**A Deep Learning Approach to Fine-grained Dog Breed Classification**

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**Abstract**

The project proposal is a description of our plan for our team’s deep learning project for this CS 465 class. It begins with a through description of the problem we are trying to solve, and why our solution will be useful. Then we have included descriptions of a variety of research papers we used to get an understanding of the scope of and helpful starting points for this project. A breakdown of the different sub-tasks in this project and its general idea are discussed next. Along with this breakdown we have included a figure to help visually describe our deep learning method’s basic pipeline. Next, we identify our data sources for this deep learning project. Finally, we wrap up this proposal with a concise calendar we will use to help schedule our workload and progress on this project, and a list of this proposal’s references.

**1. Introduction**

**1.1. Problem Specification/Project Description**

This project aims to make a tool that makes it easier for the public to identify the specific sub breeds or mixes of breeds within their dogs to help them have a better understanding of the medical/health issues their dog may face. Using image classification instead of DNA testing is not only a less expensive alternative to breed detection, but it could also have less ecological impact due to not requiring physical objects to be shipped and materials to be used. Our tool to detect breeds in dogs uses …

**1.2. Significance**

Many breeds of dogs have specific health issues that become very prominent as they reach old age. Being able to determine the sub breeds of a mixed breed dog would help dog owners understand the possible health issues their dog may face in their old age. This would allow them to take preventative action and improve their dog’s quality of life.

Similarly breed recognition could help with training by helping determine a dogs interaction behavior and inherent instincts. These behaviors and instincts are heavily linked to a dog’s genetics.

**2. Related Works**

**2.1. Review Several Research Works in Most Recent Years**

Several other deep learning approaches to fine-grained breed classification have been done previously. A paper, published in December 2020 and written by Ding-Nan Zou, Song-Hai Zhang, Tai-Jiang Mu & Min Zhang, discussed the creation of a dataset to train several pre-existing models, Inception B3, WS-DAN, PMG & TBMSL-Net (4 classification deep neural networks) [1]. A paper written by Xavier Higa in April of 2019 discusses the use of two different CNN’s, (VGG-16 & Densenet-201) trained on the Stanford Dogs dataset, to determine a specific breed for a dog [2]. Kaitlyn Mulligan and Pablo Rivas published a paper in 2019 about Breed Identification using the Xception neural network (a CNN) [3].

**2.1. The Most Similar Research Paper**

“Dog Breed Classification Using Convolutional Neural Networks: Interpreted Through a Lockean Perspective”, the paper written by Xavier Higa is most like our project topic. The paper discusses using two CNN’s, (VGG-16 & Densenet-201) trained on the Stanford Dogs dataset, to determine a specific breed for a dog [2]. They trained the CNN’s using supervised learning, on labeled image data from ImageNet, then fine tuned each Neural Network using a test set of the Stanford Dogs Dataset [2]. The two CNN’s used were VGG-16 (Figs. 6 & 7) and DenseNet-201(Fig. 8) [2].

Diagram

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Using MATLAB they gathered results of training and testing on each Network (Figs. 10 & 11) using a standard method for training both Networks.

A picture containing table

Description automatically generatedGraphical user interface

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**3. Tasks or/and Preliminary Idea**

For our project we will compare the performance of *a few different* CNNs in the fine-grained identification of different dog breeds. After finding the best performing CNN, we will make some minor modifications to it. These modifications will allow the CNN to also output several its best guesses for the dog’s breed [Figure 1 Below]. These other best guesses by the CNN should fall in line with any sub-breeds of a given dog since mixed breed dogs will have a proportionate mixture of its different sub-breeds. After making these updates to the CNN we will apply them to one or more other CNNs to compare their relative ability to handle this new output.

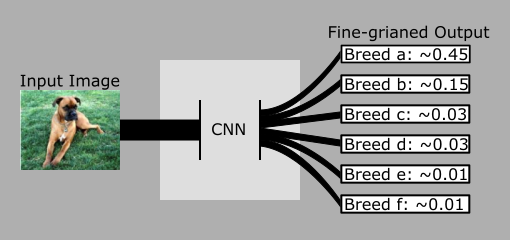


Figure 1. Skeleton pipeline of our Deep Learning method

**4. Data Acquisition**

Our team will obtain data from the Stanford Dogs Dataset as well as data from ImageNet. This data is readily available through Stanford and Princeton Universities [4][5]. We will preprocess the data to be used for object detection and image recognition/classification.

**5. Project Timeline**

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| Task | Time |
| 1. Read related research papers/codes and write research proposal | 9/1 ~ 9/16 |
| 2. Prepare and obtain the dataset for this project | 9/17 ~ 9/23 |
| 3. Implement and run the existing models and compare their performance | 9/23 ~ 9/30 |
| 4. Implement improved or new model OR update and train best model to allow for sub-breed identification | 10/1 ~ 10/15 |
| 5. Prepare Midterm Progress Report and Presentation PPT Submission | 10/15 ~ 10/24 |
| 6. Conduct experiments to compare the method with existing models | 10/15 ~ 11/1 |
| 8. Write the paper, create PPT | 11/1 ~ 11/24 |
| 9. Prepare the final submission of PPT, code, data, user documentation, final paper, etc. | 11/24 ~ 12/5 |

**References**

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