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ESTABLISHMENT OF DEEP LEARNING PERFORMANCES FOR CREDENTIAL OF SPECIFIC BIRD PATTERNS USING CURRENT TRENDS

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Abstract

Birds have accompanied human race from the evolution throughout the period of existence in many ways. Birds can be classified according to their purpose as food, for recreation, as pet and an inspiration in ancient and modern literature. Birds form a predominant class in the animal kingdom sharing certain features like feathers, wings, flight speed and migration which differentiate among them. Nearly there are 10,000 varieties in different sizes, characters and enormous ranges spreading all over the world including equable regions like Antarctica. So classification of birds became inevitable criteria for researchers and scientists to study about bird types. Ornithologists rely on numerous techniques based on machine learning and deep learning approaches to study about bird categorization. This paper focuses on the classification of birds by deep learning methods. For this purpose most famous variety of birds are collected from the data set and the initial step namely pre- processing is done with the sample of birds. Classification is done by three popular techniques namely CNN model, InceptionV3 and Mobilenet V2 method. The highest accuracy nearly 99% is obtained from Mobilenet model and the performance is compared with other two methods.

Keywords:- recreation, feathers, wings, flight speed, migration, Antarctica, machine learning, Deep learning, CNN model, Inception V3 and MobilenetV2

INTRODUCTION

Nearly 150 million years have passed since the evolution of birds but the mystery still in practice is the confusion of bird categorization. All birds are same in appearance but they belong to diverse varieties. This has become a challenge for the researchers to group the birds because of the similarity found among them like color, shape, feathers and various attractions. [1]. The classification helps the scientists and birders to identify the features and habits of birds. There are many orders to classify birds based on the morphology like beak, feet, flying nature incubation period and feathers. Gaining knowledge about such entities helps in classifying birds and understanding their ecosystem and biodiversity. [2]. Classification process becomes essential nowadays to group birds easily and recognizes them. Using classification models to categorize birds, considering minute variations also is possible.

Birds can be classified based on many attributes like audio, video and images and these features can be used as the basis for grouping the bird varieties. Using audio, birds can be classified but the problem is the circumstantialnoise mixed along with the bird sound which can misclassify birds. Also multi label classification problem is faced with inter species discrepancies which becomes the drawback. Accurate classification can be enriched by images widely available in the world with different categories and classes. Automated classification can be done by image processing methods using more than 200 types of birds. Each bird has some unique features which can be handled efficiently by machines.

Machine learning methods are generally implemented in classification of birds where the models constructed are trained with sample data and conclusion is drawn with the past data collected and examined the earlier results. The sample data are trained numerous times to detect specific features in the bird to group exactly the correct set of species. When a new variety of bird is taken as input, already recorded design is overviewed to take the final decision. So, much better results are produced when comparing with traditional method for classification. After deep learning models came into reality with digital world the classification process became informal for researchers.

Deep learning is the revised version of machine learning technique based on artificial neural network. Different techniques and algorithms were used in the field of bird classification using artificial intelligence [3] in the primary days. Deep learning follows human method by studying large amount of data to acquire attributes needed for classification. Deep neural network is constructed with many hidden layers to learn the aspects of the bird similar to human brain. Using deep learning model, bird image can be analyzed to detect the variety the bird belongs. This process is dreary and consumes more time when carried out manually so deep learning model is built with more accuracy.

RELATED WORK

Bird inhabitants are a puzzle for human eye because some species are found in scarce which cannot be identified in a simple manner. So based on the features an effective and simple way is used to predict bird category. The simple way includes [4] Convolutional neural network model, an efficient way in image recognition process with many layers and filters used for image feature procurement.This method utilizes Caltech-UCSD Birds 200 dataset for training as well as testing purposes. With the dataset and algorithm, comparison is done for accuracy.

Transfer learning model using a fusion of Inception and Resnet V2 is proposed [5] to group bird species and differentiate from other living beings. This model is prepared using the technique of exchanging wrongly classified data between training and testing values. For achieving more accuracy fivefold cross validation model is used to train the data numerous times until required accuracy is obtained. Recently deep convolutional neural network on GoogleNet framework is developed [6] to make bird species classification possible. In this method, image of the bird is

changed to gray scale format in autograph method. This autograph is checked repeatedly to find the score sheet and based on the sheet, analysis is done for bird classification. Parallel processing method is done with DCNN using GPU technology.

Deep learning model is proposed [7] to detect individual birds using pre trained Residual model using CNN network model as base to encode the image. The CNN network pre trained model provides best image representations comparing with other methods. This method tries to train the machine as human brain will perform by ignoring the background irrelevant noise and unwanted parts of the bird. Bird classification [8] is done in two different approaches like with and without transfer learning. Two models are anticipated in this paper namely Inception V3 and Mobilenet model where F1 score and ROC curve is examined for the result and four approaches comparison is performed.

DATA SET DESCRIPTION

Various categories of bird species are available throughout the world and different sorts of birds are present for study. The major data set is Caltech-UCSD birds with more than 200 categories of bird images. The data set also contains nearly eleven thousand pictures with annotations like binary attributes and bounding box. Next data set is the IOB Meta search engine exclusively for birds, an open access database to store and gain information about birds at any time.

Different types of birds can be found in internet based data bases and more than 400 types of birds are documented. Bird Snap and L-bird are some data bases containing more than 500 types of birds. Birds with light modified features are found in the data bases which can be used for accurate categorization. The four principal varieties of birds with minortransformations are given as Fig.1.

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Fig.1. Sample bird images

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PROPOSED METHODOLOGY

The proposed methodology describes the way bird images are classified based on the entire image and specific features of the images. There are various steps in this paper including image acquisition, pre-processing and classification with automatic feature extraction steps. The recommended method consists of data set with four main types of birds taken as sample for classification. The images after collected from popular data set are pre-processed using standard techniques like resizing. After the images are preprocessed they are classified with feature extraction technique by deep learning methods. For classification three models are projected like CNN model, Inception V3 and Mobilenet V2 mode based on transfer learning method.

Three models for classification are used on the basis of transfer learning approach where the last layers are free zed and required layers are appended at the bottom layer for classification. Based on the results, three models are compared for accuracy to get the final result of grouping the birds into four categories like Albatross, Auklet, Blackbird and Kingfisher. The final result shows the deep learning models accuracy with minute variations and out of three models Mobilenet V2 model shows best accuracy with 99%.

The overall architecture depicts the steps involved in classification of birds and Fig.2 shows the proposed model.

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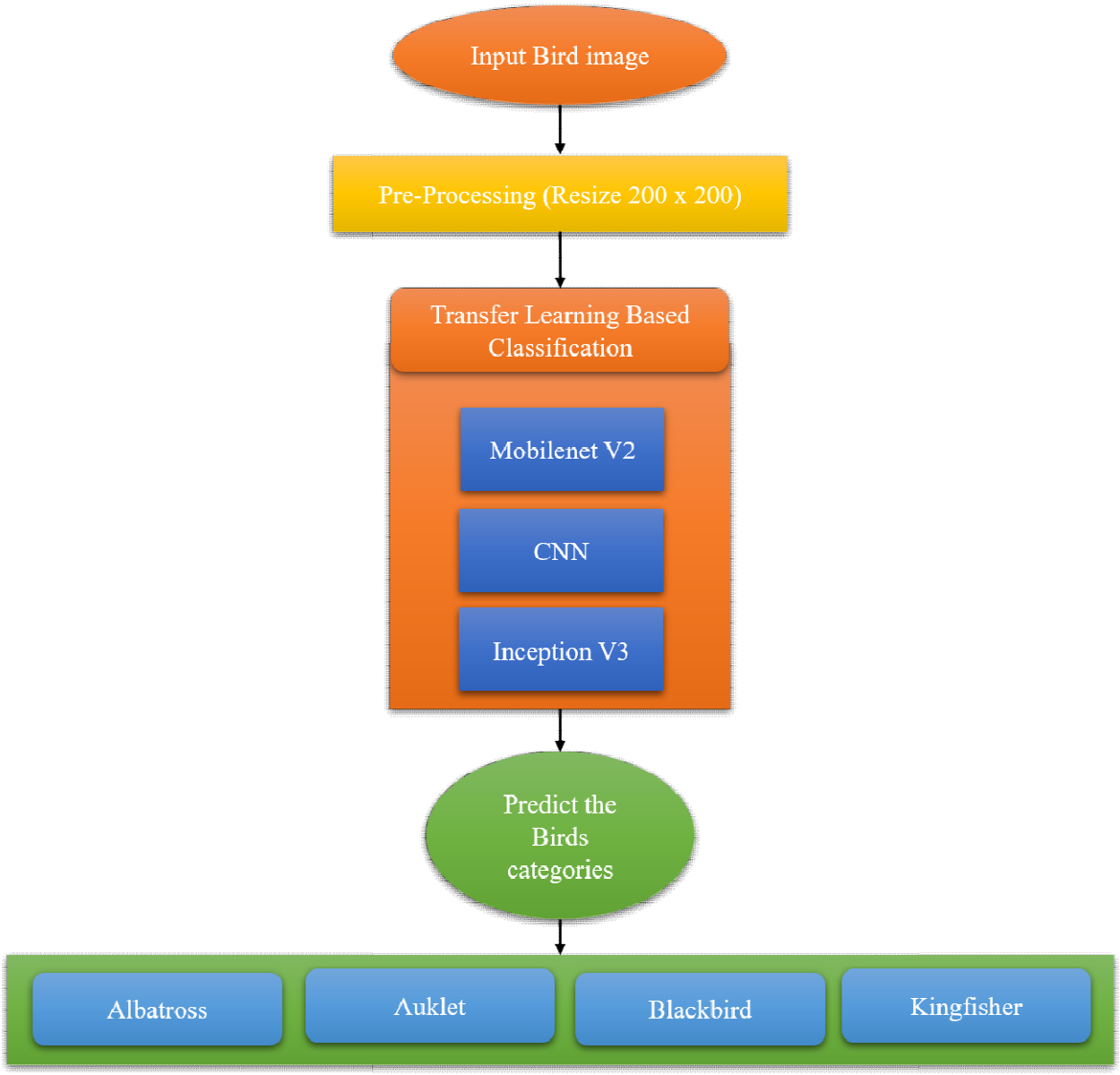

Fig.2. Overall Architecture of Proposed Bird Classification

Image Acquirement

For the proposed method four image types are considered for classification and nearly 400 images in total are used for processing. For feature extraction and classification more than 100 images are selected from each category and used for grouping of birds. The given data set is divided for training and testing purpose with 80 to 20% in ratio. The data used for training is to evaluate the performance metrics and testing data is used to confirm the results. So the data set is used for training, testing and validation to group the given bird images into any of the above four mentioned category.

Image Pre-Processing

The images collected from the prescribed data set are given as input to the next step called preprocessing. This step is needed to prepare the given image for feature extraction and classification to acquire the best result. The key step in preprocessing is rescaling of images in standard size preferably 200 x 200 in dimensions. There are two methods, one is enlarging the image to standard size from smaller image and another is reducing the image from larger to standard size.

(i) Enlarging the image

The interpolation method used for amplifying the image without loss in content is Inter linear method where the images in small sizes are enlarged to standard size.This method is used to estimate the unknown value that lies in the range of known values.Simple interpolation algorithm is used to find the unknown pixel values by estimating the new values using mathematical function. The mean value is calculated from the old pixels to find the location of new pixel. Fig. 3 shows the original and the enlarged image to standard size.

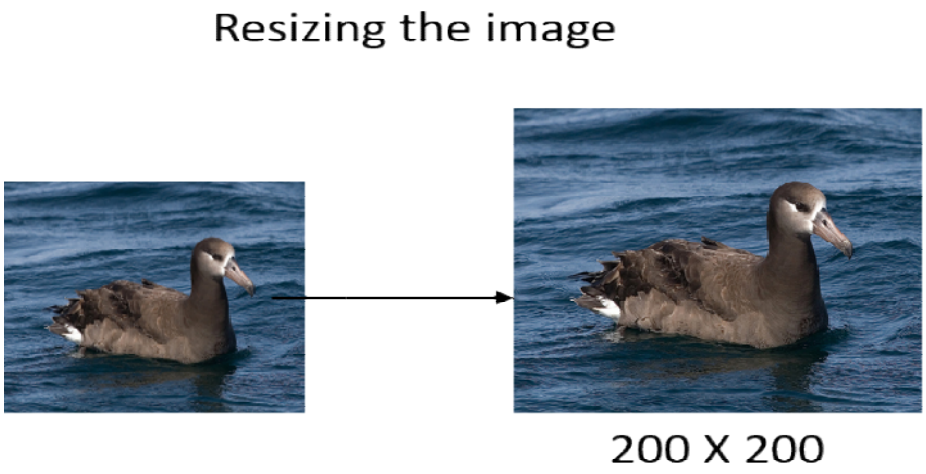

Fig.3. Enlarging the image

(ii) Shrinking the image

The interpolation method used for reducing the image size is pixel area relation method called Inter area method. The new size of the image is calculated from the old image by using the neighbor pixels in both the directions. Hence the new image is constructed from the old image by reducing the size and not the information in the image. Shrinking of image is shown in Fig.4.

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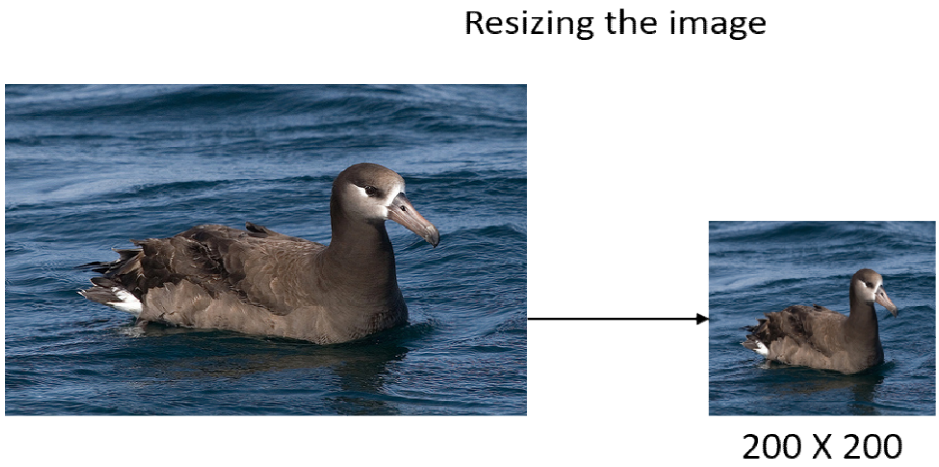

Fig.4. Shrinking the image

CLASSIFICATION OF IMAGES

Classification is the supervised method to categorize new data based on some criteria and by using algorithms and specified models. This method is used to predict the class label, the particular bird belongs. There are four main kinds of birds in the data set and classification identifies which class a bird fit in the given category. For classification of birds three models are proposed namely CNN model, Inception V3 and Mobilenet V2 model.

CNN MODEL

Convolutional Neural Network is the deep learning model used to identify specific features in the image and use the structures for classification. The CNN model is constructed with neurons used for verifying the attributes present in the portion of the image. CNN use this prediction to get the final result as the vector values. CNN architecture is composed of several layers which are described below.

(i) Convolutional Layer
This layer contains the input image in the matrix format and several feature maps are created by convolving filter on the input image. The filter may be of even or odd order and the numbers of filters used produce the same number of maps.

(ii) Pooling Layer
This layer is used for down sampling of feature maps produced in order to reduce the information content. So essential information alone is retained in the feature map.

(iii) Fully Connected Layer
This layer is used to predict the accurate label by applying weight with the input image and used for generating the final probabilities.

Proposed Architecture

The architecture proposed for CNN model is discussed in Fig.5.as follows

- Input image of standard size 200 x 200 is fed to the proposed model.
- There are 2 convolutional layers in this model with filter size 4 x 4. There are 64 filters used for convolution.
- Pooling layer used is Max Pool layer with stride 2x2. There are 2 such layers in the model.
- Batch Normalization is used for stability of the model by re centering and re-scaling the input of the layers
- Dropout is used for reducing over fitting by ignoring the neurons selected randomly.
- Finally Global Max pooling layer is performed to down sample the features of the image by calculating both the dimensions of the image.
- Two dense layers are used to act as fully connected layer where the attributes are reduced to represent the classes given in the model. Here finally 4 neurons are selected to indicate four classes.
- Sigmoid is the binary classifier used in the final layer which classifies the given image into any of the four classes.

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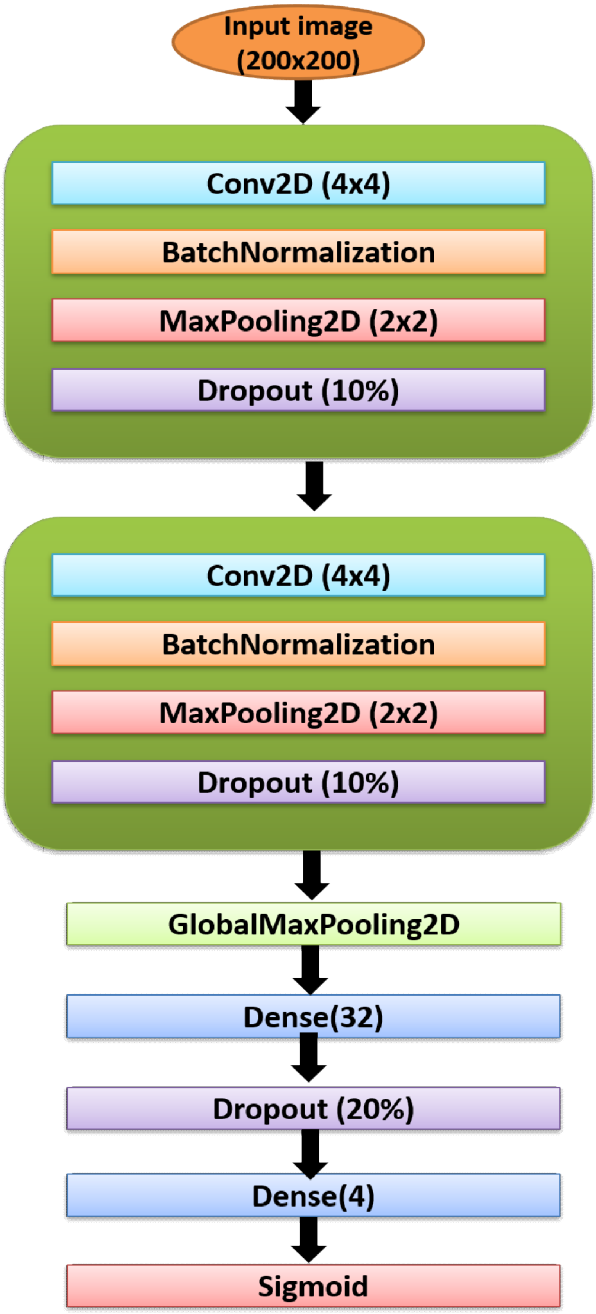

Fig.5. Proposed Architecture of CNN Model

Inception V3 Model

This model is popularly called as 48 layer model especially used for image recognition purpose. Inception model gradually developed from V1 to V3 by reducing the parameters by dimension reduction technique. Inception V3 model consists of 3 building blocks known as Block A, B and C used as the basis for proposed architecture.

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Proposed Architecture

The modified architecture built for bird classification is based on three factors. They are

- Filters of various sizes are used in parallel to arrest all the information in the input image.
- The parameters are reduced by factorizing the filter values.
- Auxillary classifiers are used to avoid problem of gradient vanishing.

First step the input image of size 200 x 200 is given to the model.
Next Module A is activated 5 times to factorized convolutions, Module B is stimulated 4 times to perform smaller convolutions and finally Module C is executed 2 times for asymmetric convolutions.
The output is received with 2048 features which are flattened using Global average pooling function.
Finally dense layers are added in the end of the architecture and the features are reduced from 32 to 16 and finally 4 features are selected.
Sigmoid classifier is used for classification of given image.
The block diagram of proposed model is given as Fig.6.

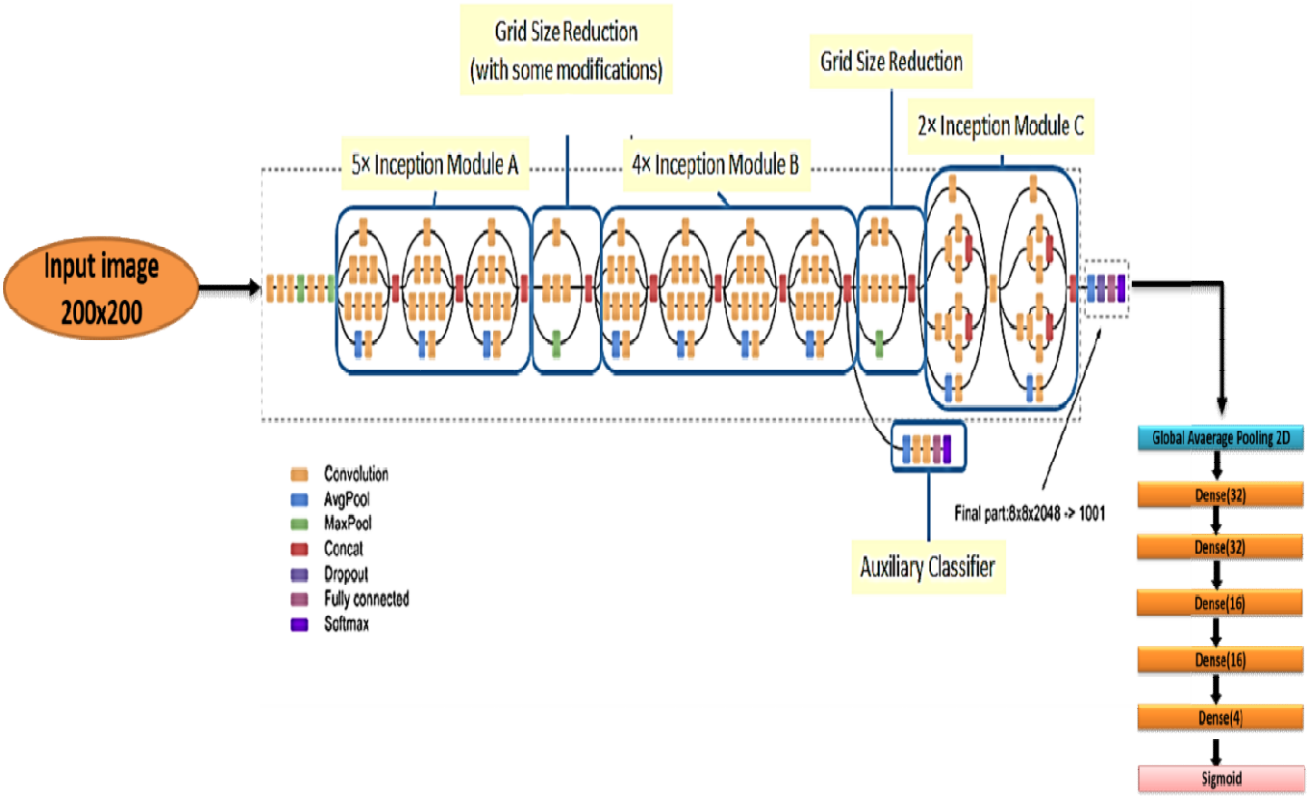

Fig.6. Proposed Architecture of Inception V3 Model

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Mobilenet V2 Model

The main delinquent in CNN architecture is the huge model size with enormous cost used to carry out the convolution process. Mobile net model brings a solution to the problem by reducing the size showing meager decline in accuracy [9] by performing well in mobile devices. This model is based on residual structure with residual connections between the adjacent layers. The basic architecture consists of two types of convolution layers which are dissimilar from the regular convolution layer. The two layers are depth wise separable layer which uses single filter for input channel and point wise convolution layer combine the output of feature map with filter multiplication operations.

Proposed Architecture

The proposed model for classifying birds into four prescribed classes is designed as follows. The block diagram is given as Fig.7 below.

- The input image of standard size 200 x 200 is fed into the model.
- Next image is given to Expansion layer of size 1x1 which is used as an intermediate layer. This layer utilizes depth wise convolutions to filter the required features used for classification.
- Batch normalization and activation function is used for standardization of the model. Relu is the activation function used for non-linearity of the values in the model.
- Next depth wise convolution of filter size 3 x 3 is performed for two purposes. One is applying single filter for each input channel and point wise convolution combines the features for classification.
- Next projection layer of size 1x1 is activated to contract the number of channels to reduce the complexity of the model.
- The final value is given to Global max pooling layer for flattening of values in the image suitable for classification.
- There are dense layers in the model finally appended, acting as hidden layers in the model.
- The features are reduced from 32 to 16 and finally the values are reduced to 4 which represent the four classes defined.
- Last is the sigmoid classifier which classifies the given image into any of the four classes.

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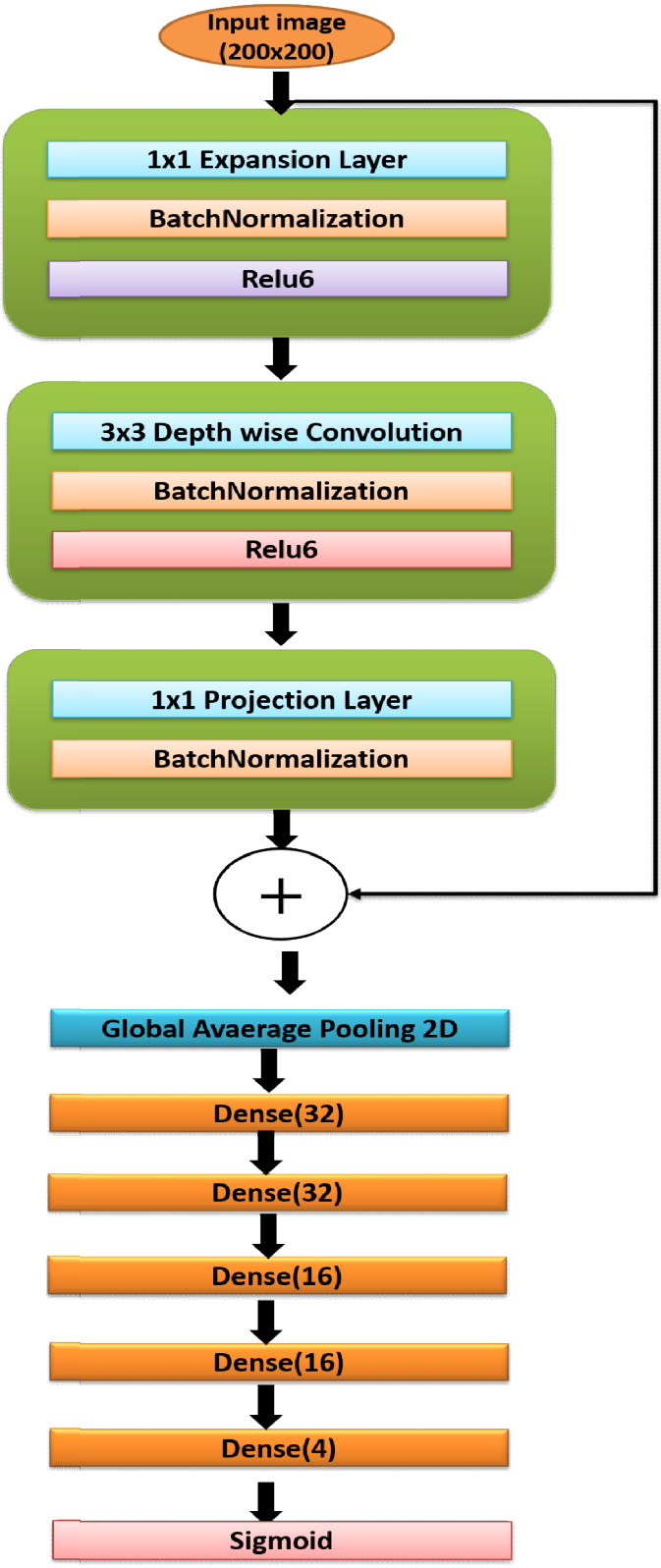

Fig.7. Block Diagram of Mobilenet V2 Architecture

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CLASSIFICATION RESULT

The proposed simulations for classification of bird is carried out using CNN, Inception V3 and Mobilenet V2 model and the output image for 4 kind of birds is given in Fig. 8. For all the three models, output is derived with full accuracy.

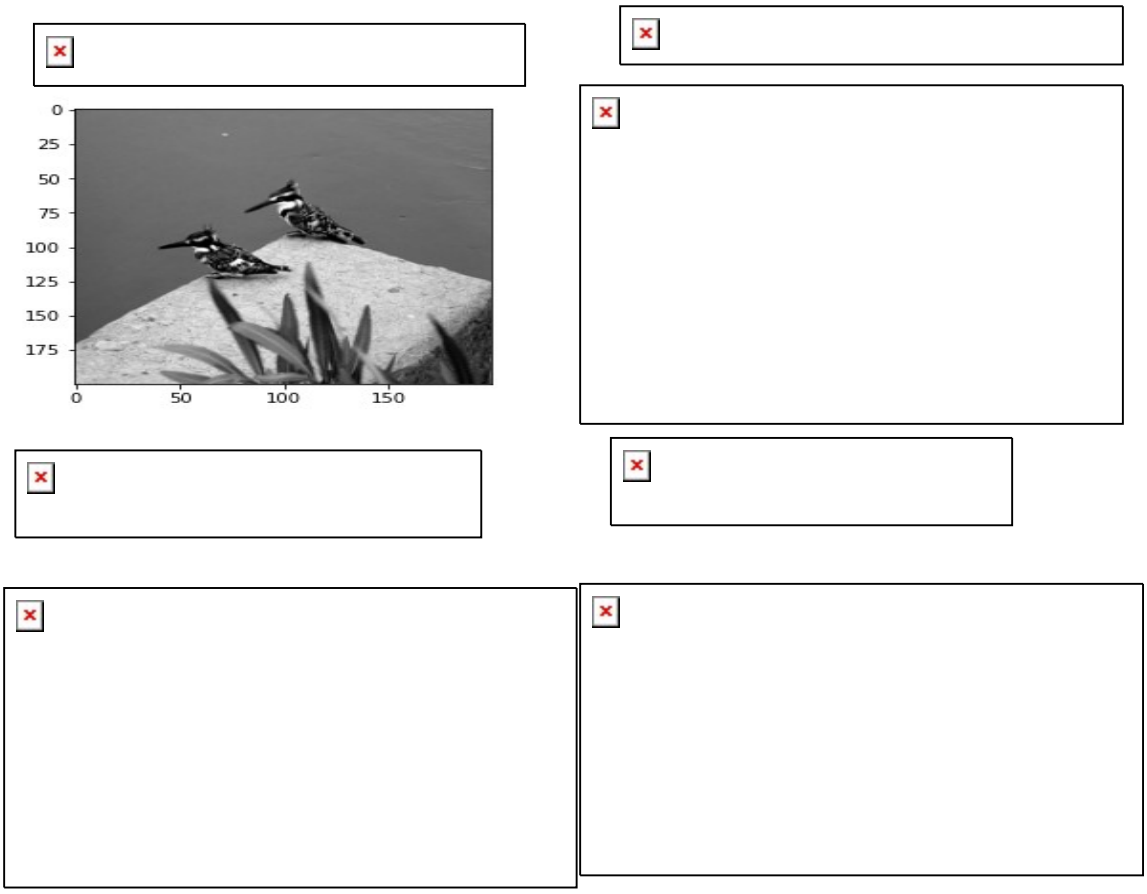

Fig.8. Classification result for four kind of birds

Experimental Analysis

The three classification models for bird classification are performed and the results are calculated and compared to find the best accuracy. The confusion matrix for the three models is given as Fig.9. The best accuracy is given by Mobilenet V2 model as 99% while other models namely CNN model shows accuracy of 95% and Inception V3 model shows accuracy up to 91%.

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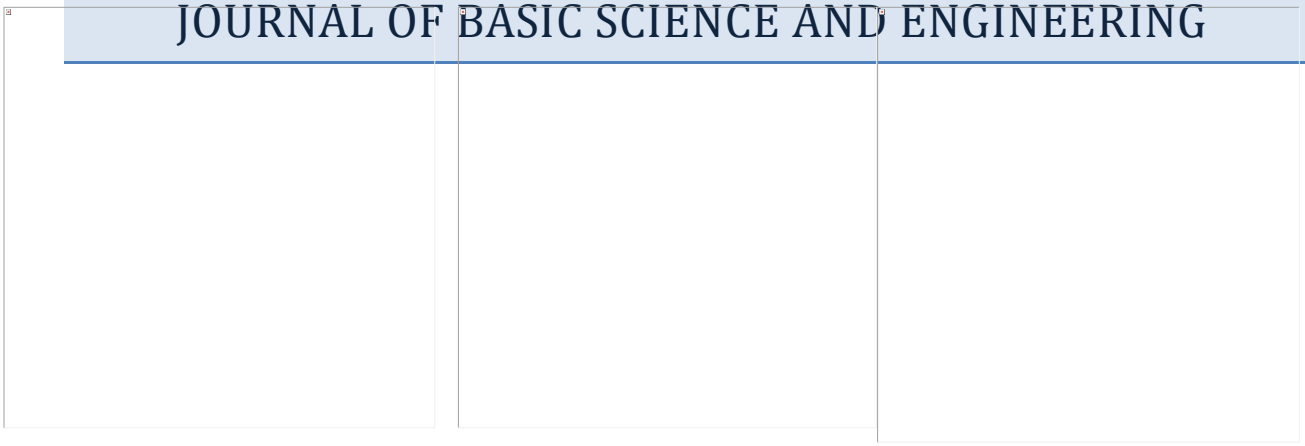

Fig.9. Confusion Matrix for three classification models

The three classification models and their accuracy are given as Table 1 and bar chart for the performance analysis is given as Fig.10.

Table 1. Performance Analysis for Three classification models

Classification models	Accuracy (in %)	Trainable Parameters
Mobile net V2 model	99	2,314,020
CNN Model	95	37,316
Inception V3 Model	91	21,907,652

Bar chart for the above accuracy comparison for three classification model is given below

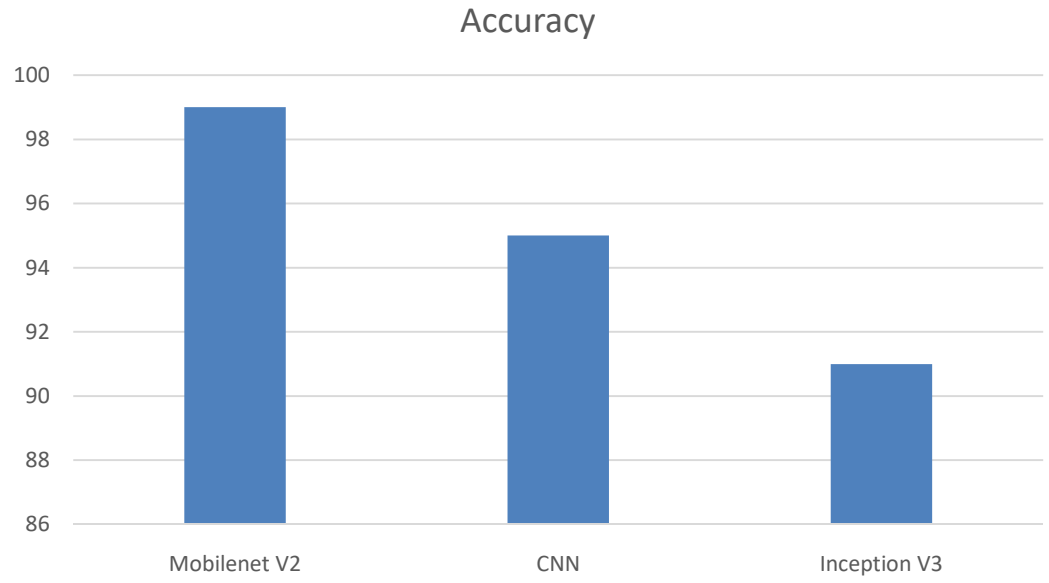

Fig.10. Bar chart for accuracy of three classification model

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CONCLUSION

From the above analysis bird classification is done by three models namely CNN model, Inception V3 and Mobile net V2 model. Of the entire models Mobile net V2 model performs fit with very high accuracy nearly 99% which cannot be achieved by other models. Four categories of birds are taken as sample for classification. This model can be enhanced further for classification of more birds. The proposed model can be further extended for identification purposes of similar entities.

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