DATA SCIENCE CANVAS

Customer: Dog owners

Project name: Puppy Master

Iteration: 04

Date: 07.02.2024

Problem Statement

Dogs have become the most popular pets among people all around the world recently. However, we found the lack of related laws about dogs training in some countries, and the public lacks basic knowledge about of dog breeds, which usually mistakenly recognize some dangerous dogs as safe ones and caused a lot of dog biting accidents among the children and adults.
This is why we try to implement a system which offer a quick and simple classification tools for breeds of the dogs in the daily life.

Solution

We use ResNet-50, a widely used neural network in image classification tasks to build a model and train it on the Stanford Dog Dataset processed on MATLAB. Then we implement a website and deploy the model on it, which makes it simple to use for both mobile devices and PC.

Users & Use

There are mainly three kinds of users:

1. Dog owners that want more information about their pets.
2. Anyone who finds a dog nearby and worries about the potential risk of biting.
3. Government staff who manages the dog in the city.

The system offers a quick and simple solutions for both of them to get the needed information. They take a picture of the dog, upload it to the website and get results after 10-15 seconds.

Data Acquisition

Existed: Stanford Dogs Dataset

- Number of categories: 120
- Number of images: 20,580
- Annotations: Class labels, Bounding boxes

Needed: Data Augmentation (Mirror, clip, gaussian, etc.)

Analytics Formulation

ResNet-50 is a classical convolutional CNN architecture for deep learning. The base layer inputs pixels, brightness values, color values edges, textures and shapes. Deeper neural network layers will then extract more abstract and complex feature representations from them.

Modeling

ResNet-50 is a relatively deep network capable of learning more complex feature representations. Residual learning is introduced to speed up the training process. The structure also allows the network to share parameters and has been pre-trained on large-scale image datasets, such as ImageNet, so it has good transferability.

Data Preparation

Data augmentation are used:
Flip, Rotation, Contrast Adjustment, Gaussian Noise, Gray, Sharpen.
An OOD dataset is generated from over-augmented dataset such as adjusting contrast a lot.

Evaluation

ResNet-50 Models can be evaluated by using different metrics like: loss, accuracy, precision, recall, F1-score.
We also use maximum softmax probabilities and error of energy function to determine the threshold of OOD.

Success Criteria

Success is based on objective and subjective criteria
Objective:
• Extensive database of dog breeds
•Visual representations for model parts with periodic changes in the data(loss, accuracy, precision, recall, F1)
• Good UI/UX
• Accuracy, precision, recall, F1 > 0.7

Constraints

- The dataset only contains 120 breeds of dogs, whereas there's much more mixed breeds of dogs in the daily life.
- The accuracy of model strongly depends on the image and is not stable for all breeds.

Technology stack

PL: Python, Java, HTML5, CSS3, JAVASCRIPT
Libraries: TensorFlow, sklearn, NumPy, matplotlib, keras
Database: MySQL, Redis
Data Process: Matlab, Image batch processor
Backend: SpringBoot, MyBatis, Swagger
Frontend: React, Node, Umi, Ant Design

Business Value

The system can improve more functionalities as a professional medical dog website and application, which provide information on the health condition and suggestions on dogs and build a vertical society for dog owners to share experience with their dogs. With such amount of users related ads are easily to find to make profits.

MVP

Fast and simple. Prevent users from potential biting risks with 10 seconds.

Key Actors

Internal: Resources to make advertisements and get users from the beginning.
External: More functionalities, more data that increased the model performance which make users trust our products.