Investigating an Enhanced Deep Learning Ensemble Model for Automated Poultry Disease Detection Using Multi-Stage Lightweight CNNs

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Introduction
Infectious diseases in birds have been a major cause of economic problems for the poultry industry. The presence of such diseases remains unidentified until extensive outbreaks start. Traditional diagnostic procedures take too much time and require professional clinicians to handle them. Early detection of poultry diseases plays a vital role in sustaining poultry health and preventing disease outbreaks. This research applied an enhanced deep learning ensemble model for poultry disease detection through a multi-stage ensemble method based on lightweight convolutional neural network architectures. This study aims to compare the performance of CNN lightweight models against weighted average ensemble model.

Methodology
The study used three CNN models which are InceptionV3, MobileNetV2, and NasNetMobile. The model used an image dataset of chicken fecal which was gotten from Kaggle. the dataset was divided into four classes, the classes are Healthy, Coccidiosis, Salmonella, and New Castle Disease. The total sample in the dataset is 9678 images of chickens fecal. The dataset was split into ratio 80:20 for training and testing data. The three selected CNN models were then ensemble using weighted average technique. The performance of the models was evaluated using following metrics; accuracy, recall, f1 score, and precision. They research was carried out using python programming language on Jupyter notebook environment.

Results and Discussion
The weighted average ensemble model combines all three models in other to calculate the overall average. The t esting accuracy for the ensemble model is 80%. When compared with the CNN lightweight models, MobileNetV 2 outperformed the other models with an accuracy score of 81%, InceptionV3 has an accuracy of 74%, and Nas NetMobile has 71%.

Conclusions
The study performs a performance analysis that evaluates weighted average ensemble models against individual CNN architectures, which include InceptionV3, NasNetMobile, and MobileNetV2 for diagnosing poultry diseas es. The purpose was to achieve improved classification results alongside minimal computational requirements, e specially when processing poultry fecal images. The MobileNetV2 model delivered outstanding single-model re sults of 81.6% accuracy, which exceeded InceptionV3 and NasNetMobile results. The weighted average ensemb le model reached a 80% accuracy while merging all three examined models together. The experiment reveals the difficulties that arise from combining multiple CNN models since every model performs best at identifying diff erent poultry conditions but struggles at others. The ensemble system models need upgraded methodologies to el iminate overfitting and achieve higher accuracy across all classification groups during additional research.

Keywords: Deep Learning Ensemble, Lightweight CNN Models, Machine Learning in Agriculture, Poultry Disease Detection.