Domestic Animal Breed Identification

CSA301 Deep Learning
Bachelor of Computer Science (AI Development and Data Science
(Year III, Semester I)

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1 Proposed Methods

1.1 System Overview

Explain the overview of the system using flowchart. Use draw.io to draw the flowchart.

1.2 Algorithm

For the Domestic Animal Breed Identification project, we are employing Convolutional Neural Network (CNN) algorithm. Since the project involves image datasets, CNNs are particularly well-suited for the image classification tasks due to their ability to capture spatial hierarchies or relationships and patterns within the images.They can automatically relevant features such as texture, shape, and patterns, which are essential for distinguishing different domestic animal breed.

Key Parameters

- **Input Layer:** The input to the model will be the images of domestic animals (Dogs, Cats, Cattles), resized to a standard resolution (e.g., 224x224 pixels) to maintain uniformity.

Convolutional Layers

Number of Filters: Starting with 32 filters in the first layer and progressively increasing in deeper layers.

Filter Size: 3x3 filters, commonly used for feature extraction, will be used to capture detailed patterns without losing too much spatial resolution.

Activation Function:

ReLU (Rectified Linear Unit): ReLU is used to introduce non-linearity while being computationally efficient. It helps the model learn complex patterns by avoiding vanishing gradients.

Pooling Layers:

Max Pooling: 2x2 max pooling layers will be used after certain convolutional layers to reduce the spatial dimensions of the feature maps, reducing computational load and preventing overfitting.

Fully Connected (Dense) Layers: After flattening the feature maps, one or more dense layers will be used to make the final classification.

Output Layer: The output layer will use a softmax activation function to classify the image into one of the predefined breed categories.

Loss Function: Categorical Cross-Entropy will be used as the loss function since this is a multi-class classification problem.

Optimizer: Adam Optimizer will be employed due to its adaptive learning rate and robustness in handling noisy gradients, leading to faster convergence. **Key Parameters**

1.3 Dataset

Explain you are going to collect or use an existing dataset for the project. You need to also mention the format of dataset.

Source: For this project on domestic animal breed identification, we will be using the existing datasets form Kaggle. The dataset is publicly available on kaggle and contains labels for various domestic animal breeds, such as dogs, cats and cattles

Format: The dataset that we will use for our project in image format(all type), with each image corresponding to a specific animals breed. The dataset is organized in a folder, where images of different breed of various animals are stored in one folder.

1.4 Evaluation Metrics

Explain how you are going to evaluate the trained model

For this project on domestic animal breed identification, which is a classification task, we will use Accuracy, Precision, Recall, F1-Score, and Confusion Matrix as evaluation metrics to evaluate the performance of out trained model.

Here's how we are going to use these evaluation techniques:

1. **Accuracy:** We will use accuracy to assess the model's capability to classify domestic animal breeds correctly.

2. **Precision:** We will use precision to check the proportion of true positive predictions out of all the positive predictions made by the model.

3. **Recall:** We will use recall to measure how well our model identifies all instances of a particular breed.

4. **F1-Score:** We will use the F1-score to evaluate the overall effectiveness of the model.

5. **Confusion Matrix:** We will use the confusion matrix to spot any specific breeds that the model is confusing with others. It will summarize the model's performance in a table, displaying the number of true positives, true negatives, false positives, and false negatives for each breed of different animals.

1.5 Experimental Setup

Programming language, Deep learning library, Platform for training the model

Pyhton:
Python is used in domestic animal breed identification due to its simplicity and availability of libraries such as TensorFlow, Keras and PyTorch which make it easy to develop models. These libraries offer pre-trained models and functions and structures, thereby sparing developers the time of writing special algorithms. Python also collaborates nicely with other tools and environments, including cloud services and enables highly scalable training and deployment of models. With over half a million subscribers on YouTube, it implies that there are numerous resources, tutorials, and updates available for developers, thereby making it easier to learn. Due to this flexibility and ease of use coupled with the mighty libraries, Python is the preferred language.[1] For this project we are going to use the

following libraries:

1. TensorFlow:

TensorFlow is an open source software framework created by Google for high level computation and machine learning. It is used to develop and train deep learning models and provides significant features for most kinds of neural networks. TensorFlow ensures that the building blocks as well as the training of big models are simplified. It is appropriate for production, contains tools for model scaling and is designed for production-level projects.[2]

2. Keras:

Keras is an open-source, deep learning application-programming interface written in Python, designed to execute on the top of TensorFlow,Microsoft Cognitive Toolkit and others. First designed as an independent library, it has been included into TensorFlow ecosystem and extended as tf. keras which offers a simplified access to TensorFlow's features. Keras is widely employed as a tool to come up with new ideas about model architecture design due to its simplicity and effectiveness for the fast prototyping. It offers great levels of interface, which enables the creation and training of deep learning models and executes those models using TensorFlow's strong framework.

3. OpenCV:

Open Source Computer Vision Library is actually very helpful in image preprocessing especially in resizing, normalization as well as augmentation. The use case can be employed together with TensorFlow or PyTorch to pre-process images before feeding them for model training.

4. Matplotlib:

Matplotlib is one of the most significant and powerful collections of command to create stock, animated and interactive visualization among the Python's scientific setup. It is very flexible and can plot a variety of things like the line plot, the bar plot, histogram and the scatter plot among others. Marketers like to utilize it to portray training progress, model's performance, and data distributions.

5. Seaborn:

Seaborn is an extension of the Matplotlib library which has a high-level interface where it is easier to create advanced and beautiful statistics graphics. It also makes it easy to draw other types of plots such as heat map, pair plots and violin plots in understanding the relationship between data or interpreting model results.

6. Numpy:

As stated, NumPy, short for Numerical Python, is a basic package in numerical computations in Python. Supports arrays and matrices as well as a vast number of mathematical functions to work on these data structures. NumPy is useful in data preprocessing where raw data is normalized or standardized and numerical transformations done. It assists in handling big data as well as conducting operations that are essential in preparing data for training of machine learning algorithms. [1]

7. Pandas:

Pandas is a popular and effective tool for data processing and analysis, which includes tools for working with data vectors: DataFrames and Series. Pandas is primarily used in carrying out data loading, exploration, cleaning and preprocessing. It assists in the data input operation involving different formats of data such as CSV, Excel, SQL, and

many others, preparing it for analysis. It enables enhancement of data including sorting, aggregation, and formatting which are critical when preparing data for modeling algorithms.

The platform that we will be using for the project, domestic animal breed identification are:

1. google colab

Google Colab is a cloud service provided by Google that works almost the same as Jupyter notebooks but with some extra features such as the ability to change cell types, enable multiple selections, execute Python code, etc. By making GPUs and TPUs available for use for free, which are important for training deep learning models, it benefits academicians and researchers.

2. jupyter Notebook

Jupyter Notebook is an open-source web application that users use to create and write computer code. Operates on your computer which means you have full control over its setup and the resources utilized. This environment gives you the advantage of being able to install and configure any libraries, tools among other essentials and you can work offline once you are done with the settings.

References

[1] K. J. Millman and M. Aivazis, "Python for scientists and engineers," *Computing in science & engineering*, vol. 13, no. 2, pp. 9–12, 2011.

[2] S. Saabith, T. Vinothraj, and M. Fareez, "A review on python libraries and ides for data science," *Int. J. Res. Eng. Sci*, vol. 9, no. 11, pp. 36–53, 2021.