PERFORMANCE OF CONVULUTIONAL NEURAL NETWORKS (CNN) IN DETECTING ELEPHANTS FOR MITIGATING HUMAN – ELEPHANT CONFLICT (HEC)

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1. INTRODUCTION

The Human-Elephant Conflict (HEC) is one of the highly significant ecological and social problems in rural Sri Lanka. Every year, elephants cause around US ten million dollars in farming and property destruction, and farmers kill the elephants in retaliation. Farmers have killed an average of 225 elephants each year since 2008, but elephants have killed 60-80 people a year, the great majority of whom were in their own villages and farms (Binns, 2021).

In both the past and today, the Sri Lankan Elephant has served as a symbolic figure. In reality, historical evidence demonstrates a link that dates back over 5,000 years. However, the human population has grown rapidly in recent years, posing serious challenges to this tight link. In 2019, 405 elephants and 121 humans perished as a result of human-elephant conflict, leaving many concerns unanswered (Slycantrust, 2021).

In Sri Lanka, most agricultural lands are damaged by elephant poaching and pose a threat to public life. In fact, the government is making various efforts to protect humans from elephant attacks and to protect elephants from human attacks. Significant progress, however, has not yet been made in this regard. Elephants are one of the cultural heritage animals of Sri Lanka. Thus controlling them is also seen as a matter of sensitivity. Either way it is one of the most necessary to control the HEC.

The first elephant census in Sri Lanka was done in 2011 by a team under the supervision of the Department of Wildlife Conservation (DWC), and 5879 elephants were identified in the wild [3]. According to official data, the wild elephant population in Sri Lanka is expected to reach 7,500 by 2020 (Xinhuanet, 2021).

Sri Lanka has the highest human-elephant conflict death rate in the world, according to Dr. Sumith Pilapitiya, former General Director of the Sri Lankan Wildlife Department. About 85 percent of cases, elephant deaths have been connected with human conflict. In this conflict between man and beast, people also have paid a ridiculous cost. The average human death rate due to the human conflict was 71 between 2005 and 2010, and 54 between 1992 and 2001. Over the previous decade, the human death rate increased by roughly 14%, and over 50% over the past two decades (Thecitizen, 2021). The number of individuals killed or injured of this cone.

HEC is producing a host of issues in Sri Lanka, many of which have far-reaching social and political ramifications. HEC has an influence on around 142 Divisional Secretariat Divisions (DSDs) in 19 districts across the country, according to DWC statistics. These DSDs

are home to 5.7 million people, or 27 percent of the population, according to data from the Department of Census

and Statistics (DCS). It is most common in the North Western, North Central, Southern, Northern, Eastern, Uva, and Central Provinces of the island. The battle has been described as particularly violent in Anuradhapura, Ampara, Kurunegala's northern and northeastern districts, and Puttalam's northern area.

There are several typical strategies utilized throughout the forest boundary zones to drive elephants away whenever they enter human population areas. They primarily produce noise with smoke bombs, pipe cannons, car horns, yelling, gun gunshots, and beating on things like drums and tins. They may occasionally build fences strung with honeybees made of hollow logs and burn elephant dung, chile, or any other smoldering object to make a powerful toxic smoke (Ahmed et al., 2019).

However, elephants acquire acclimated to these procedures over time and have the capacity to overcome traditional techniques. As a result, a monitoring and detecting system is necessary to transmit an alarm to the arriving elephants ahead of time so that suitable safety precautions may be implemented.

That is why it is a matter of concern that despite efforts to control this conflict in various ways, no major progress has been made. In addition, individuals are appointed as elephant protectors to protect the elephants from attacks on agricultural lands. It is also seen as a major threat to elephants, causing more human casualties. Therefore, Artificial Intelligence (AI) tools and techniques can be tested and executed on behalf of human for detecting elephants and can take necessary steps to prevent the attacks of elephants against human or properties.

The proposed study is motivated by the identification of species using camera traps, as well as the classification of elephants photographs from other elephant photos. According to the study, cameras were crucial in detecting elephants since they used repeated databases searches and image processing algorithms. But at the other hand, false notifications are unavoidable.

Image classification methods are accessible in AI. However, Convolutional Neural Networks (CNNs) are the most often used neural network model for image categorization. The key notion underlying CNNs is that a local comprehension of a picture is sufficient (Le, 2021). The goal of this study is to examine the efficacy of CNN models in recognizing elephants in order to minimize HEC by efficient recognition of camera images. Therefore, this research is attempted to suggest a state of art model for detecting elephants accurately. The researchers have applied Inception V3 and Six Layer CNN algorithms for this research work to compare the performances of both algorithms in detecting elephants for further steps.

2. METHODS

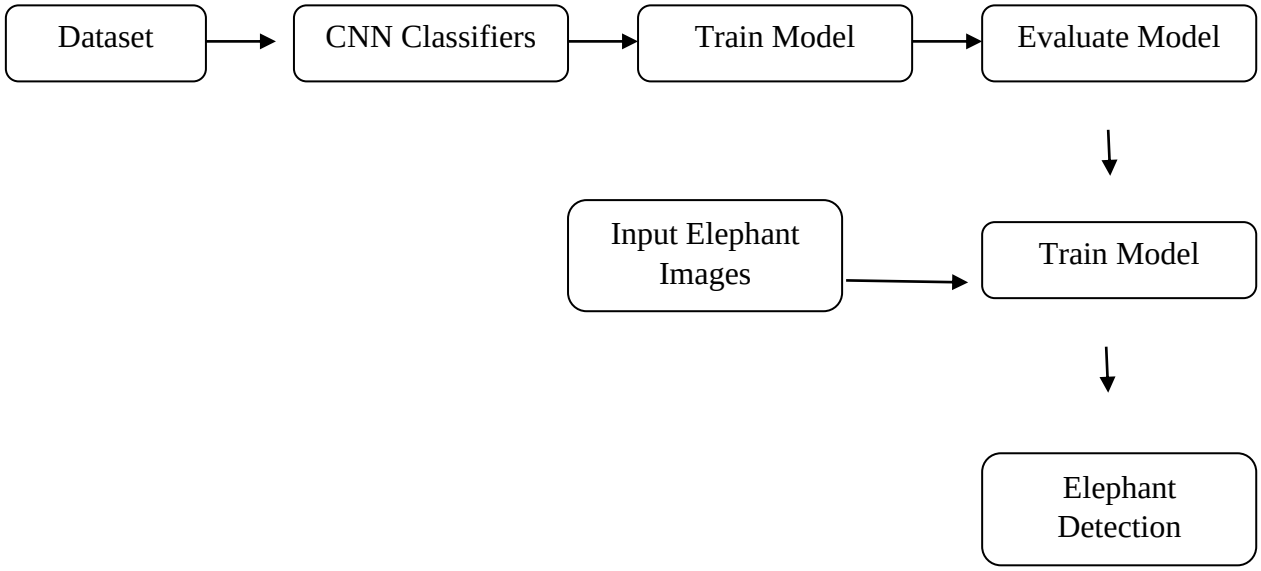

Figure 1. Overall Research Process

As image detection techniques, two types of CNN algorithms are employed in this study. Object identification is a term that incorporates both machine learning and image processing, which are both used to assess the levels of an object. In real-time applications, object detection algorithms are commonly used. Figure 1 depicts the entire method diagram.

2.1 Dataset

The Animals - 10 dataset, uploaded by Corrado Alessia to Kaggle, was used by the researchers. It includes around 28K medium-quality animal photographs from ten categories: dog, cat, horse, spyder, butterfly, chicken, sheep, cow, squirrel, and elephant. All of the photographs were gathered from "Google Images" and manually reviewed. To imitate real-world settings, some erroneous data is used (Ramesh et al., 2017).

2.2 CNN Classifiers

CNNs (Convolutional Neural Networks) is a sort of deep-rooted artificial neural network that is used for feed-forward to provide accurate computer vision results such as picture categorization and identification. CNN They are similar to ordinary neural networks, but include extra layers. There are weights, biases, and a nonlinear efficiency in this. Turn on (Animals-10, 2019, December 12). This study used Inception V3 and a six-layer CNN to do this.

2.3 Train Model

The CNN model was built using Python and the Visual Code IDE, and the data set was partitioned as per the 80:10:10 ratio. (80% for the training dataset, 10percent of total for the test dataset, and 10% for the validation dataset).

In code there's a variable for test and train data set (val_ratio = 0.10, test_ratio = 0.10). So the train data set is 80%. Validation data is 10% and test dataset is 10% .The splitting code is

given below,

```
def train_test_split():
print("############ Train Test Val Script started ############")
root_dir = './'
classes_dir = ['cavallo', 'pecora', 'elefante', 'gatto', 'scoiattolo', 'gallina', 'ragn
processed_dir = '../input/animals10/raw-img/'
val_ratio = 0.10
test_ratio = 0.10
for cls in classes_dir:
# Creating partitions of the data after shuffeling
print("$$$$$$$ Class Name " + cls + " $$$$$$$")
src = processed_dir +"//" + cls # Folder to copy images from
allFileNames = os.listdir(src)
np.random.shuffle(allFileNames)
train_FileNames, val_FileNames, test_FileNames = np.split(np.array(allFileNames),
[int(len(allFileNames) *
int(len(allFileNames)
```

2.4 Evaluate model

The two algorithms of CNN have been evaluated by precision, recall, F1 score and accuracy. For the validation purposes, researchers applied the below coding which was for validate the results.

```
History =model.fit (train_dataset, validation_data = valid_dataset, epochs = 10, verbose = 1,
callbacks=lr_scheduler)
```

2.5 Input Elephant Images and Train the model

Various animal images are provided to the test algorithm after training data set images using the training algorithm to validate the function of the algorithm.

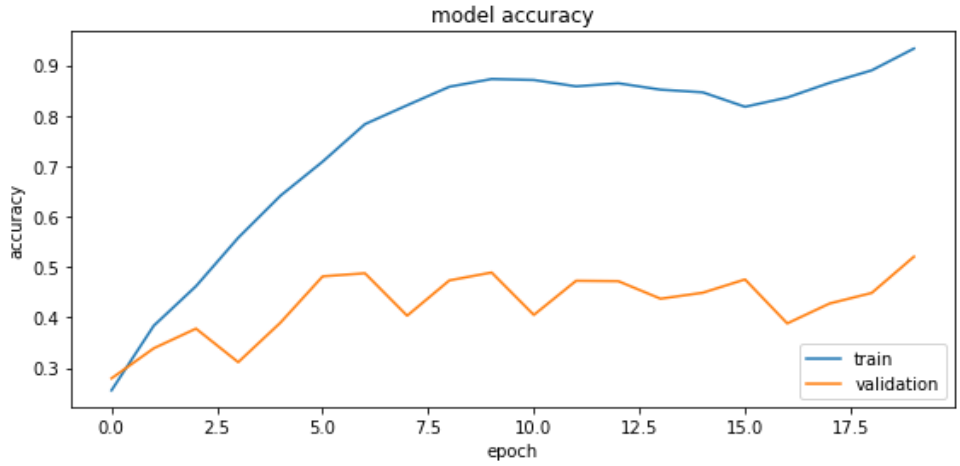

Figure 2. Model Accuracy of Inception V3

3. RESULTS AND DISCUSSION

The following study results were obtained to achieve the objectives of this study using the research methodological features mentioned above. Researchers have analyzed the two classifiers of CNN. The performance of Inception V3 are given below in figure 2.

Researchers have got very good accuracy in Inception V3. It shows that 90% after first epochs of accurate classification sample. The commands of training and testing is given below

X_train_val, X_test, y_train_val, y_test = train_test_split(X, y, test_size=0.2, stratify
X_train, X_val, y_train, y_val = trai_test_split (X_test, y_test, test_size = 0.5, random

From the above commands, we can observe the test percentage which was 20% and again it has been splitted into validation and test set by half. Therefore, in this research 10% of data has been used to validate the model and 10% of data has been used to test the model. Test data is similar to train and evaluate data (same distribution). But it's not seen by the model. So, the test set is unseen and unbiased. The performance of six layer CNN is given below in figure 3.

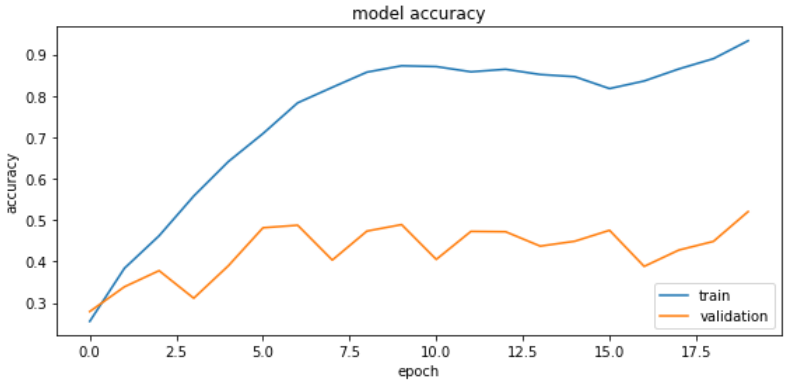

Figure 3. Model Accuracy of six-layer CNN

3.1 Comparison of Inception V3 and six-layer CNN in detecting elephants

Researchers have analyzed the metrices of precision, recall, F1 and accuracy of both algorithms to find out the state of art classifier to detect elephants more accurately. The entire analysis and comparison is given below in Table 1.

Table 1. Comparison of Inception V3 and six-layer CNN in detecting elephants

	INCEPTION V3	**SIX-LAYER CNN**
ACCURACY	**91%**	74%
PRECISION	97%	98%
RECALL	95%	45%
F1	**96%**	62%

4. CONCLUSION

In this research, researchers have found the problems of current mitigating techniques on HEC. The conventional methods are outdated, and the elephants are more familiar to such methods. Therefore, the researchers have notices that the image processing and image classification techniques will be a good solution for controlling the HEC issues. From the literature, it was observed that the CNN is a most efficient deep learning model to detect and classify images. Based on the literature, researchers have applied Inception V3 and six-layer CNN algorithms to find out the state of art classifier in detecting elephants among many objects accurately. It has found that the Inception V3 has outperformed six-layer CNN. In future, researchers can connect the Inception V3 classifier with detection cameras and join alarming systems when it detects elephants to mitigate HEC. We can apply different deep learning image classifiers and AI tools to measure the performance further.

REFERENCES

Animals-10. (2019, December 12). [Dataset]. Corrado Alessia. https://www.kaggle.com/alessiocorrado99/animals10

2019. SITUATIONAL ANALYSIS REPORT SRI LANKA. Livelihood Insurance from Elephants (LIFE) - 2019. Colombo: Institute of Policy Studies, International Institute for Environment and Development and Darwin Initiative, pp.1 - 3.

Ahmed, A., Jalal, A. and Kim, K. (2019) 'Region and Decision Tree-based segmentations for Multi objects detection and classification in Outdoor Scenes', pp. 209–214. doi: 10.1109/FIT47737.2019.00047.

Binns, S., 2021. Human-Elephant Conflict, Sri Lanka. [online] International Elephant Foundation. Available at: <https://elephantconservation.org/human-elephant-conflict-sri-lanka/> [Accessed 1 November 2021].

Le, J., 2021. The 4 Convolutional Neural Network Models That Can Classify Your Fashion Images. [online] Medium. Available at: <https://towardsdatascience.com/the-4-convolutional-neural-network-models-that-can-classify-your-fashion-images-9fe7f3e5399d> [Accessed 1 November 2021].

Ramesh, G. et al. (2017) 'An Automated Vision based Method to Detect Elephants for Mitigation of Human-Elephant Conflicts', pp. 2284–2288

Duporge, I., Isupova, O., Reece, S., Macdonald, D. W., and Wang, T. (2021). Using very-high-resolution satellite imagery and deep learning to detect and count African elephants in heterogeneous landscapes. Remote Sensing in Ecology and Conservation, 7(3), 369-381.

Fernando, P.; Jayewardene, J.; Prasad, T.; Hendavitharana, W.; Pastorini, J. Current status of Asian Elephants in Sri Lanka. Gajah, 2011, 35, 93–103.

Marais, J. C. (2018). Automated elephant detection and classification from aerial infrared and colour images using deep learning (Doctoral dissertation, Stellenbosch: Stellenbosch University).

Premarathna, K. S. P., and Rathnayaka, R. M. K. T. (2020). CNN based image detection system for elephant directions to reduce human-elephant conflict.

Slycantrust.org. 2021. Addressing Human-Elephant Conflict in Sri Lanka. [online] Available at: <https://www.slycantrust.org/post/addressing-human-elephant-conflict-in-sri-lanka> [Accessed 1 November 2021].

Thecitizen.in. 2021. Human-elephant conflict exacts a heavy toll in Sri Lanka. [online] Available at: <https://www.thecitizen.in/index.php/en/newsdetail/index/13/20162/human-elephant-conflict-exacts-a-heavy-toll-in-sri-lanka> [Accessed 1 November 2021].

Xinhuanet.com. 2021. Sri Lanka says deaths caused by human-elephant conflict decline in 2020 - Xinhua | English.news.cn. [online] Available at: <http://www.xinhuanet.com/english/2021-01/07/c_139649714.htm> [Accessed 1 November 2021].