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Wildlife Detection System Using Deep Neural Networks

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Abstract –

Animals moving out of the forest region and moving into the human environment is growing day by day. Animals entering the farming regions put close to the forest ruin crops or even assault on people therefore there is a need of system which detects the animal existence and gives caution about that in the position of security objective. The proposed project "Wildlife Detection using Deep Neural Networks" provides the users with type of animal and count to make the process of animal vehicle collision easy. The detection of the animal is done using CNN by converting images into greyscale, segmented and masked in the pre-processing stage. Then using Computer Vision technique, bounding boxes are formed around animals and count is also printed with the use of CV library. The whole project can tell which animal and count of those animals present. The proposed system uses the algorithms namely AlexNet, ResNet, Maxpooling 2D.

KeyWords : Computer Vision, Machine Learning, Twilio, CNN

1.INTRODUCTION

Observing wild animals in their natural environments is a central task in ecology. An increasing area of land surface has been transformed by human action, altering wildlife population, habitat, and behaviour. Since there are many different animals, manually identifying them is a daunting task. So, an algorithm that can classify animals based on their images can help researchers monitor them more efficiently. Wildlife detection and classification can help prevent animal vehicle accidents, trace animal facility, prevent theft, and ensure the security of animals in zoo.

The application of deep learning is rapidly growing in the field of computer vision and is helping in building powerful classification and identification models. Wildlife Detection System will help to prevent or reduce the number of animal-vehicle collisions. It facilitates individuals to have a well knowledge of living animals on earth by monitoring animal activities, particularly how the animal cooperates with its ecosystem. The animal identification is used to classify the animal that has been identified. Administration of animal treatment develops an essential problem as animals immediately impact the inner and physical health of humans.

Objective

The aim of the project is:

1. To build a wildlife detector that can approximately identify and classify the animal breed and class.

2. The model will also give count of animals present in front of camera.

2. LITERATURE SURVEY

Yu, X., Wang, J., Kays, R. et.al [1] have proposed a system in which the algorithm used is ScSPM. The dataset consisted of 7196 images with 18 different vertebrate species. The images used were of wildlife depicted with motion-sensitive camera traps, which generated series of 3.1 Megapixel JPEG images at about 1 frame/s upon activating by an infrared motion sensor. The images were all converted into grey scale and both the SIFT descriptor were then extracted from 16x16 pixel patches. All patches of each image were deeply sampled on a grid with step size of 4 pixels. In the proposed model, both SIFT and cLBP were normalized to be unit norm with dimensions 128 and 59, respectively. For the dictionary learning process, the system extracted SIFT and cLBP from 20, 000 patches that were randomly sampled on training set. Dictionaries were trained for SIFT and cLBP separately, with the same dictionary size K = 1, 024. The overall performance achieved by the system was about 82%. For one third of the 18 species, this system obtained classification accuracy over 90%.

Willi, M., Pitman, R. T., Cardoso, A. W., Locke, C., Swanson. et.al [2] have provided a step-by-step approach in recognizing four camera trap datasets which were accumulated by various research squads. Every dataset comprised of camera-trap images and their observations provided by citizen scientists on Zooniverse. The proposed method used capture event interpreted by various citizen scientists applying the Zooniverse platform.

Parikh, M., Patel, M., & Bhatt, D. et.al [3] describes where the dataset consisted of one folder consisting of target images and other the template images. Here the proposed system has used mixture of frame differencing method for background subtraction. To perform template matching in MATLAB, the system has used the concept of normalized cross co-relation. The method used in this system searches a long-duration signal for a shorter, known feature. The proposed system gave a false positive rate for the code was 13.3 %. Thus, the efficiency of the code comes out to be 86.7%. The system lacks efficiency so in future SVM, Neural networks was used.

Shetty, Singh, Shaikh et al. [4] describes that Tenfold cross validation can be used to classify animal images. The system consisted of camera-trap data for demonstration and assessed the accuracy. The dataset contained 20 varieties of animals with 100 image sequence for each species. The method divided the full feature dataset into ten identical folds. From ten folds, nine were contemplated as training data and enduring one was used as test. The system then repeated the process ten times so that each image was used as test image. The end result was the average of all results. The wildlife detection showed performance accuracy of 91% with F1-measure up to 0.95.

Schindler, F., & Steinhage, V. et.al [5] shows that the dataset material implemented was supplied from the Bavarian Highway Directorate, Germany. It showed video slides, each one around 10 s with 8 fps (frames per second) and a resolution of 1280 × 720 pixel. This system used two approaches namely Mask R-CNN and Flow-Guided Feature Aggregation. Mask R-CNN was the method of selection due to its enhanced recognition performance in images Flow- Guided Feature Aggregation offered the occasion to enhance object detection in video clips by incorporating temporal information in conditions of the optical flow in their internal feature computation. This system yielded the finest results with an median precision of 63.8% for animal recognition and identification. Mask R-CNN achieved an average accuracy of 39.8% on the official COCO challenge dataset. For activity recognition the correctness ranged between 88.4% and 94.1%.

3.METHODOLOGY

The proposed system is a wildlife detection system which detect animals using deep learning model. The proposed system presents a system where first the datasets are defined and then introduce a CNN model which will help in classifying these images into wildlife animals.

Initially, preprocessing is the first stage of the project where images are transformed to 3D and 4D tensor for spatial fillings. For preprocessing, libraries like Keras and PIL are imported. Keras is an open-resource software library that offers a Python interface for artificial neural networks. Keras can support multiple back-ends like TensorFlow, Theano and PlaidML. Convert 2-dimensional images to 3D tensor is done by adding depth to the image. 4D tensor image can be made by putting all these 3D tensors to an array.

AlexNet also plays a major role in deep learning for image classification. It is a CNN architecture which has 8 layers of Neural Networks. AlexNet architectures has sequential layers of neural networks as well as Maxpooling with activation function ReLu. It also has two fully connected layers which consists of ReLu non activated layer and DropOut layer to reduce overfitting. The softmax layer is used here for multiclassification of images. All layers have a size of 3x3 filter for calulation of weights.

The following figure shows how the flow of system works:

1. The user will input the image of animal the camera trap would have captured.
2. Image processing will take place using Keras library of Deep Learning.
3. Features will get extracted using TensorFlow as backend.
4. Based on feature extraction a machine learning model will get generated and trained.
5. Then the test images have to be provided to compare the trian and test data.
6. Animals will get classified and detected based on trained model.

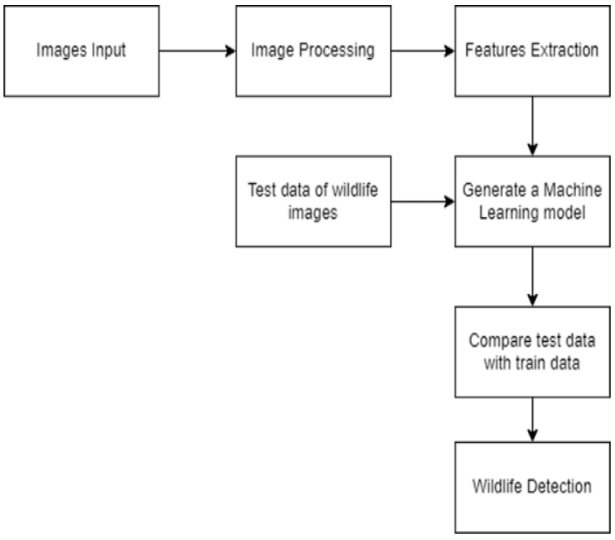

Fig-1 Flow Diagram of Methodology

System Architecture

The architectural configuration procedure is involved with constructing up a basic system for a framework. It involves identifying the real parts of the framework and exchanges between these segments. The starting configuration procedure of recognizing these subsystems and building up a composition for subsystem control and correspondence is called construction modelling outline and the return of this outlined procedure is a depiction of the product structural planning.

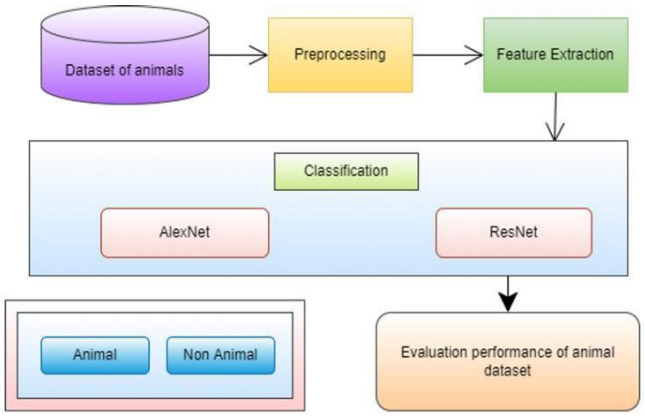

Fig-2 System Architecture

A series of experiments were conducted using deep learning models which include AlexNet, ResNet, etc. to evaluate animal dataset. Figure shows the general structure of animal diagnosis in this paper. In pre-processing, the mean method was used to convert images into 3D and 4D spatial features. The features of importance associated with the types of significance related with the types of importance for wildlife detection were chosen using the CNN model. These chosen features were fed into layers for wildlife detection. In this study, these layers were utilized to detect animal Sequential, MaxPooling, Convolutional and Dropout.

The system works as below:

1. The dataset in the file system is uploaded into the system.
2. The uploaded image is sent for preprocessing. This step involves: Reading and capturing of image, converting image to 3D tensor and 4D tensor.
3. The image is further processed to detect if any animal is present in them.
4. The detected animals in the previous step are classified into their type like bear/ elephants /empty /etc.
5. The count of animals is then printed to the user.
6. The result is printed and sent as a message.

System Data Flow DFD or Data Flow Diagram signifies the flow of data of a method or a process. It provides insight into the inputs and outputs of each object and the way itself. DFD does not have a control flow and no loops or judgment rules are triggered. Specific operations varying on the type of data can be described by a flowchart. The DFD belongs to structured analysis modelling tools. Data Flow diagrams are extremely widespread because they help us to imagine the main activities and data engaged in software-systems procedures.

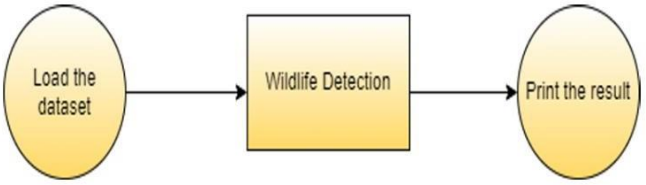

Fig-3 System Data Flow

The image dataset is loaded into the wildlife detection system.

The system detects the loaded dataset into the types of animals and this result is printed the console.

4. IMPLEMENTATION

The proposed System uses the different modules which the system uses and comes across:

- Data Collection
- Data Preprocessing
- Building Training model
- Prediction of animals
- Detecting count of animals
- Sending message with number using APIs.

The animal dataset was collected from various camera trap images. The dataset comprises 610 images divided into 410 training images and 200 testing images. Features include size, pattern on animals, background images type of animal, color of animal, night light etc. The detection class animals contain two values: animal and empty. The dataset is unbalanced because it contains 400 cases of “animal” class by 97.5 percent and 10 cases of “empty” by 2.5%.

5. CONCLUSION AND FUTURE ENHANCEMENT

This project deals with the prediction of wildlife on roads and forests. Out of the 610 images present 410 best train images are taken for prediction. Prediction is done using the deep learning technique, CNN which has AlexNet and ResNet architecture present. In this classification problem CNN classifies the output into two class with animal and without animal in given test image. The main objective of this study was to predict animals using less number attributes while maintaining a higher accuracy. Here we obtain an accuracy of about 93 %. The model which we used here gave an accuracy of 85 to 92 percent. Using MATLAB for template matching algorithm showed that the accuracy for 80% which was not feasible with F score up to 0.23.

This work can be more extended by adding camera before the model for capturing real time images.

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