Recognition of Different Bird Category Using Image Processing

https://doi.org/10.3991/ijoe.v18i07.29639

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Abstract—People like to do bird watching but to identify bird species they need help of Zoological Science. Bird watching gives health benefits which we get by enjoying nature. Species identification is a challenging task which may result in many different labels. Sometimes even experts may disagree on species. It is both difficult of humans and computers that hit the limit of visual abilities. Hence, to help the bird spectator, we have developed deep learning based algorithms using the concept of image processing that help in identifying bird species. It will recognize the input image by comparing the model with a trained model and then predict the bird species. All the details of the bird will be displayed as an output. Also, it will help us to create dataset if any image captured or uploaded by user is missing in dataset then user can add that image to dataset.

Keywords—machine learning, deep learning, bird species recognition, image processing.

1 Introduction

Many people do this to see the bird and be happy listening to their voice and try to sound like them. Some people keep birds. But we are not able to predict the bird, sometimes it belongs to which species. Bird can also provide health benefits and enjoyment as a result of being in nature. Identification of bird and insect species is a difficult process that often results in confusing labels. Even expert bird and bug watchers have their own opinion on the species of bird or insect. It is a challenging challenge that tests both the visual talent of people and computers. Even while various bird and insect species share the same basic set of components, their form and appearance might vary. Attempts to automate species identification in audio recordings have included birds, amphibians, bats, insects, fish, and marine mammals [1-2]. Recently, machine learning techniques for identifying numerous species have been effectively applied to audio data [3-4]. Deep learning models, such as convolutional neural networks (CNNs), have demonstrated outstanding performance [5–7]. CNNs have also been used effectively for many other sound identification applications, including as bioacoustic recognition for taxonomic groups other than birds, and human voice recognition [8].

Neural Network model has three layers, i.e., input layer, hidden layer, and output layer. A neural network works exactly similar to a human brain which identifies relations between datasets with the help of some algorithms. The system of neural network may be organic or artificial in nature. Input layer fetches the data into the system and then the other layers of neural network conduct further processing on it. Hidden layer is present between Input layer and Output layer. It computes the weighted inputs and produce net input which further produce actual output with the help of activation function. Output layer-is the last layer of neural network. It produces output for the system.

1.1 Convolution neural network

Convolution neural network are feedforward networks in which information flows unidirectional, i.e., from inputs to outputs. CNN consist of convolution and pooling layers which is used for image classification. An input image is passed through convolution and pooling layer. After that, input image of many symbolized parts of a bird were gathered. Then the feature extraction takes place in which each generic part is identified and differentiated on the basis of shape, size, and color. Thereafter, the training of CNN model takes place with some pictures in a graphics processing unit for feature extraction with the above-mentioned features, and the trained dataset were stored in a server to target instance. Lastly, we get information as an output result from an image the end user uploaded which is captured using a camera. So, by the image we can obtain information and predict the specie from the trained model with the help of Figure 1.

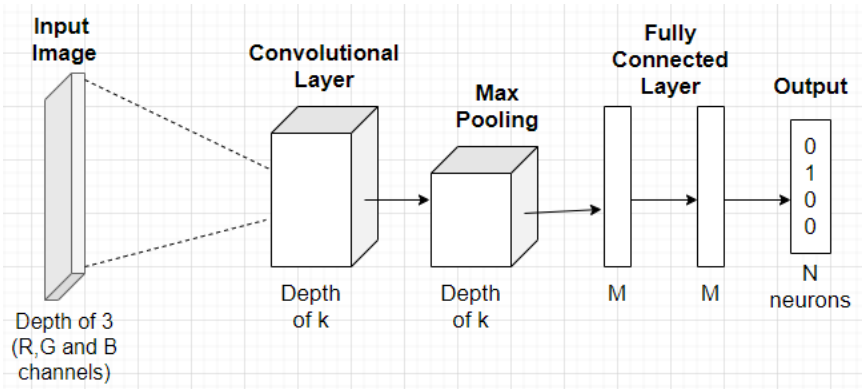

Fig. 1. Schematic representation of CNN Architecture

1.2 Image processing

Image processing is a procedure in which we operate an image to obtain an upgraded image or few important details from that image. It is done by the help of digital computers by using some computer algorithms so that we get improved image or features

of that image. Figure 2 depicts the various phases of image processing. Phases of image processing are:

1. Image Acquisition is the primary and the foremost step of digital image processing. It is very basic as it gives a digital form image. AudioMoth recorders are used to collect acoustic data [9]. Usually, it involves pre-processing like: a) Scaling b) Color conversion.
2. Image Enhancement is the easiest and fascinating regions of image processing. The basic plan of improving process is to take away knowledge i.e., unknown, or to focus some elements of the image. Such as, brightness adjustment & contrast etc.
3. Image Restoration is a field which takes care of enhancement of the image. It is a technique as it is developed on mathematical models of image degradation.
4. Color Image Processing is a field that acquires importance as it is thoroughly used for digital imaging. This consists of color modeling and processing in a digital acquisition etc.
5. Wavelets and Multi resolution Processing are the substructure for representation of images in multiple resolution. For data compression and for pyramidal presentation, the images divide itself into shorter areas.
6. Compression takes care of those techniques which help in decreasing the storage space which is needed to save an image or bits for the transmission. It is an essentially used for the compression of image.
7. Morphological Processing uses those means which are beneficial for the extraction of image components which help in identifying and describing the shape of the object.
8. Segmentation is the most difficult process in digital imaging as it parts the image into basic elements. This roughly segmented process gives out many solutions to the digital imaging problem which occur during the recognition process.
9. Representation and Description follows the result of a segmentation part, that generally composed of raw pixel image. The part of the representation in the result is just that it converts raw data in such a way that it is acceptable in successive computer processing. Description handles those kinds of feature extraction which helps in the differentiates between 2 or more types of objects.
10. Object recognition is a procedure where object is given a name or a title according to the description after the identification and is displayed.

Knowledge Base is an area in which the minute details of the image are stored [10]. It can be as complicated as a dataset consisting of high-definition satellite images of an area in connection with change-detection applications.

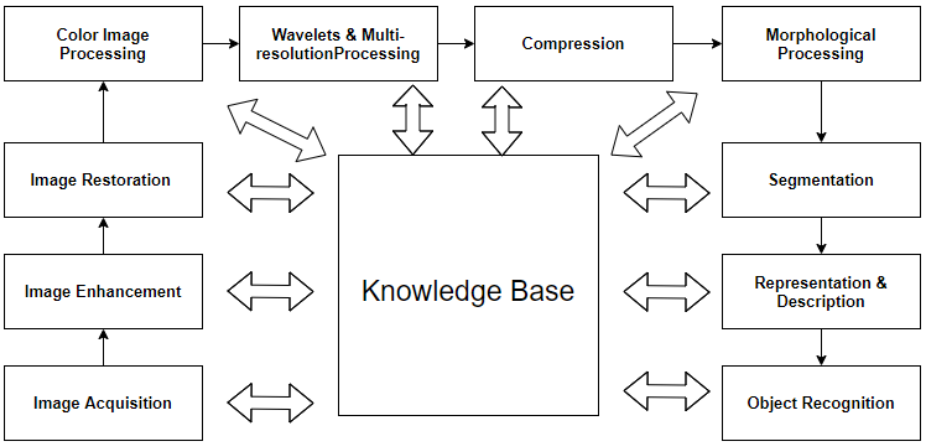

Fig. 2. Different phases in image processing

1.3 Organization of the work

The remainder of this paper is organized as follows: The Literature survey is briefly presented in Section 2. The proposed bird prediction scheme is defined in detail in Section 3. In section 4 explain the implementation of proposed methodology. Section 5, 6, 7, present the result and comparison, conclusion, and future scope respectively.

2 Literature survey

Nadimpalli et al. [11] made a model with the assistance of image processing method it identifies birds in Aqua cultural lakes is a novel idea that empowers expanded adaptability in conveying predatory birds. Three image processing algorithms, image morphology, artificial neural network and template matching, were designed and used. They extended the algorithms for identifying birds in real-time situations and created key algorithms for use by using the Image Processing and Neural Networks Tool Box of MATLAB 6.5 version to build the algorithms. The ANN model took three minutes to train the images. But results were delivered immediately when testing the images.

Christiansen et al. [12] they utilized digital image processing procedures to automatically identify and contemplate animals based on the video clips. The investigation of thermal radiation tells that occasionally radiation surpasses from the background, which causes the object to seem brighter on the video snapshots. But during daylight, the thermal contrast between the animal and the background may decrease and a few spots of grass may radiate nearly a similar temperature as the animals. All things considered; filtering procedures can be executed to improve the presence of the animals. For this reason, they preferred the Laplacian of Gaussian filter for pre-processing to upgrade the appearance. Under most conditions, recognition rates, were near 100% through dense crops may hamper the recognition of animals.

Nadimpalli et al. [13] focuses on bird identification and analyzes the motion identification with image subtraction, bird identification with template matching and bird identification with the Viola-Jones Algorithms. Out of all these methods, bird identification with Viola Jones Algorithm had the more accuracy (87%) with a less negative rate. This image processing procedure would preferably be integrated with hardware to form a smart scarecrow system. Although the training for the object classifier is slow, the actual detecting is fast that is why there have been some web browser implementation and mobile implementation. The Viola-Jones algorithm can be trained for nearly anything as long as there are many similar positive images that can be used for training the classifier.

Moreira et al. [14] represents the best in class of video identification and chasing of marine vehicles. The marine time condition is challenging and dynamic. The algorithm for identification and tracking, when utilized in a marine time condition without appropriate steadiness, so it doesn't create proficient outcomes. Errors in recognition and tracking may happen because of commotion, mess, waves, dynamic and erratic sea appearance, daylight reflection, awful natural conditions and image contrast, presence of objects that float over the ocean, white froth, the variability of certain marine time vehicle highlights, for example, size, mobility, appearance, geometric shape and the presence of birds, clouds, haze and airplane that emerges over the skyline. The algorithm appeared not to perform well in some the constant circumstance when little vessels that have low contrast from the foundation emerge in the camera field of view.

Shalika et al. [15] are concerned about watching animal conduct in wild life utilizing face recognition and tracking. An algorithm for recognition and tracking animal in wildlife video clips. The recognition depends on a human face identification strategy, utilizing Haar-like highlights utilizing Ada Boost classifiers. Tracking is finished utilizing the Kanade-Lucas-Tomasi tracker and by applying a particular model to the identified face and consolidating the two procedures in a particular tracking model, a solid and briefly sound recognition/tracking of animal faces is given. So as to the distinguish specific animal species, the data accumulated by the tracker can be utilized to help like grouping of wildlife recordings. The reason for this undertaking is to make a framework for automatically distinguishing wild animal. This paper primarily centers on characterization and identification.

Nguyen et al. [16] used dataset of Wildlife Spotter, consists of enormous images taken by cameras in Australia, they have developed and illustrated the practicality of a deep learning approach for creating automated wildlife monitoring system. With different settings as an experiment for balanced and imbalanced, shows that system is strong, steady and reasonable for managing with images captured. They have worked on many different methods to enhance the system's working by improving the dataset, by using deeper CNN models and utilizing particular features of camera. For a completely automated wild life identification system, we would go into transfer learning to manage with issues of imbalanced information. Later on, they will make a "hybrid" wild animal classification system whose automated module work as a recommendation system for the present citizen Wildlife Spotter project.

Niemi et al. [17] they have gathered the non-deep CNN for picture classification, and demonstrated that the model is satisfactory for real-world application, particularly,

when the quantity of training data is restricted. They presented and demonstrated that data augmentation strategy upgrades enormously the performance of the classifier, and the alluring condition of execution as an image classifier can be accomplished by applying it. In this way, they indicated that the data augmentation is significant for the classification performance. The primary execution of the image classifier was provided without utilizing the boundaries given by the radar, those boundaries give more and applicable information to the framework and they can transform a wrong classification into the right. Information gathering will be done at the test site which gives huge informational collection.

Nyaga et al. [18] create a mobile application that can recognize Kenya bird species from an image and create a bird map of the observations. It is easy for a human to identify that a given image is a bird. This study starts by reviewing present methods of bird species identification. Machine learning supports image recognition and focus on transfer learning and convolutional neural networks that are used for image processing. This study displayed that advance in computer vision has been able to create deep neural networks that can effectively and efficiently perform fine-grained categorization. Then the study gives a detailed solution to solve the problem of bird species identification using transfer learning and came up with a mobile application for bird species recognition. The model performed well and was able to tell the bird species in an image provided by a user and also allowed to save the results into the database and later on retrieval.

Huang et al. [19] designed an automatic model which was made to order the 27 endemic birds of Taiwan by skipped CNN model. The reason behind skip connection was to give a continuous gradient flow from the first to last layer, which can solve the disappearing gradient problem. They do comparison of working of different models such as CNN with and without skip connections, and SVM. CNN with skip connection performed two algorithms. The proposed model was able to identify the input image of a bird as bird with the accuracy of 100%. Because of minute visual similitudes among the bird species, the model in some cases do not have interspecific comparisons between the bird species. The test dataset yielded 93.79% of sensitivity and 96.11% of specificity.

Gavali et al. [20] tell that instead of identifying numeral of different classifications, the issues of identifying an enormous number of classes in one classification of bird were suspected. Characterizing birds posture an additional dare over classifications, on account of the huge similarity between classes. Likewise, bird are adaptable objects that can distort in numerous ways, and simultaneously there is additionally an enormous variety inside classes. In this way, the current investigation finds a strategy to recognize the bird species utilizing Deep learning algorithms on the dataset for classification of images. It has 200 classes or 11,788 photographs. The created framework is associated with an easy-to-understand site where user will transfer photograph and it will give the output. The proposed model deals with the rule of identification of a section and extracting CNN highlight from numerous convolution layers.

3 Proposed work

Various point describes in propound work these are as follows.

3.1 Work flow

The work flow of the model is like a user will upload the image as an input and it will store in database if it is not there. Then system will fetch the image and apply CNN on it and it will be compared with the trained model. After that features of the image will be extracted and the classifier will classify the extracted features and display the required result.

The Figure 3 shows the flow of the proposed system. We would need a trained dataset which has two things trained result and test result that will recognize image to make this model. We will use retrain.py in order to train the dataset properly for high accuracy; a greater number of steps mean more system accuracy. When an input image file uploads by user, it will be stored in database temporarily. Then it will be feed to system where CNN is linked with trained dataset. A CNN has of different convolutional layers [21]. Complete image of bird is taken for classification like different elements such as head, body, color, beak, shape to have more accuracy. All features are passed through convolutional network to filter out features. The image is then classified using a CNN using an unsupervised method known as deep learning. These features are then collected and sent to the classifier. To get the actual result, the input will be compared with the training dataset.

Fig. 3. Work flow diagram of proposed scheme

3.2 Use case

Figure 4 shows that the model would be accessed by 2 participants, the system administrator and the user. The system administrator would be able to pre-process the dataset and train the model then he would generate a model which will help in comparison between the trained model and the pre-processed data. Afterwards he can upload an image by either capturing it or by selecting it from their gallery and make the upgradations. Meanwhile the user would be able to register and login into the system and make the inferences by uploading an image by selecting it from the gallery or by capturing it, then he would be able to get the desirable results.

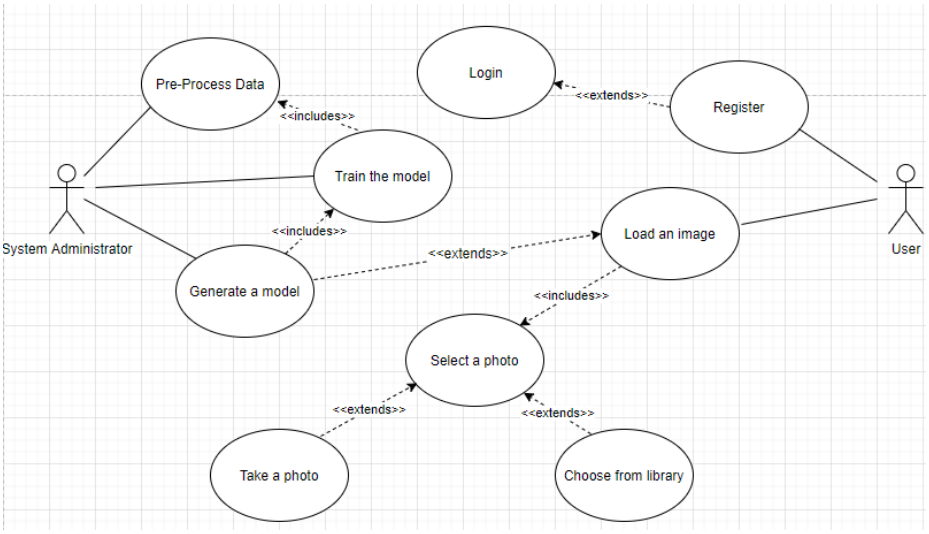

Fig. 4. Use case diagram

3.3 Proposed algorithms

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  1. Acquire from position of tested image (A, B) and
scale (R) of N strong scatters.
  2. Arrange (A, B, R) triples by sliding R.
  3. For every source O from 1 to N do 4.
  4. For every position M from O+1 to N do 5,6
  5. dA = Ap – Ao; dB = Bp – Bo
  6. For DA from dA-1 to dA+1 do 7
  7. For DB from dB-1 to dB+1 do 8, 9, 10
  8. Weighted_vote = |DA| + |DB|
  9. seem at inventory of model data entries at DA, DB
  10. For each entry C in the list do 11
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```
  11. If |ta=Ao-Ae| < translational_limit and |tb=Bo-Be|
< transitional_limit and |1-Reo/Ro|< magnitude_limit and
|1-Rep/Rp|< transitional_limit
  Then increment array [Specie, Az, ta, tb] by
weighted_vote.
  12. Doubt saver array for every Specie, Az, ta and tb,
summing the votes in a 3x3 section in conversion subspace
regarding ta, tb; proof the uppermost vote_sum and the
appropriate Specie.
  13. If highest vote_sum > threshold Then result is Spe-
cie Else result is "Not found".
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4 Implementation

4.1 Feature extraction

Feature extraction is the process in which a raw image is an input for a primary task which extracts important and detailed elements for fined grained image recognition. It is a challenging task of its morphological and intra class variation.

4.2 Training neural network

Initially neural networks start with random weights and biases, but it trains itself again and again till it reaches to its best performance. It is done by calculating amount of error they have at that moment, which is known as cost of neural network. Training neural network for image recognition from set of data is developed, by TensorFlow, it is open-source software for computation using data flow graphs. Training of neural network is a learning about the values of parameters and this process of learning in a neural network as a repetitive process of "going and return" through all the layers of neurons.

4.3 Training dataset

The implementation of learning of bird species with the help of CNN was performed on a GPU workstation with a 12 Intel Xeon CPU, 32 GB of memory, and a Nvidia GeForce 2 11 GB GTX 1080 Ti graphics card on a TensorFlow platform. The input images of fixed size 112×112 pixels were provided to the convolutional neural network for feature extraction and recognition process. A dataset of bird species is used for training, validation and testing in this study. Different features of the input image are extracted like colors, shapes, body, legs, angle, head etc. while we pass it through the pile of convolutional layers. The transformation of input image into pixels takes place in the first convolutional layer which moves forward to the next layer and then feature extraction takes place till the image classification is completed with probability distribution. Figure 5 shows that the outcome of proposed work of bird prediction scheme.

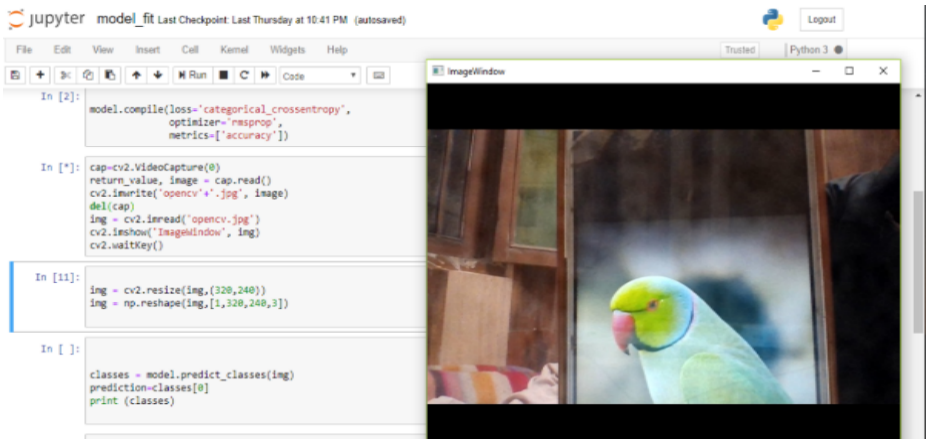

Fig. 5. Image capturing

In Figure 6, model is capturing and predicting the specie of the bird and it shows the output parrot for the captured image. The captured image is compared with the trained dataset and after that a scoresheet is generated, so in scoresheet which ever specie gets the maximum score will be displayed in the output.

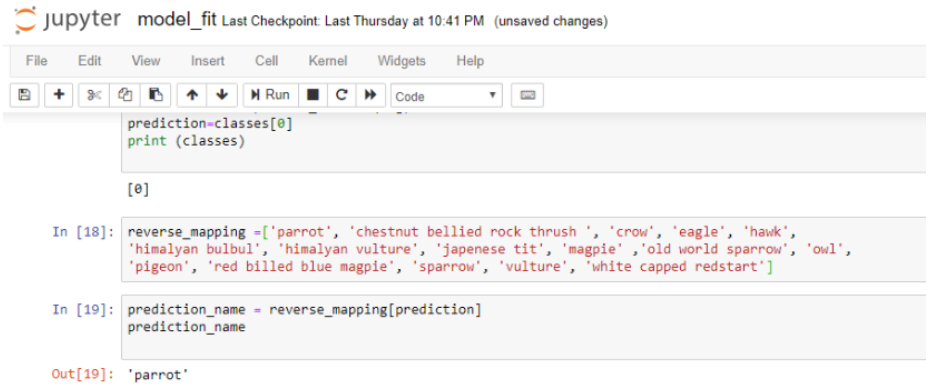

Fig. 6. Specie prediction

5 Result and comparison

A software platform has been developed in this research article. With the help of which, image processing has been used to identify the bird species in real time from the user-shot digital picture. The picture taken by the user is stored in the database and uploaded. The system then sends this input file to the CNN, which is then combined with the dataset learned. To achieve optimum accuracy, several aspects such as head, body, colour, beak, form and the complete picture of the bird are evaluated for classi-

fication. To extract features, each feature is provided through a deep convolution network. These features are then gathered and passed to the classifier. To generate the result, the input will be compared with the training dataset. The image is compared with images from a pre-trained dataset, and a score sheet is generated. The largest match value of the score sheet is the result of the bird species, which is the output of the top 5 match results. By the above implementation, as a result we get name of the specie which is shown in the figure 6. In comparison, with other works, our work has feature which builds dataset for non-existing species in the present dataset.

6 Conclusion

Classification of bird species with the help of a dataset is done by neural network. Accuracy of classification cannot be increased with the use of multiple-width frequency delta data augmentation when compared to raw spectral data, but the classification accuracy is near to the state-of-the-art and has a benefit over raw spectral data when there are limited computational resources. With the help of meta-data in prediction model it pushes the rank of the species, but it doesn't look like enough to raise it to the top rank, which shows that the model has to predict few species, but the actual number 1 accuracy don't be affected. This work will help the upcoming researchers and engineers to work on other areas like defect recognition in the industries, image segmentation for various purposes like in medical field [22-24]. The only drawback of this algorithm is that the accuracy of the identification totally depends upon the quality of the camera which results to inaccuracy above the certain range of the camera.

7 Future scope

In future, image processing will consist of improved digital automation which will include the recreation of many image processing software. Soon the idea of living would be transformed into a totally new world of technologies as by changing a few things in this image processing technology, scientists will give us millions of robots who would make our lives much easier and fast forward [25-27]. According to the researches, image processing and AI would include voice commanding, language translations, navigation and records, diagnosis of medical issues, automated driving systems etc. Talking about the work, in this we can improve or upgrade a cloud feature in which we can save huge dataset for comparison and high computational power in case of neural network.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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Article submitted 2022-01-20. Resubmitted 2022-03-08. Final acceptance 2022-03-08. Final version published as submitted by the authors.