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Image-Based Animal Detection and Breed Identification Using Neural Networks

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Abstract: *Having accurate, detailed, and up-to-date information about the behaviour of animals in the wild world would improve our ability to study and conserve ecosystems. We investigate the ability to automatically, accurately, and inexpensively collect such data through various sources, which could help catalyse the transformation of many fields of ecology, wildlife biology, zoology, conservation biology, animal behaviour into "big data" sciences and many more. So extracting information from the pictures remains an expensive, time-consuming, and manual task for us. We demonstrate that such information can be automatically extracted by deep learning and convolutional neural network. Leveraging on recent advances in deep learning techniques in computer vision, we propose in this project a framework to build automated animal recognition in the wild, aiming at an automated wildlife monitoring system. In particular, we use a single-labelled dataset done by citizen scientists, and the state-of-the-art deep convolutional neural network architectures, face biometrics, to train a computational system capable of filtering animal images and identifying species automatically and counting the number of species. Our results suggest that deep learning could enable the inexpensive, unobtrusive, high-volume, and even real-time collection of a wealth of information about vast numbers of animals in the wild and this, in turn, can, therefore, speed up research findings, construct more efficient citizen science-based monitoring systems and subsequent management decisions, having the potential to make significant impacts to the world of ecology and trap camera images analysis .*

Keywords**:** *machine learning, deep convolutional neural networks, face biometrics.*

I. INTRODUCTION

Problems related to wild animals are tremendous and are classified as human–wildlife conflict, endangered species overabundant species. These will results to agricultural damage by animals. Endangered species are threatened with extinction by hunting or human activities, such as land-use changes and many mo.

To efficiently detect road-animals before their collisions with vehicles, camera-based systems seem to be the best option, compared to the aforementioned solutions. For this purpose, we present in this section the main idea behind the detection and recognition of animals either by images. Animal detection, especially in night time, is an extremely challenging problem due to the surrounding conditions such as illumination changes and cluttered background; and, on the other hand, the large intra-class variability between different types of animals, and between animals of the same category. Surprisingly, animal detection systems for collision mitigation have not received high interest by computer-vision community. In this study, we represented the following stages for classification and identification.

Detection

It is checked whether an image feature of a given type is at that point or not. In computer vision and image processing feature detection includes methods for computing abstractions of image information and making local decisions.

Texture features based detection

Texture is a feature used to partition images into regions of interest and to classify those regions. Arrangement of colours or intensities is provided by texture feature based detection in an image. Texture is specified by the spatial distribution of intensity levels in a neighbourhood.

Gradient features-based detection

Gradient edge detection method detects the edges by looking for. The maximum and minimum in the first derivative of the image.

Color based detection

Color is an important and the most straight-forward feature that humans perceive when viewing an image. Human vision system is more sensitive towards color oriented things so that features can be extracted easily.

Recognition

Pattern recognition is the process of recognizing patterns by using a Machine Learning algorithm. Classification and cluster of patterns are used for recognizing a system.

The recognition stage receives a list of ROIs that possibly contains one or more animals. In this stage, ROIs are classified as animal or non-animal, with minimal false positives and false negatives. Animal recognition is usually performed using template matching or machine learning techniques such as Neural Network (NN), Support Vector Machine (SVM) and AdaBoost. The choice of the suitable recognition algorithm depends essentially on the training sample statistics (e.g., class distribution and size), the features used and the output of the detection algorithm.

Image Features Extraction

Features are functions of the original measurement variables that are useful for classification and/or pattern recognition of an image. Features extraction is the process of defining a set of features, or image characteristics, which will most efficiently or meaningfully represent the information that is important for detection analysis and classification. The purpose of features extraction is to enhance the effectiveness and efficiency of object detection and classification.

II. LITRATURE SURVEY

As typical ask is fine-grained classification, identification and classification have been addressed in multiple studies. However, fewer results have been reported on the specific breed identification.

Transfer learning on convolutional neural networks for dog identification by Xinyuan Tu, Kenneth Lai, Svetlana Vanushkevich in 2015

ILSVRC posted on going deeper with convolutions in which mentioned feature extraction of hidden animals from the different datasets using K-NN and SVM. At that time the system has given an accuracy of 70%.

Where is my puppy? Retrieving lost dogs by facial features by T.P. Moreira, Mauricio Lisboa Perez, Rafael de Oliveira Werneck, Eduardo Valle In 2017

Human facial recognizers are not much efficient for dogs showing that dog facial recognition is not a trivial task than human facial recognition. They proposed about facial feature extraction with BARK attaining up to 81.1 % accuracy, and WOOF, 89.4 % for a labelled dataset.

Fast Human-Animal Detection from Highly Cluttered Camera-Trap Images Using Joint Background Modelling and Deep Learning Classification by Hayder Yousif in 2017.

They proposed a system using Deep convolutional neural networks for normalizing image size for an efficient segmentation improvement for the labelled dataset. The 83.78% accuracy was reported. The optimized DCNN was able to reduce the classification time by 14 times and maintain high accuracy.

Wild Animal Detection using Discriminative Feature-oriented Dictionary Learning by Pragya Gupta and Gyanendra K. Varma in 2017

For Animal detection, implemented a method with 92% accuracy. In 2017, they have done wild animal detection using discriminative feature-oriented dictionary learning where there was a class-specific dictionary for each class. Discriminative features of positive images and negative images were calculated.

A two-step learning method for detecting landmarks on faces from different domains by Bruna Vieira Frade, Erickson R. Nascimento in 2018.

The most relevant to our work is paper that describes an approach to identify dogs using a coarse-to-fine grained method. There were two important stages after data processing. First one was the coarse stage for breed classification and the second one was a fine stage for dog identification with an accuracy of 70.94% using their approach

III. METHODOLOGY AND ARCHITECTURE APPROACH

Firstly an input image is considered. Let's take an example that it's of two animals i.e., dog and cat as shown above in Figure 1. And now there count of animals from input image is generated.

Now feature extraction processing from image is done like displayed in red box (considered only faces of image). After that it is cleared that which one is cat and which one is dog.

Now their separate species and breeds are identified after that CNN only search in that particular species folder of trained dataset.

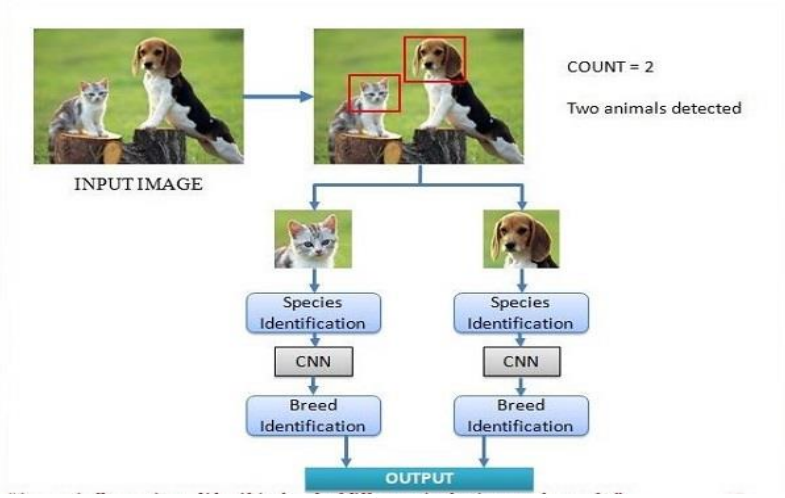

Figure1: Structure of the proposed manifesto.

Depending upon the species instead of searching whole trained dataset, it will start searching particular folder of identified species. Hence at the end we will get output as identified breed and count of it from input image in visualized manner.

Above is only theoretical approach we have considered, but in practical approach our system works as shown in Figure 2.
Firstly combined image of dog and cat is considered/ uploaded in the system using dialog box. Then this image is successfully get uploaded alert will get generated and image will get displayed. After clicking image detect button following image with detection of species will directly displayed on the screen.

Figure 2: Depicts the feature extraction process and declaration of animal type

Figure 2 will depict that in the given image of dog and cat, our system is able to differentiate between different animals very easily. Also it is having confidence that the image consist of cat and dog with 95% and 93% of confidentiality.
Also it is able to determine that how many animals are present in the image. There are two count of animal, one is dog and other is cat.
Now this image gets divided into two images of dog and cat and gets stored in Frames folder in .jpg format. Now for breed detection this folder path is given to proceed further process.
In next part of project will depict the actual breed of those animals.
After clicking Breed detection button, the system will search in trained dataset folders and give output as shown in Figure 3.

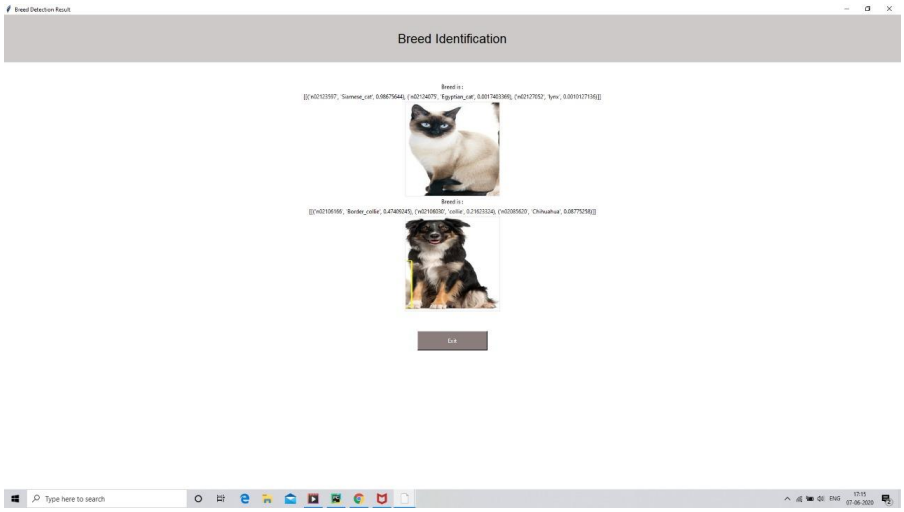

Figure 3: Breed detection of animals

In Figure 3, this is the result of breed detection. Our CNN system will identify prediction of cat and dog separately. Cat as Siamese cat or Egyptian cat or lynx and dog as Border collie or collie or Chihuahua .The one which is having higher confidence will be the result of breed identification. Here in this case, the cat is Siamese cat and dog is Border collie.
In any other image if there are more animals it will show similarly their confidence on the image and give output as same. Those which have higher confidence will be the correct breed of the animal.

IV. **EXPERIMENTAL RESULTS**

Dog and cat Identification

The dog and cat dataset was used to identify dogs and cats within two sample breeds: Border Collie and Siamese Cat. We evaluated the accuracy of the classifiers for each of these groups, respectively, using a lO-fold cross-validation.

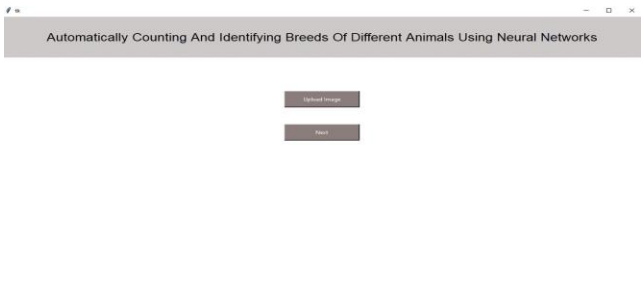

Figure 4: Front page of GUI, a way to get identification of animals

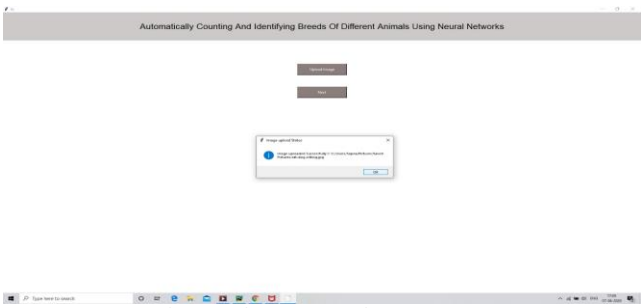

Figure 6: Pop-up of successfully upload of image.

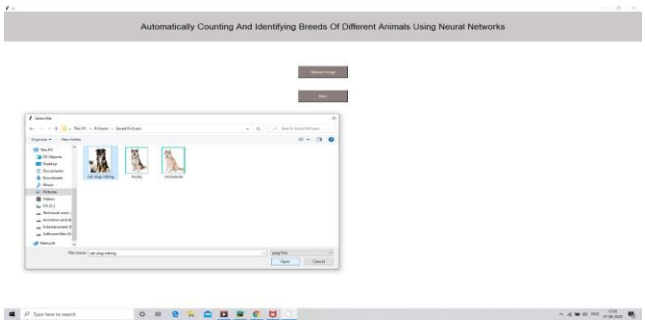

Figure 5: Dialog Box to choose image from directories.

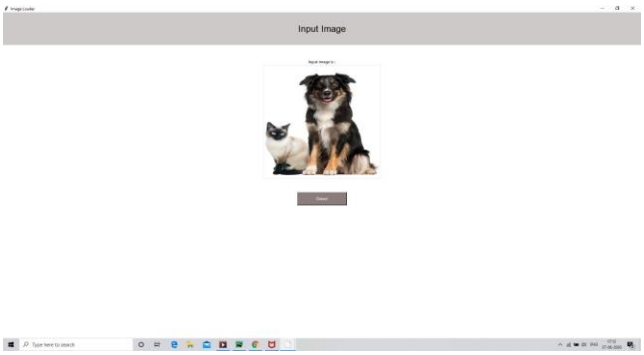

Figure 7: Page showing uploaded image.

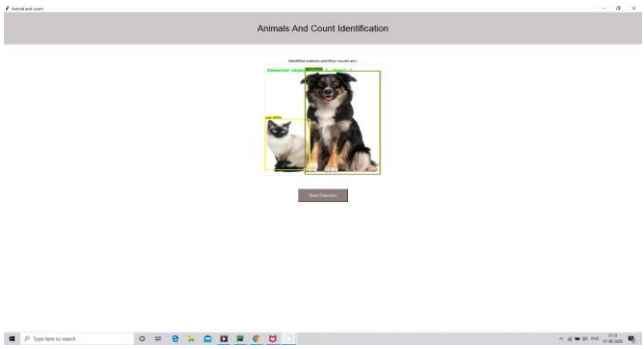

Figure8: Showing detected animal dog and cat.

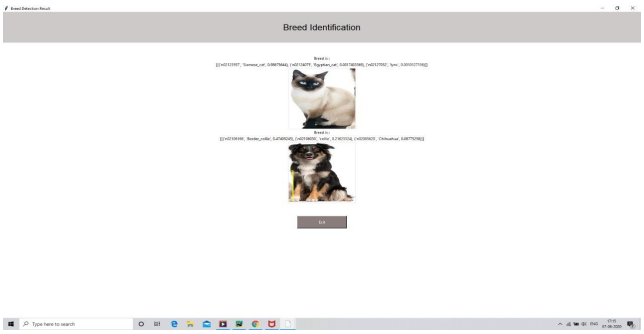

Figure 9: Showing detected Breed of those previously detected animals.

Breed Classification

We trained the dataset into followings: (a)raw images from the cat dataset, normalized images from the same database, and the images obtained using the SSD; (b) same selections of images from the dogs dataset . Similarly, there were two groups of testing data .For the combined database; we used 70% of the images for training and 30% for validation separated randomly. The accuracy was defined as follows: Accuracy = TP/(FN +TP) where TP is the number of images correctly classified using rank-one matching, FN is the number of incorrectly classified images, and FN + TP is the total number of images for testing.

IV. CONCLUSION

In this paper, advanced technology such as machine learning and deep learning are used for animal identification and its classification along with their count. The proposed method was performed on a case study on publicly available animals' dataset. Many ecologists are having an interest in identifying individual animals with their count of breeds. Thus, the different local and textual features have extracted and the result is predicted from the image by using CNN (Convolutional Neural Network).

The proposed system uses a labeled dataset for training and classification to evaluate the breeds of animals with an accurate count. The accuracy of the system is good because the trained dataset is admirable and capable to detect image of innocent animals.

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