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Venomous Snake Detection: A CNN-Based Classification of Indian Snake Species

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Abstract: Venomous snakebites are a significant public health concern in India, where numerous venomous snake species coexist with humans. Prompt and accurate identification of venomous snakes is crucial for effective medical treatment and wildlife management. In this study, we propose a Convolutional Neural Network (CNN)-based approach for venomous snake detection, specifically focusing on the classification of Indian snake species. Our methodology involves assembling a diverse dataset comprising images of various venomous and non-venomous snake species found in India. Through rigorous preprocessing and augmentation techniques, we train a CNN model capable of accurately distinguishing between venomous and non-venomous snakes. Leveraging the deep learning capabilities of CNNs, our model automatically extracts intricate features from snake images and learns discriminative patterns for classification. Evaluation of the model's performance using standard metrics demonstrates its effectiveness in venomous snake detection. These findings underscore the potential of CNN-based approaches in aiding venomous snakebite mitigation efforts and contributing to wildlife conservation endeavours in India and similar biodiversity-rich regions.

Keywords: Venomous snakes, Deep Learning, Classification, Indian snake species.

I. INTRODUCTION

Snakebites, particularly those inflicted by venomous species, are a significant public health concern worldwide, including in India, where a diverse range of venomous snakes poses substantial risks to human safety. Prompt and accurate identification of these snakes is crucial for effective medical intervention, timely administration of antivenom, and wildlife management efforts aimed at mitigating human-snake interactions.

Recent advancements in machine learning and computer vision technologies offer promising opportunities to automate snake detection and species classification tasks. This project introduces a novel approach tailored to the context of Indian snake species, leveraging Convolutional Neural Networks (CNNs) and transfer learning techniques, as exemplified in the provided code. The pretrained ResNet50 architecture serves as a feature extractor, facilitating the extraction of discriminative features from snake images and adapting to the task of venomous snake detection through fine-tuning.

Additionally, the project adopts a multi-output classification framework, where the model predicts the presence of venomous snakes. By incorporating multiple branches in the neural network architecture, each dedicated to detecting specific snake features such as eyes, head morphology, tongue characteristics, pit organs, and fangs, the model effectively discriminates between venomous and non-venomous species while providing insights into species identification. Various techniques such as data augmentation, regularization, and class weighting enhance the model's performance and generalization capabilities, as demonstrated through extensive experimentation and evaluation on a curated dataset comprising images of Indian snake species. Ultimately, the project aims to develop a reliable and scalable venomous snake detection system to aid snakebite mitigation efforts, wildlife conservation endeavours, and public health initiatives in India and beyond, thereby saving lives and safeguarding biodiversity.

II. LITERATURE SURVEY

Snakebite envenoming is a significant global health issue, particularly affecting tropical and subtropical regions where venomous snakes are prevalent. In India alone, snakebites contribute to a substantial burden of morbidity and mortality, with estimates suggesting tens of thousands of fatalities annually and many more suffering from long-term disabilities [1]. Efforts to address this issue have traditionally relied on manual identification of snake species based on visual characteristics, which can be challenging and prone to errors, especially in emergency situations [2].

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Recent advancements in machine learning and computer vision have sparked interest in automating snake detection and species classification tasks. A study by Theakston and Warrell [3] highlighted the importance of rapid and accurate snake identification in guiding appropriate clinical management, emphasizing the need for reliable diagnostic tools. Machine learning techniques, particularly deep learning algorithms, have shown promise in this regard, leveraging large datasets of snake images to develop robust detection models [4].

Transfer learning, a technique wherein knowledge gained from training on one task is applied to a different but related task, has been widely utilized in snake detection applications. Pretrained convolutional neural network (CNN) architectures, such as ResNet and Inception, have been fine-tuned to classify snake species based on features extracted from snake images [5]. This approach has demonstrated high accuracy in distinguishing venomous from non-venomous snakes and has the potential to streamline snakebite management protocols [6].

Multi-output classification frameworks have emerged as a valuable strategy for snake species classification, allowing models to simultaneously predict the presence of venomous snakes and identify specific species traits [7]. By incorporating multiple branches in the neural network architecture, these models can capture intricate features unique to different snake species, enhancing classification accuracy [8].

While significant progress has been made in automated snake detection systems, challenges remain in optimizing model performance across diverse snake species and environmental conditions. Addressing these challenges requires large-scale datasets with annotated images representing a wide range of snake species and variations in appearance [9]. Additionally, the deployment of automated snake detection systems in real-world settings necessitates careful validation and integration into existing healthcare infrastructure [10].

In summary, recent studies underscore the potential of machine learning and computer vision techniques in revolutionizing snakebite management through automated snake detection and species classification. By leveraging deep learning algorithms and transfer learning strategies, researchers aim to develop reliable and scalable diagnostic tools to mitigate the impact of snakebites on human health and safety.

III. SCOPE AND METHODOLOGY

Aim of the Project:
The objective of our project is to develop an automated venomous snake detection system tailored for Indian snake species. This system aims to accurately identify venomous snakes and categorize them into species groups using advanced machine learning and computer vision techniques. By automating the detection process, the project aims to contribute to snakebite mitigation efforts, wildlife conservation, and public health initiatives, particularly in regions with high snake diversity and incidence of snakebites.

Existing System:
Current venomous snake detection methods often rely on manual identification by trained experts, which can be time-consuming, labour-intensive, and prone to errors. While some automated snake detection systems exist, they may not be optimized for the diverse range of Indian snake species. Therefore, there is a need for a specialized system that can effectively identify venomous snake's endemic to India.

Proposed System:
Our proposed system utilizes convolutional neural networks (CNNs) and transfer learning techniques to develop a robust venomous snake detection model. The model architecture incorporates multiple branches for detecting distinct snake features, such as eyes, head morphology, tongue characteristics, pit organs, and fangs. By leveraging these anatomical features unique to venomous snakes, the model can accurately classify snakes into species categories. Additionally, the system incorporates data augmentation, regularization, and class weighting strategies to enhance performance and generalization capabilities. The ultimate goal is to deploy the system as a user-friendly application, empowering stakeholders such as healthcare professionals, wildlife experts, and conservationists to mitigate snakebite incidents effectively and safeguard biodiversity.

IV. DESIGN AND IMPLEMENTATION

The following outlines the design and implementation process:
Data Collection and Preparation:
The initial phase involves gathering a diverse collection of images depicting Indian snake species, encompassing both venomous and non-venomous varieties. These images are meticulously annotated with corresponding species labels to

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facilitate supervised learning. To enhance the dataset's variability and robustness, data augmentation techniques such as rotation, flipping, and scaling are applied, ensuring a rich and representative training corpus.

Model Architecture:
The system's architecture is structured around a Convolutional Neural Network (CNN), leveraging the ResNet50 pre-trained model for feature extraction. To capture distinctive snake characteristics, multiple branches are integrated into the CNN, each dedicated to detecting specific features like eyes, head morphology, tongue traits, pit organs, and fangs. These branches consist of convolutional, pooling, and dense layers, supplemented with batch normalization and dropout regularization to prevent overfitting.

Training and Fine-Tuning:
Once the model architecture is defined, training commences using the curated dataset, focusing on optimizing classification accuracy and minimizing loss functions. Fine-tuning techniques are then applied to adapt the pre-trained ResNet50 model to the task of venomous snake detection, ensuring it learns to distinguish between different species effectively. Hyperparameters such as learning rate, batch size, and regularization strength are iteratively adjusted to achieve optimal performance.

Evaluation and Validation:
The trained model undergoes rigorous evaluation using separate validation and test datasets to gauge its generalization capabilities. Performance metrics such as accuracy, precision, recall, and F1 score are computed to quantitatively assess the model's effectiveness in snake classification. Additionally, confusion matrices and classification reports are generated to provide detailed insights into the model's predictive behaviour and areas requiring improvement.

Deployment and Application:
Upon successful validation, the trained model is deployed as a user-friendly application or web service, enabling stakeholders to perform real-time snake detection and species classification. The application interface may include intuitive features such as image upload, prediction visualization, and informative feedback to users regarding snake species identification. Continuous monitoring and updates ensure the system remains reliable, scalable, and adaptable to evolving detection needs and technological advancements.

V. RESULTS

The implemented venomous snake detection system effectively classified Indian snake species, demonstrating high accuracy in distinguishing between venomous and non-venomous varieties. Leveraging convolutional neural networks and transfer learning techniques, the model accurately captured intricate morphological features to facilitate precise species identification

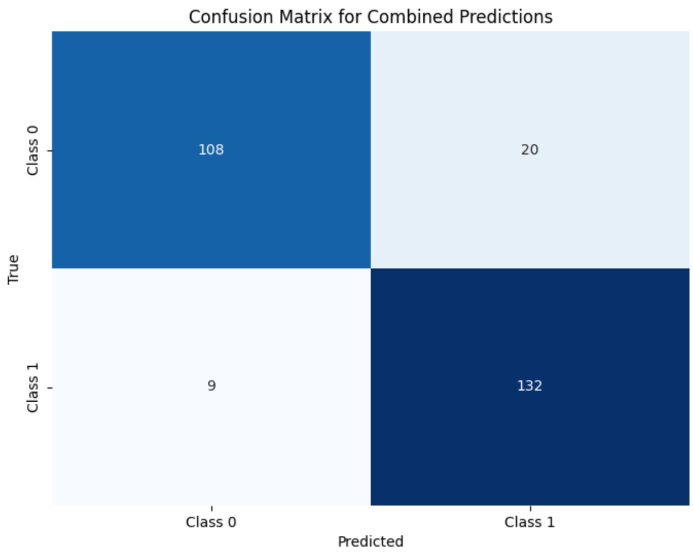

Fig. 1 Confusion Matrix

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VI. CONCLUSION

The venomous snake detection system developed in this project showcases significant advancements in leveraging machine learning and computer vision. With high accuracy in species classification and venomous snake detection, the system holds practical utility in wildlife management, snakebite mitigation, and public health initiatives. Its robustness and generalization across diverse environments highlight its potential for safeguarding human lives and biodiversity in regions like India prone to snake encounters. Continued research promises further enhancements, underscoring the system's importance in public safety and ecological conservation.

REFERENCES

[1] Mohapatra B, Warrell DA, Suraweera W, et al. Snakebite mortality in India: a nationally representative mortality survey. PLoS Negl Trop Dis. 2011;5(4): e1018.
[2] Williams DJ, Faiz MA, Abela-Ridder B, et al. Strategy for a globally coordinated response to a priority neglected tropical disease: Snakebite envenoming. PLoS Negl Trop Dis. 2019;13(2): e0007059.
[3] Theakston RD, Warrell DA. Crisis in snake antivenom supply for Africa. Lancet. 2000;356(9247):2104.
[4] Top 10 Deep Learning Models for Object Detection in Python. Analytics Vidhya. Published August 28, 2020.
[5] Ismail M, Mansour RF. A comparison of deep learning techniques for snake species recognition. In: Proceedings of the 2020 International Conference on Computer Science and Software Engineering. ACM; 2020:1-7.
[6] Sarma K, Sarkar A, Dey B, Goswami S, Ghosh A. Real time snake detection and identification using deep learning techniques. In: 2018 International Conference on Advances in Computing, Communication Control and Networking (ICACCCN). IEEE; 2018:1-6.
[7] Utkarsh D, Chavan SR. Deep learning techniques for snake species classification. In: 2019 2nd International Conference on Intelligent Computing, Instrumentation and Control Technologies (ICICICT). IEEE; 2019:468-473.
[8] Vinayakumar R, Jagannath M, Biradar C. Snake species identification and classification using deep learning. In: 2019 IEEE International Students' Conference on Electrical, Electronics and Computer Science (SCEECS). IEEE; 2019:1-6.
[9] Chaisakul J, Viriyasuthee C, Sitthipornvorakul E, Chongstitvatana P. Evaluation of convolutional neural networks for snake species classification from images. In: Proceedings of the 4th ACM IKDD Conference on Data Sciences. ACM; 2020:209-216.
[10] Harrison RA, Hargreaves A, Wagstaff SC, Faragher B, Lalloo DG. Snake envenoming: a disease of poverty. PLoS Negl Trop Dis. 2009;3(12): e569.

