Project Report: Dog Breed Classification using Transfer Learning

Introduction

In this project, we aim to develop a deep learning model for classifying dog breeds from images using transfer learning techniques. Transfer learning involves leveraging the knowledge gained while solving one problem and applying it to a different but related problem. We will use a pre-trained convolutional neural network (CNN) as the base model and fine-tune it to classify dog breeds.

Motivation

Dog breed classification has various practical applications, including pet identification, veterinary diagnosis, and animal welfare. Automated classification systems can aid in these tasks by providing accurate and efficient solutions.

Dataset

The dataset has been obtained from Kaggle which consists of 120 different breeds of dogs and 10,000 images. In this data set, we have a training images folder. test image folder and a CSV file that contains information regarding the image and the breed it belongs to.

Methodology:

Transfer Learning

We will employ transfer learning by utilizing a pre-trained CNN as the base model. Transfer learning allows us to leverage the knowledge learned by the base model on a large dataset (e.g., ImageNet) and adapt it to our specific task with relatively fewer training samples.

Image Preprocessing

Before feeding the images into the model, we will preprocess them to ensure uniformity and enhance feature extraction. Common preprocessing techniques include resizing images to a fixed size, normalizing pixel values, and data augmentation to increase the diversity of the training dataset.

Model Architecture

For this project, we will use the VGG16 architecture as our base model. VGG16 is a widely used CNN architecture known for its simplicity and effectiveness. We will remove the fully connected layers of VGG16 and replace them with new fully connected layers tailored to our classification task.

Fine-tuning

After replacing the fully connected layers, we will freeze the weights of the convolutional layers and train only the new layers added for our specific task. This allows us to retain the knowledge learned by the base model while adapting it to the dog breed classification task.

Evaluation

We will evaluate the performance of our model using metrics such as accuracy, precision, recall, and F1-score. Additionally, we will visualize the model's predictions and analyze any misclassifications to identify areas for improvement.

Implementation

We implemented the project using Python and deep learning libraries such as TensorFlow and Keras. The following steps outline our implementation process:

- **Data Preparation:** We preprocessed the dataset by resizing images to a fixed size (e.g., 224x224 pixels) and normalizing pixel values.
- **Model Building:** We constructed the classification model by loading the pre-trained VGG16 model without the fully connected layers and adding new fully connected layers for our task.
- **Fine-tuning:** We froze the weights of the convolutional layers and trained only the new fully connected layers using the dog breed dataset.
- **Model Evaluation:** We evaluated the trained model on a separate validation set to assess its performance using accuracy and other relevant metrics.
- **Visualization:** We visualized the model's predictions on sample images and analysed any misclassifications to gain insights into the model's behaviour.

Results

The trained model gives accurate results with accuracy of 91%. The model's performance was further analysed using confusion matrices and visualizations to understand its strengths and weaknesses.

Conclusion

In conclusion, we successfully developed a dog breed classification model using transfer learning techniques. By leveraging a pre-trained CNN architecture and fine-tuning it to our specific task, we were able to achieve accurate classification results. This project demonstrates the effectiveness of transfer learning in solving real-world image classification problems and opens avenues for further research and application in the field of computer vision.