000$ | $1 \times 1 \times 1024$ |
| Softmax / s1 | Classifier | $1 \times 1 \times 1000$ |

## V. ADVANTAGES

- Accurate classification
- Less complexity
- High performance
- Easy Identification

## VI. RESULTS
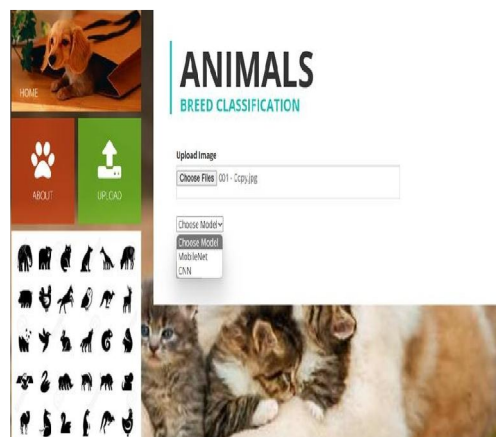
We tested a variety of input images with diverse breeds, By providing a photograph of the animal breed, we were able to accurately classify the breed name. We classified the breed names of the animal and accuracy by using two algorithms MobileNet and CNN.
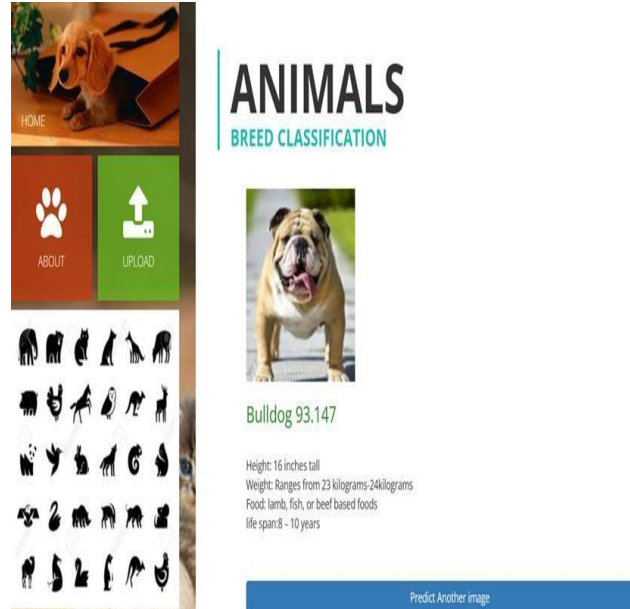


With the help of the MobileNet algorithm, we achieved accuracy levels of 90+. We achieved an accuracy of 93+ when using the CNN algorithm. Additionally, we displayed the approximate characteristics of the animals, such as height, weight, and lifespan.

## VII. DATASET

Kaggle offers a variety of animal-related datasets, covering a wide range of topics such as biodiversity, animal behavior, animal sounds, and animal images. Kaggle is a platform for data scientists and machine learning engineers that provides a wide variety of datasets for analysis and modeling. These datasets come from a range of sources, including government agencies, academic researchers, and private companies. To access Kaggle datasets, you need to register a free account on the Kaggle website. Once you have an account, you can browse through the datasets available on the platform, which are organized into categories such as computer vision, natural language processing, and time series analysis. On Kaggle, each dataset has a description, along with details about the source and any necessary citations. Additionally, many datasets come with sample code and tutorials to help you get started with your analysis.

Popular Kaggle datasets include:

Images of dogs and cats make up the "Dogs vs. Cats" dataset, which is frequently used to train image classification algorithms. 12,500 photographs of cats and 12,500 images of dogs make up the dataset's 25,000 total images.

The images are in JPEG format and have a resolution of 256x256 pixels. They came from a number of places, including the Kaggle competition forum and the Microsoft Research Cambridge website.

The dataset is frequently used in machine learning contests where competitors are asked to create the best algorithm for determining if an image contains a cat or a dog.

A training set and a testing set are created from the dataset. 20,000 images make up the training set, while 5,000 images make up the testing set. The testing set is used to evaluate the correctness of machine learning models learned on the training set.

The "Dogs vs. Cats" dataset may be classified using a wide range of alternative methods. Convolutional neural networks (CNNs), a subset of deep learning algorithms frequently employed for image classification tasks, are one of the more well-liked strategies.

The "Dogs vs. Cats" dataset, which has been utilized in several research projects and contests, has grown to be a well-liked benchmark for picture classification tasks. The dataset has also been used to investigate ideas like feature extraction, data augmentation, and transfer learning

## VIII. FUTURE SCOPE

The model can then be deployed on the Google Play Store as an App, where anyone can download it and then can be used at the dog, cat or hen's shop. At these shop, if any pet lover wants to know the dog, cat and hen breed without even asking the shop owner, he/she can use this app to identify the dog breed. Knowing Dog, cat and hen's Breed will help the individuals to get information about the them, whether the detected types of the dog breed as any history of diseases, whether the detected dog eats more or eat less, whether the dog behaves good or bad. All these things and information will help. We can even use this model to identify the lost dog, cat or hen through Cameras and CCTV. With the help of this model, we will search dogs cats or hens only on the detected breed types rather than identifying the whole dog breeds data.

## XI. CONCLUSION

In the paper, Overall, we consider our results to be a success given the number of breeds in this fine-grained classification problem. We are able to effectively predict the correct breed over 91.147% of the accuracy in one guess using CNN, a result that very few humans could match given the high variability both between and within the different breeds contained in the dataset. We were successful in classifying the animal breed categorization photographs. Here, we've taken into account a dataset of animal breeds that will include a variety of sorts and animals and was trained using CNN and MobileNet. Following the training, we tested the system by submitting a picture and categorizing it.

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