Final Project report

BIRD SPECIES CLASSIFICATION

Milestone 1: Project Initialization and Planning Phase

The Project Initialization and Planning phase for the "Bird Species Classification" involves establishing a clear project vision, defining objectives, and outlining a strategic approach to achieve desired outcomes. The primary objective of this project is to develop a robust deep learning model using Convolutional Neural Networks (CNN) During this phase, the project scope is defined to include data collection, preprocessing, model development, training, evaluation, and deployment. The planned approach includes initializing the model, criterion, optimizer, and scheduler, followed by training the model using CNN architectures. Key deliverables include a functional classification model, a web interface for image uploads through Flask, and model integration with IBM Watson for enhanced analytics.

Activity 1: Define Problem Statement
Problem Statement :

Bird species identification is a challenging task for researchers, conservationists, and bird enthusiasts. Traditional methods rely on manual identification, which is time-consuming, prone to human error, and requires expert knowledge. With the rise of machine learning and deep learning, automated classification systems can improve accuracy and efficiency.

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Activity 2: Project Proposal (Proposed Solution)

Project Proposal:

The proposed solution for the Bird Species Classification with project involves developing a robust and efficient deep learning model to accurately classify bird species from images. Utilizing a Convolutional Neural Network (CNN), the model will be trained on the 200 Bird Species with 11788 Images dataset from Kaggle, ensuring the model learns to recognize intricate patterns and features unique to each bird species. The project workflow includes data preprocessing, such as resizing, normalization, and augmentation, to improve model generalization. The CNN model will be built and trained in Google Colab.

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Activity 3: Initial Project Planning

The initial planning for the Bird Species Classification with CNN Using IBM Watson project involved defining the project's objective: to accurately identify bird species using deep learning techniques. The project uses a Convolutional Neural Network (CNN) model and leverages IBM Watson's capabilities for deployment and analysis. The dataset, 200 Bird Species with 11788 Images, was sourced from Kaggle and stored in Google Drive for seamless access in the Google Colab environment.

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Milestone 2: Data Collection and Preprocessing Phase

The Data Collection and Preprocessing Phase of the Bird Species Classification with CNN Using IBM Watson project involves curating and preparing a high-quality dataset to enhance model accuracy and performance. The dataset, 200 Bird Species with 11788 Images, was sourced from Kaggle and consists of a diverse range of bird species images.

Activity 1: Data Collection Plan, Raw Data Sources Identified, Data Quality Report

The dataset used is '200 Bird Species with 11788 Images', sourced from Kaggle, which provides a comprehensive collection of bird species images with varying poses, lighting conditions, and backgrounds. The dataset is pre-labeled, containing images categorized into 200 bird species, which eliminates the need for manual labeling and accelerates the data preparation process. However, data validation will be performed to ensure image quality and label accuracy. Additional data augmentation techniques will be applied to enhance the dataset's variability and improve the model's robustness to different image conditions.

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Activity 2: Data Quality Report

The Data Quality Report for the Bird Species Classification project highlights the integrity, completeness, and suitability of the '200 Bird Species with 11788 Images' dataset sourced from Kaggle. The data is consistent, with uniform JPEG file formats and standardized class labels across 200 bird species,

preventing discrepancies during preprocessing. Random sampling confirmed label accuracy, and the balanced distribution of images per species mitigates model bias and enhances generalization. Preprocessing steps, including resizing, normalization, and augmentation, were effectively applied, with visualization confirming the transformations' correctness without label distortion.

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Activity 3: Data Exploration and Preprocessing

The Data Exploration and Preprocessing phase of the Bird Species Classification with CNN Using IBM Watson project involved analyzing the '200 Bird Species with 11788 Images' dataset from Kaggle to gain insights into its structure and distribution. During preprocessing, images were resized to a uniform input size required by the Convolutional Neural Network (CNN) model and normalized to scale pixel values between 0 and 1. Data augmentation techniques, including rotation, flipping, scaling, and color jittering, were applied to enhance dataset variability and improve the model's robustness to diverse image conditions. The dataset was then split into training, validation, and testing subsets, maintaining a balanced representation of all species.

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Milestone 3: Model Development Phase

The Model Development Phase for the Bird Species Classification with CNN Using IBM Watson project focuses on building and training a Convolutional Neural Network (CNN) to accurately classify bird species based on images. The model will include several convolutional layers for feature extraction, pooling layers to reduce dimensionality, and fully connected layers for classification. Techniques like batch normalization will be incorporated to improve training stability, and dropout will be used to prevent overfitting. The model's performance will be evaluated using standard metrics like accuracy, precision, recall, and F1-score on the validation set. Hyperparameters such as learning rate, batch size, and epochs will be fine-tuned using techniques like grid search or random search to optimize the model.

Activity 1: Feature Selection Report :

The Feature Selection Report for the Bird Species Classification with CNN Using IBM Watson project outlines the process of identifying and selecting the most relevant features from the image dataset to improve model performance and reduce computational complexity. In this project, feature

selection is primarily achieved through the use of Convolutional Neural Networks (CNNs), which automatically learn hierarchical features directly from the raw image data. Since CNNs excel at detecting patterns such as edges, textures, and shapes in images, traditional feature engineering methods are not required. Instead, the model learns relevant features through its convolutional layers, eliminating the need for manual feature selection.

Activity 2: Model Selection Report

The Model Selection Report for the Bird Species Classification with CNN Using IBM Watson project outlines the decision-making process for selecting the appropriate model to classify bird species from images. Given the nature of the task, which involves image recognition and classification, Convolutional Neural Networks (CNNs) were selected as the primary model type. CNNs are well-suited for image classification tasks due to their ability to automatically learn hierarchical features, such as edges, textures, and object shapes, without the need for manual feature extraction. This makes them highly effective for handling the complex visual patterns present in bird species images.

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Activity 3: Initial Model Training Code, Model Validation and Evaluation Report:

The Model Training, Validation, and Evaluation for the Bird Species Classification with CNN Using IBM Watson project focused on developing a Convolutional Neural Network (CNN) to classify bird species from images. Initially, the model was trained using an augmented dataset to prevent overfitting and improve generalization. The training code involved setting up an image data generator for both the training and validation sets, applying resizing, normalization, and augmentation techniques like rotation, flipping, and zooming. The CNN model, consisting of convolutional and pooling layers, was designed to learn hierarchical image features and predict one of the 200 bird species. The model achieved a solid accuracy during training, with the validation performance being closely monitored to avoid overfitting.

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Milestone 4: Model Optimization and Tuning Phase

The Model Optimization and Tuning Phase for the Bird Species Classification with CNN Using IBM Watson project focuses on enhancing the performance of the Convolutional Neural Network (CNN) by fine-tuning hyperparameters, adjusting model architecture, and implementing techniques to reduce overfitting and improve generalization. Following the initial training phase, several strategies were applied to optimize the model's performance. Firstly, hyperparameter tuning was performed to find the optimal combination of parameters such as the learning rate, batch size, and number of epochs. This was achieved using techniques like grid search or random search to test different configurations and identify the values that provided the best validation accuracy. The learning rate was carefully adjusted to avoid overshooting the minimum loss or causing slow convergence.

Activity 1: Hyperparameter Tuning Documentation

The Hyperparameter Tuning for the Bird Species Classification with CNN Using IBM Watson project focused on optimizing key parameters to improve the model's performance. The learning rate was adjusted using grid search to find the optimal value that would balance convergence speed and accuracy, with a rate of 0.001 being most effective. Batch size was tested at values of 16, 32, and 64, with 32 providing the best balance between training efficiency and accuracy. The model was trained for a maximum of 30 epochs, with early stopping applied to prevent overfitting. A dropout rate of 0.5 was found to effectively regularize the model without hampering its learning capacity. The Adam optimizer was chosen for its adaptive learning rate, leading to faster and more stable training.

Activity 2: Performance Metrics Comparison Report

The Performance Metrics Comparison Report for the Bird Species Classification with CNN Using IBM Watson project provides a detailed analysis of the model's performance after applying different training strategies and hyperparameter tuning. The model's effectiveness was evaluated using key classification metrics: accuracy, precision, recall, and F1-score. Initially, the model's baseline performance was evaluated without extensive optimization, resulting in an accuracy of approximately 75% on the validation set. The precision and recall scores for different species varied, as the model struggled with classes that had similar visual features. The F1-score, which balances precision and recall, was also moderate, indicating that the model had room for improvement. In conclusion, the model's performance significantly improved after hyperparameter tuning and transfer learning. The final model achieved a

high level of accuracy and a solid balance between precision, recall, and F1-score, confirming its capability to effectively classify bird species in diverse conditions.

Activity 3: Final Model Selection Justification :

The Final Model Selection for the Bird Species Classification with CNN Using IBM Watson project was based on the choice of a ResNet pre-trained model with transfer learning due to its superior ability to generalize and classify complex image data. Compared to custom CNN models, ResNet, which had already been trained on large datasets like ImageNet, showed significantly better performance in terms of accuracy (85%), precision, recall, and F1-score after fine-tuning. The deep residual blocks of ResNet allowed the model to effectively learn complex features without vanishing gradients, enhancing its robustness against variations in bird images. Additionally, leveraging transfer learning reduced training time and computational costs, while improving convergence speed. This model was not only accurate and efficient but also scalable, allowing for easy adaptation to new bird species in the future, making it the optimal choice for the project.

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Milestone 5: Project Files Submission and Documentation

For project file submission in , Kindly click the link and refer to the flow.

For the documentation, Kindly refer to the link Click Here

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Milestone 6: Project Demonstration

In the upcoming module called Project Demonstration, individuals will be required to record a video by sharing their screens. They will need to explain their project and demonstrate its execution during the presentation.