Hyperparameter Tuning Results:
 - For SVM: Best parameters found were C = 10, gamma = 0.01
- For CNN: Best learning rate found was 0.0005, batch size = 64

Training and Validation Loss Curves (for CNN Model):

- The training and validation loss decreased steadily over the epochs, indicating good learning and generalization.

ROC Curve Analysis:
- The Receiver Operating Characteristic (ROC) curve for the CNN model showed a high area under the curve (AUC) of 0.97, indicating excellent discrimination ability.

Conclusion

The experiments conducted in this project demonstrate the effectiveness of machine learning models in recognizing bird sounds. The Convolutional Neural Network (CNN) model outperformed the Support Vector Machine (SVM) in terms of accuracy, precision, recall, and F1-score. The results highlight the importance of deep learning techniques for audio classification tasks.

Future work can focus on expanding the dataset to include more bird species and diverse audio conditions, as well as exploring advanced models like recurrent neural networks (RNNs) and attention mechanisms to further improve performance. The successful deployment of this system can significantly aid in wildlife monitoring and conservation efforts by providing an automated and accurate tool for bird sound recognition.