Image Detection System for Elephant Directions along with the Forest Border Areas

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***Abstract* —Human-Elephant Conflict (HEC) and its mitigation have always been a serious conservation issue in Sri Lanka. It occurs mainly due to the encroachment of forests by humans as part of societal development. Consequently, these human settlements are highly affected by the intrusion of wild elephants as they cause extensive crop-raiding, injuries, and even death in many cases. The major aim of this study is to reduce human-elephant conflict along with the forest border areas. Convolutional Neural Network (CNN) is playing a major role in elephant detection by supporting efficient image classification. The trained CNN-based model achieved the highest accuracy of 92%. Furthermore, the study can be useful for scientists in bio-acoustics for the studying of wildlife recordings.**

Keywords — Human-Elephant Conflict, wild elephants, Convolutional Neural Networks (CNN)

I INTRODUCTION

The Asian elephant is heavily threatened by fragmentation of habitat, loss of habitat, and conflict between the human and elephant. The conflict between humans and elephants is one of the biggest environmental problems today[1]. Owing to human population expansion, the conversion of forest lands into human settlements occurs. This results in the common position being shared by wild animals and humans. Sharing gives rise to the Human-Elephant conflict and catalyzes it [2]. HEC minimization can be accomplished effectively by elephant monitoring. Different methodologies for elephant tracking have been considered in earlier studies, namely, fetching radio collars, electric fencing, usage of video cameras and wireless sensors, etc[3]. The following study proposed a hat system that helps to find the elephants which are nearing the forest border area, thus disseminating warning at the appropriate times and thereby helping in reducing human-animal conflicts in forest areas. The related issues include crop-raiding, injuries, and death to humans caused by elephants, and also the elephants being killed by humans to prevent crop-loss, and land encroachment(Fig. 1)[4].

Fig. 1: House destroyed by elephants

Elephants are normally the largest mammals, which require vast amounts of food, water, and living space. Due to deforestation, elephants have no other choice, therefore they invade human living areas in search of food and water through elephant corridors [5]. To shunt the elephants back to the forest, conventional strategies such as beating drums and bursting firecrackers are less successful. The use of elevated electric fences and walls are neither economical nor effective. Electric fences are dangerous to both elephants and humans. This can be achieved by detecting the presence of elephants and giving prior information about their presence to the respective locals in need by using the advancement of technology. The areas where the unexpected confrontation of humans and elephants occur may be identified by an automated surveillance system and appropriate alerts can be sent for helping the people living near elephant habitat regions [6]. Here used image data sets containing elephants in different poses, sizes, in groups, or as individuals. This detection system helps to find whether the elephants are nearing the forest border area or not, thus disseminating warning at the appropriate times and thereby helping in reducing human-animal conflicts in forest areas[7].

II OBJECTIVES

The major aim of the study is to minimize the human-elephant conflict in the forest border areas and the conservation of elephants from human activities as well as protect humans from elephants.

-Protection of elephants, their habitats, and elephant corridors

Due to the increase in the population, human settlement is extending to forest border areas, causing conflicts between elephants and humans, leading to loss of life and property, also elephants lose their habitats due to human activities. Hence, large scale monitoring is required for real-time detection and warning of elephant intrusion into human settlements. Existing solutions using seismic waves, image processing, etc. are costly solutions for large-scale monitoring. The project aims at low-cost solutions and protection of elephants their habitats and elephant corridors.

-Got a clear idea about the elephant population nearly forest border areas

Elephant monitoring is essential in forest boundary areas for minimizing human-elephant conflict. To calculate the elephant population nearly forest border areas is another important goal of this. Forest authorities should gather these calculations for the annual census. Having accurate and reliable data about elephant population numbers and distribution is needed to form long-term conservation management plans.

-Find out factors that increase human and elephant deaths

The primary focus of HEC mitigation has been limited to preventing elephants from raiding crops. The complexities of HEC do not allow such a simplistic approach in all cases and that is the major failing for most HEC mitigation efforts. Furthermore, the complexities of HEC have not been taken into consideration in most if not all HEC mitigation efforts and HEC research. In the absence of a comprehensive understanding and approach to HEC mitigation, the bulk of the efforts have failed; HEC has not been reduced across the Asian elephant range.

III METHODOLOGY

Here we use the Convolutional Neural Network to build the model. Object detection relates to both machine learning and image processing which is used to detect the instances of the object. The algorithms for object detection are popularly used in real-time applications. Fig. 2 shows the overall diagram of the methodology.

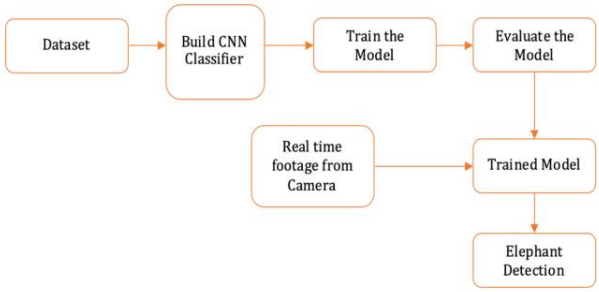

Fig. 2. overall diagram of the methodology

Here we collected different animals namely elephants, deer, bears, buffalo, hens, cats, etc. After gathered data, it is divided into two folders, testing data set and training data set. We divide all images (of size 800 × 600 pixels) into the same size. To get a high accuracy we use the data augmentation technique. Using python and visual code IDE, we build the CNN model and divide the data set according to the 70:30 rule. (70% for the training data set and 30% for the testing data set).

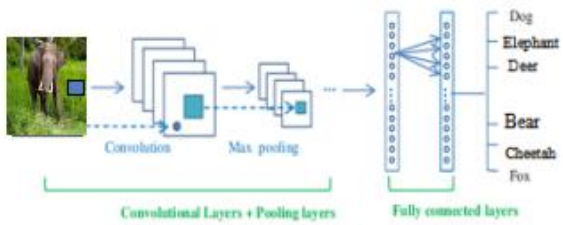

Fig. 3. Layered architecture

Then we developed the CNN model with various layers and training data. The CNN neurons are organized in a volumetric fashion like height, width, and depth. Illustration fig. 3. shows CNN architecture, it consists of a completely linked layer, convolutional layer, pooling layer. [8] Usually, the traditional layer and pooling layer are alternated, and each filter's depth increases from left to right, while the output size (height and width) decreases.

IV RESULTS AND DISCUSSION

1. Data analysis

The study used 6500 images with 2000 images of elephants (Table1). In terms of lighting and context, images will vary from one another, so that the model can generalize better. Like this, the data is collected and organized into two separate files as the training data set, and the test data set respectively. We need to resize our images after collecting the data, because some of them may be pretty tall.

Table 1. No of the images collected from different data sets

Name	*Number of Animals*
Elephant	2000
Deer	800
Bear	1000
Buffalo	1000
Cheetah	850
Fox	100

The advancement of machine vision technologies in combination with artificial intelligence and a camera can be utilized for the automatic accomplishment of image identification. This helps in deep learning, the machine learning built on deep neural networks (DNNs). CNN is a class of deep, feed-forward artificial neural network, which has been proved successful in analyzing images.[9] The convolution operation identifies different features of the input. The idea is to include the detection of elephants; hence it is useful for the forest officials to chase the elephants back to the forest and to help the public to save their property and life.

2.Data set preparation:

We need to collect as many images as possible in the given time frame to train a CNN model to obtain some respectable precision. We gathered pictures of the courses we needed and then developed a CNN model on it. The programming was done using Keras, which is a back-end library of Python using Tensor-flow. We divide the training data into batches after data collection and then optimize the loss function using the CNN algorithm. Fig. 4 shows the sample images of elephants used for training.

Fig. 4. Sample images of elephants used for training (elephants,2020)

As a result of this, we achieved the highest accuracy of 92% (Fig. 5), and we hope to develop this model, by identifying

elephants and other animals using object detection techniques.

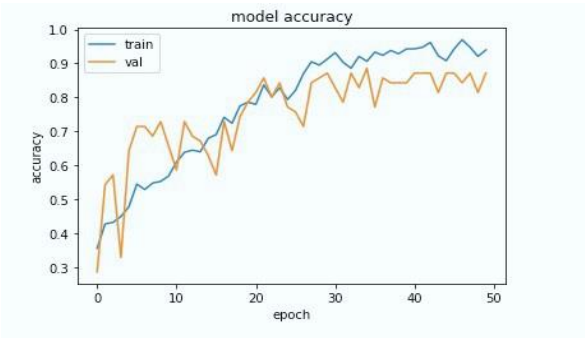

Fig. 5. Accuracy with training and validation

3. Object detection

Different animal images are provided to the testing algorithm after training of data set images using the training algorithm to validate the working of the algorithm. The results show that all animals are correctly detected and that the percentage of accurate results for each animal image is displayed. The data set represents the number of segmented image objects and each result displays the number of pixels matched by the segmented data set images used for the training algorithm.

Fig. 6. Result of the object detection

Typical results are illustrated in the above fig 6 with an elephant image .

VI. Conclusion

We have shown how to train an elephant detection system using convolutional neural networks. The study has identified the most critical challenges and necessary improvements of the proposed detection methods and concludes that our findings have the potential to form the basis for a future automated early warning system for elephants. We discuss challenges that need to be solved and summarize the features of a future early warning and monitoring system. The system can also be deployed along with forest border areas or food plantation areas for elephant tracking and monitoring. More importantly, these results demonstrate the importance of certainty in identifying elephants into human living areas and provide early warning about the elephant entry into the human habitat. This technique is useful to identify an approaching individual elephant as well as a group of elephants. Taking into consideration the frequent incidents of human-elephant conflicts in the forest border areas, this work mainly aims at reducing elephant intrusion in the human habitation area nearer to the forest. There are areas where wild elephants cause horrible damages and people and authority become helpless. The proposed idea gives the best solution to such situations by giving an early warning to the authority and people. The approach minimizes the manual work which is not possible all the time because it is difficult to monitor the presence of elephants manually. Our results demonstrate the importance of identifying elephants in human living areas and providing early warning about the elephant entry into the human habitat.

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