SP SEG ("Animal Image Identification and Classification")

DAKSHATA CHAUDHARI[1], KANISHKA LABHANE[2], PURVA CHOUDHARI[3], KOMAL MARASKHOLE[4], PROF. MADHAVI SADU[5]

[1, 2, 3, 4] *Student, Department of Computer Science and Engineering, Rajiv Gandhi College of Engineering Research and Technology, Chandrapur, Maharashtra, India*

[5] *Guide, Department of Computer Science and Engineering, Dr. Babasaheb Ambedkar Technological University (DBATU), Lonere.*

Abstract*— This research paper proposes a novel method that uses TensorFlow, OpenCV, PIL, Matplotlib, VGG-16 architecture Convolutional Neural Networks (CNNs) for the classification and identification of wild animals in their natural habitats. The study advances the field of automated animal classification and identification by demonstrating the value of deep learning methods for conservation and wildlife monitoring[1,3]. The user interface will be improved, accuracy will be increased, errors will be decreased, and training and testing times will be optimized in future work[1]. Classification performance can be further improved by adjusting neural network weights and learning rates, as well as by incorporating low-level variables like shape and spatial location[1]. The research adds to the expanding body of work in the field of automated animal identification in wildlife monitoring and conservation initiatives utilizing deep learning techniques[2,1]. To protect wildlife for future generations, the suggested solution offers an effective and precise way of identifying and detecting animal species[2]. Applications for the research can be found in many fields, including crop protection, animal tracking, and wildlife conservation[2,3]. In this research paper, we have studied how to classify and identify different wildlife species and animals in the images by using Convolutional Neural networks (CNNs) and VGG16 architecture.

***Index Terms*— Image processing, Image classification, Image Identification, Animal Detection, Convolution neural network(CNN), VGG16.**

I. INTRODUCTION

The vital task of wildlife conservation challenges is to save and maintain the planet's biodiversity. Understanding the actions, population dynamics, and environmental needs of wild animals depends on monitoring their numbers. Conventional methods of wildlife specialist care, such as tracking and direct observation, are frequently costly, time-consuming, and labor-intensive. The mechanization of wildlife monitoring through the use of computer vision techniques has gained popularity in recent years. Convolutional Neural Networks (CNNs) or VGG16 is one such method for classifying and identifying images of wild animals[4,1]. CNNs help to extract features like shapes, curves, and textures, from the images and that helps to classify and identify which animals are present in the images[4].

Between the deep neural network classes, Convolutional Neural Networks(CNNs) are especially compatible with image recognition applications[4,3]. Many applications, such as object identification, facial recognition, and medical picture analysis, have been successfully implemented using them. CNNs can be used in the context of wildlife monitoring to categorize images of wild animals according to their species and types, which can produce important information for conservation initiatives. In this project, we also have used Keras a high-level neural network API constructed on top of TensorFlow and TensorFlow, an open-source machine learning framework created by Google[5].

A perfect model like the CNN model that has been applied to many image recognition tasks is the VGG16 architecture. VGG16 architecture can recognize complex details in images thanks to its deep architecture, VGG16 consists of 3 fully connected layers and 13 convolutional layers, totally it has 16 layers. In this project, we proposed classification and identification of wild animal images using the VGG16 architecture.

In this project, we will analyze and preprocess the images using a number of important libraries and tools in addition to the CNN model. The Python Imaging Library(PIL) will be used for manipulate images, in addition turning them into arrays that the CNN model can use. OpenCV (Open Source Computer Vision Library) will help in the preprocessing of the images, including normalization and resizing[6]. Matplotlib will help in utilizing the visualizing of the outcomes of the classification and identifying procedure[7].

Through this project, our main goals is to create a reliable CNN model for the classification and identification of wild animals from images that we have captured from camera tracking and to access the model's effectiveness using a dataset of such images[1]. We will use a dataset that includes images of several wild animal species, such as tigers, lions, deer, bears, elephants, etc. The CNN model will be trained on the training set and assessed on the validation and test sets after the dataset has been split into training, validation, and test sets.

II. THEORETICAL BACKGROUND

In today's time Convolutional neural networks, or CNNs, have become an effective tool for problems relating to image classification and object detection in the images. The capacity of convolutional neural networks (CNN) to study hierarchical information from Images makes them specifically appropriate for tasks like animal detection and classification[4].

Pre-trained CNN models like VGG16 are frequently active for computer vision applications. VGG16 is well-known for being easy to understand and use and well-organized in the classification of images[2,3]. We can expedite the training progress to improve the complete efficacy of the animal identification and classification system[1]. Google created the open-source machine learning framework TensorFlow[5]. Tensorflow offers an adaptable and effective framework for generating and improving deep learning models, such as CNNs and VGG16[5,1].

OpenCV (cv2) offers several tools and features for analyzing images. OpenCV is very useful For tasks like object detection, feature extraction, image preprocessing, and most importantly OpenCV especially helps in animal detection and classification of images [7]. The (PIL)Python Imaging Library is a python library. It is the perfect option for loading and processing animal images in our dataset. Matplotlib is a Python charting toolkit that helps in data visualization. It helps display the effectiveness of the system for the classification and detection of animals in the images.

III. SYSTEM DESIGN

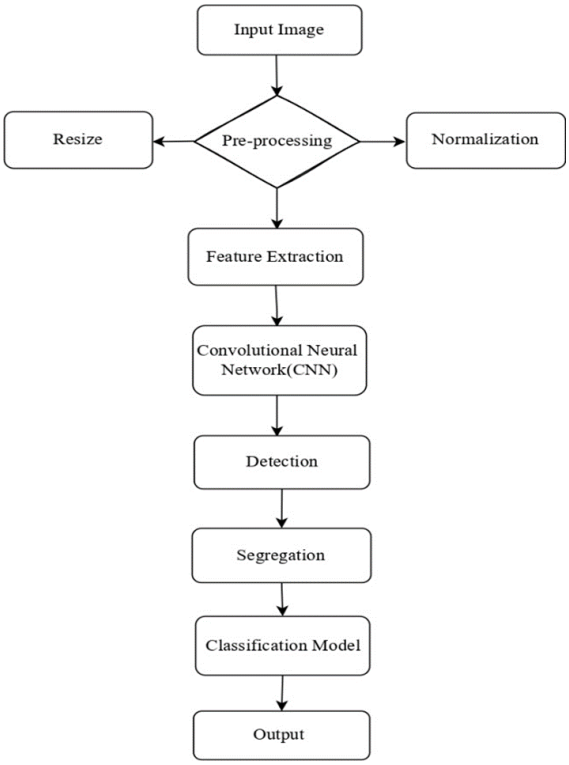
Several considerations and components go into the design of an AI-based system for animal identification and classification.

- Model Selection: In this process, we look for the ideal AI model that can be used to classify various animal species and kinds. Convolutional neural networks (CNNs) are often employed for this kind of work; they process photos that we can use to categorize any animal or species[4].
- Data Collection and Preprocessing: During this step, we gather a dataset of photos of animals and ensure that each animal's class's bounding boxes are included. Increasing the photos dimensions to an even number, standardizing the pixel standards in the photographs, and improving the data to expand the dataset's range are examples of preparing the images.
- Model Training: We use transfer learning techniques to get the understanding learned by pre-trained models and adapt them to the specific task of animal detection and classification. We also choose models that use the preprocessed dataset in the training model and monitor its performance to prevent any kind of overfitting. We use a portion of the datasets for training and some additional ones for verification
- Deployment: After the model has been trained and assessed, it is put to use in a creative setting where it can be utilized for both real-time animal identification and classification. Take into consideration employing edge devices for deployment that is conditional on the size and specifications of the application.
- Model Evaluation: In this step, the performance of the trained model is evaluated by measuring its presentation in the identification and categorization of animals using a different test

dataset. Metrics including accuracy, recall, and F1 score are then used.

- Post-processing and Integration: In this step, post-processing techniques are applied to enhance the AI model's output, such as removing false positives or better localizing animals that have been discovered.

IV. BLOCK DIAGRAM



1. Data collection and Preprocessing: Compile a dataset of labeled pictures of different kinds of animals. After that, we have to standardize size, and color, and perform preprocessing on the photos.
2. Feature Extraction: To get the features from the input images we have to use a convolutional neural network (CNN) that has already been trained, such as ResNet, and VGG16 or VGG19. With the help of CNN layers, we can easily extract features like textures, curves, patterns etc from the input images
3. Classification Model: in the classification model we use the collected features to train a classifier, like a support vector machine (SVM), or neural network. the classifier gains the ability to differentiate between various animal classifications.
4. Model Evaluation: in model evaluation, we utilize a different validation dataset, to assess the trained model's performance. Utilize metrics such as F1 score, accuracy, precision, and recall to evaluate the model's performance.
5. Layers in Convolutional Neural Network(CNN):

- Layer Convolutional: In CNN the first layer is the convolutional layer and it is the core part of CNN. In the convolutional layer, first, we give the input image then we apply the convolutional layer over the input image, in the convolutional layer there are filters present, filters are also called kernels, and kernels are used to extract features from the input images, such as edges, curves, textures, and patterns. In the convolutional layer, each filter produces a feature map that highlights a specific area of the input image.
- Activation Function: In the activation function, To present non-linearity, every member of the network is visible to the activation function, such as the Rectified Linear Unit (ReLU), once the convolutional process is done.
- Pooling Layer: In between the convolutional layer there are also pooling layers, pooling layers help to reduce the size of the images while keeping its important features. The feature maps are down-sampled by the pooling layer using the maximum (Max Pooling) or average (Average Pooling) value inside a certain region. Pooling layers focus on the most significant part of the images, making it easier for the network to understand and process.
- Fully connected layer: the fully connected layers are used to classify the features extracted by the Previous layers into different categories that help the network understand and recognize which animal is present in the input image.
- Output Layer: The output layers create the final prediction or classification of the input image. In softmax activation, in which each and every neuron represents a class and outputs of the input image likelihood that belongs to the class, it is commonly used for multi-class classification tasks.

6. Segregation: The technique of dividing a digital image into several segments also referred to as image regions or image objects is called image segmentation. Image segmentation aims to

transform an image's representation into something more meaningful and interpretable, either by simplification or alteration.

This CNN layer creates the final classification or prediction of the input image to find out which objects or animals are present in the input image.

V. OUTPUT OF THE MODEL

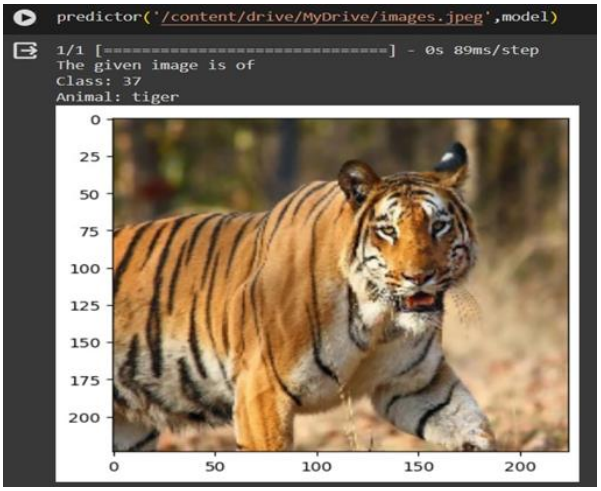


Fig: Tiger

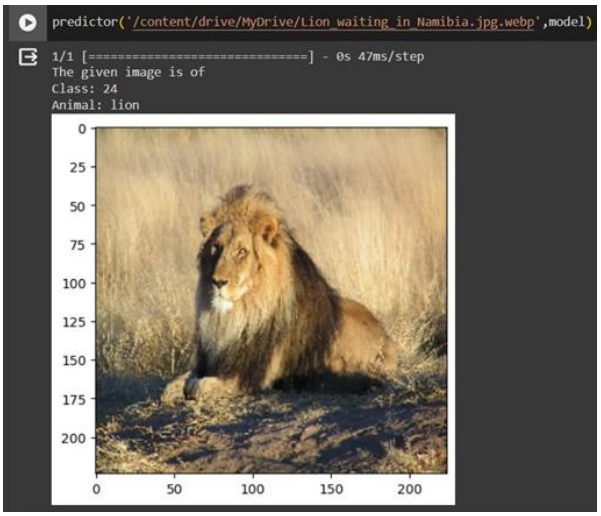
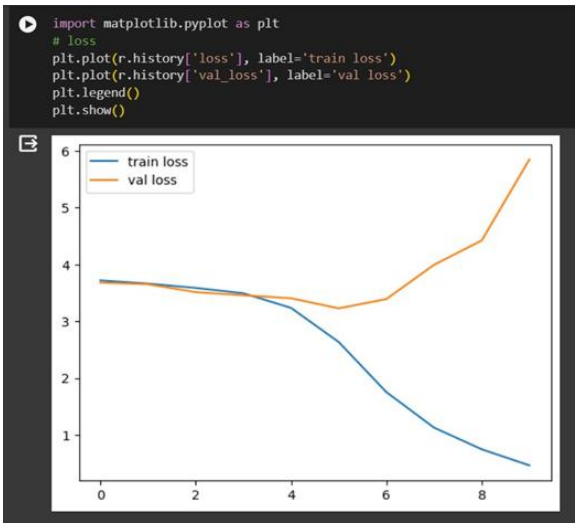
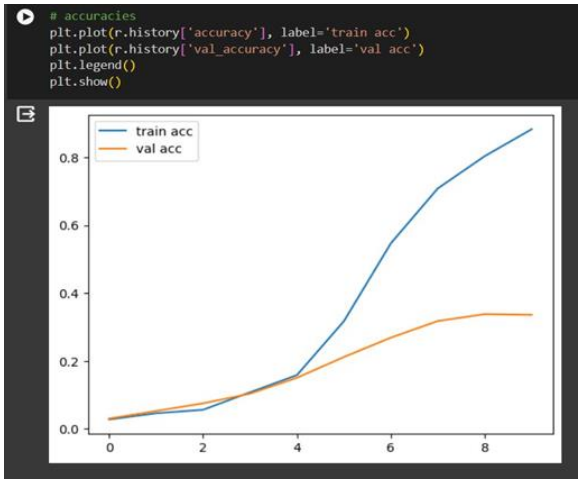


Fig: Lion

VI. GRAPH



Graph: Loss



Graph: Accuracy

VII. FUTURE SCOPE

- Increased Accuracy: In today's world deep learning technologies are progressing, and animal image classification, categorization, and identification accuracy are anticipated to increase day by day. So, we are required to create CNN architecture and models like VGG16 architecture that are more complex and help to utilize more data processing methods.
- Real-time Processing: Today Real-time image processing is becoming in demand, for animal monitoring we need applications like conservation to monitor animals. Subsequent signs of progress

might focus on filtering algorithms with higher speed of accuracy to process information

- Transfer Learning: Transfer learning involves optimizing a pre-trained model for a specific work and transfer learning works very well for the classification of images. In the field of animal image classification, forthcoming research might explore more effective approaches to transferring data from pre-trained models to new tasks.
- Multi-model learning: Multi-model learning for animal image classification and identification systems may be in the future more dependable and accurate if we get the data from many sources, including like audio, video, and images.
- Animal identification systems may be more reliable and accurate if data from many sources, including audio, video, and pictures, is integrated. For this reason, upcoming work may be focused on creating multi-modal learning algorithms.

CONCLUSION

In conclusion, for our project, we have used convolutional neural networks (CNNs), it has made great decisions in the classification and identification of animal images, in this field we get the best results in animal classification and identification, and monitoring wildlife.

- Accuracy: The accuracy and efficiency of convolutional neural networks and the VGG16 model have been very helpful in the classification and identification of animals in the images. And in the future, these technologies will be going to continue to improve and become more effective.
- Real-World Applications: in today's world these technologies are also tracked for analyzing the behavior of animals, we also find out the population of the animals, and keep an eye on wildlife and animals.
- Challenges: Challenges and operations for animal image classification and identification its important to find out problems like data quality, and interpretability of the model. Problems like these will offer the chance for additional study and advancement in the areas like classification and identification of images.
- Future directions: in the future direction, real-time processing, multi-model learning, transfer learning, computing of edges, and ethical problems are going to be the most important developments in the future of animal image classification and identification by using deep convolutional neural networks (CNNs) and VGG16 model. These technologies going to be a major part of monitoring wildlife and animals efficiently and effectively. All things considered, we found out that Convolutional neural networks(CNNs) are powerful technologies for animal image classification and identification. these technologies have the power to completely change the way we identify and classify the animals in the images as well as to monitor wildlife and safeguard animals in the future.

REFERENCES

[1] Samiya Khan1 , Sanjana Singh2 , Sadaf Almas3 , Prof. Abdul Razzaque4,'' Animal Classification Using CNN with VGG-16 Architecture".(IJARSCT) Volume 2, Issue 3, April 2022

[2] IDV Narasimha1 , I. Samuel Moses2, H. Balaji3, "Automated Animal Identification and Detection of Species". (IJARSCT) International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal Volume 3, Issue 2, June 2023.

[3] Margarita Favorskayaa, Andrey Pakhirkaa," Animal species recognition in the wildlife based on muzzle and shape features using joint CNN", ScienceDirect Available online at www.sciencedirect.com Procedia Computer Science 159 (2019) 933–942. 23rd International Conference on Knowledge-Based and Intelligent Information & Engineering Systems.

[4] Simonyan, K., & Zisserman, A. (2014). Very deep convolutional networks for large-scale image recognition. arXiv preprint arXiv:1409.1556.

[5] Abadi, M., Agarwal, A., Barham, P., Brevdo, E., Chen, Z., Citro, C., ... & Zheng, X. (2016). TensorFlow: Large-scale machine learning on heterogeneous systems. Software available from tensorflow.org.

[6] Bradski, G., & Kaehler, A. (2008). Learning OpenCV: Computer vision with the OpenCV library. O'Reilly Media, Inc.

[7] Hunter, J. D. (2007). Matplotlib: A 2D graphics environment. IEEE Annals of the History of Computing, 9(03), 90-9 H. Yousif, J. Yuan, R. Kays and Z.

[8] He, "Fast human-animal detection from highly cluttered camera-trap images using joint background modeling and deep learning classification," 2017 IEEE International Symposium on Circuits and Systems (ISCAS), 2017, pp. 1-4, doi:10.1109/ISCAS.2017.8050762.

[9] Zhou, B., Khosla, A., Lapedriza, A., Oliva, A., &Torralba, A. (2014) "Object detectors emerge in deep scene cnns. Srinivas, S., Sarvadevabhatla, R. K., Mopuri, K. R., Prabhu, N., Kruthiventi, S. S., &Babu, R. V. (2016) "A taxonomy of deep convolutional neural networks for computer vision."

[10] ANIMAL DETECTION USING DEEP LEARNING ALGORITHM N. BANUPRIYA, S. SARANYA, RASHMI SWAMINATHAN, SANCHITHAA HARIKUMAR, SUKITHA PALANISAMY

[11] Animal Classification Using CNN with VGG-16 Architecture" - This paper describes a model that utilizes the Convolutional Neural Network (CNN) algorithm to distinguish animals with an accuracy of 87.22 for 6 animal classes.

[12] He, K., Zhang, X., Ren, S., & Sun, J. (2015). Delving deep into rectifiers: Surpassing human-level performance on ImageNet classification. In Proceedings of the IEEE International Conference on Computer Vision (pp. 1026-1034). Szegedy, C., Vanhoucke, V., Ioffe, S., Shlens, J., & Wojna, Z. (2016). Rethinking the inception architecture for computer vision. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) (pp. 2818-2826).

[13] "Image-Based Animal Recognition based on Transfer Learning" - This paper proposes a transfer learning approach for image-based animal recognition, using a pre-trained Convolutional Neural Network based on the ResNet101 model for animal classification from noisy and low-quality images with few samples.

[14] "Improved Image Classification Algorithm Based on Convolutional Neural Network" - This paper presents an improved VGG16 convolutional neural network model for image classification.

[15] "Animal Classification Using Deep Learning" - This research discusses the application of deep learning techniques for animal classification.

[16] Zhou, B., Khosla, A., Lapedriza, A., Oliva, A., & Torralba, A. (2016). Learning deep features for discriminative localization. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) (pp. 2921-2929).

[17] Szegedy, C., Vanhoucke, V., Ioffe, S., Shlens, J., & Wojna, Z. (2016). Rethinking the inception architecture for computer vision. In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) (pp. 2818-2826).

[18] Deng, J., Dong, W., Socher, R., Li, L. J., Li, K., & Fei-Fei, L. (2009). ImageNet: A large-scale hierarchical image database. In 2009 IEEE conference on computer vision and pattern recognition (pp. 248-255).

[19] Zhou, B., Khosla, A., Lapedriza, A., Oliva, A., & Torralba, A. (2016). Learning deep features for discriminative localization. In Proceedings of the IEEE conference on (CVPR) (pp. 2921-2929).

[20] Deng, J., Dong, W., Socher, R., Li, L. J., Li, K., & Fei-Fei, L. (2009). ImageNet: A large-scale hierarchical image database. In 2009 IEEE conference on computer vision and pattern recognition (pp. 248-255).