

Predicting Dog Emotions by Machine Learning

Based on Posture Analysis



Idea

- Use image recognition techniques to determine a dog's pose from an image
- Predict the dog's emotion from pose information by using a pretrained machine learning model



Process Overview



1. Dog Emotion Image Data Set



3. Predictive Model



5. Web App

2. Dog Keypoint Detector



4. Explanatory Model





Dog Emotion Image Data Set

Scientifically Accepted Dog Emotions

Happiness

Sadness

Anger

Surprise

Fear

Disgust

Primary Emotions:
Emotions without Need of
Self-Reflection





Dog Emotion Image Data Set

Scientifically Accepted Dog Emotions

Happiness

Sadness

Anger

Surprise

Fear

Disgust

Relaxation

Primary Emotions:
Emotions without Need of
Self-Reflection





Dog Emotion Image Data Set

Stimuli Based Image Search

Happiness

Trusted Partner (Owner), Playing, Food

Anger

Inaccessible Resource (Leash Aggressivity)

Fear

Veterinarian, Thunderstorm, Toenail Trimming ...

Relaxation

Absence of any Events





Dog Emotion Image Data Set

Image Collection with Search Engines & Social Media

Happiness



100 Images

Anger



100 Images

Fear



100 Images

Relaxation



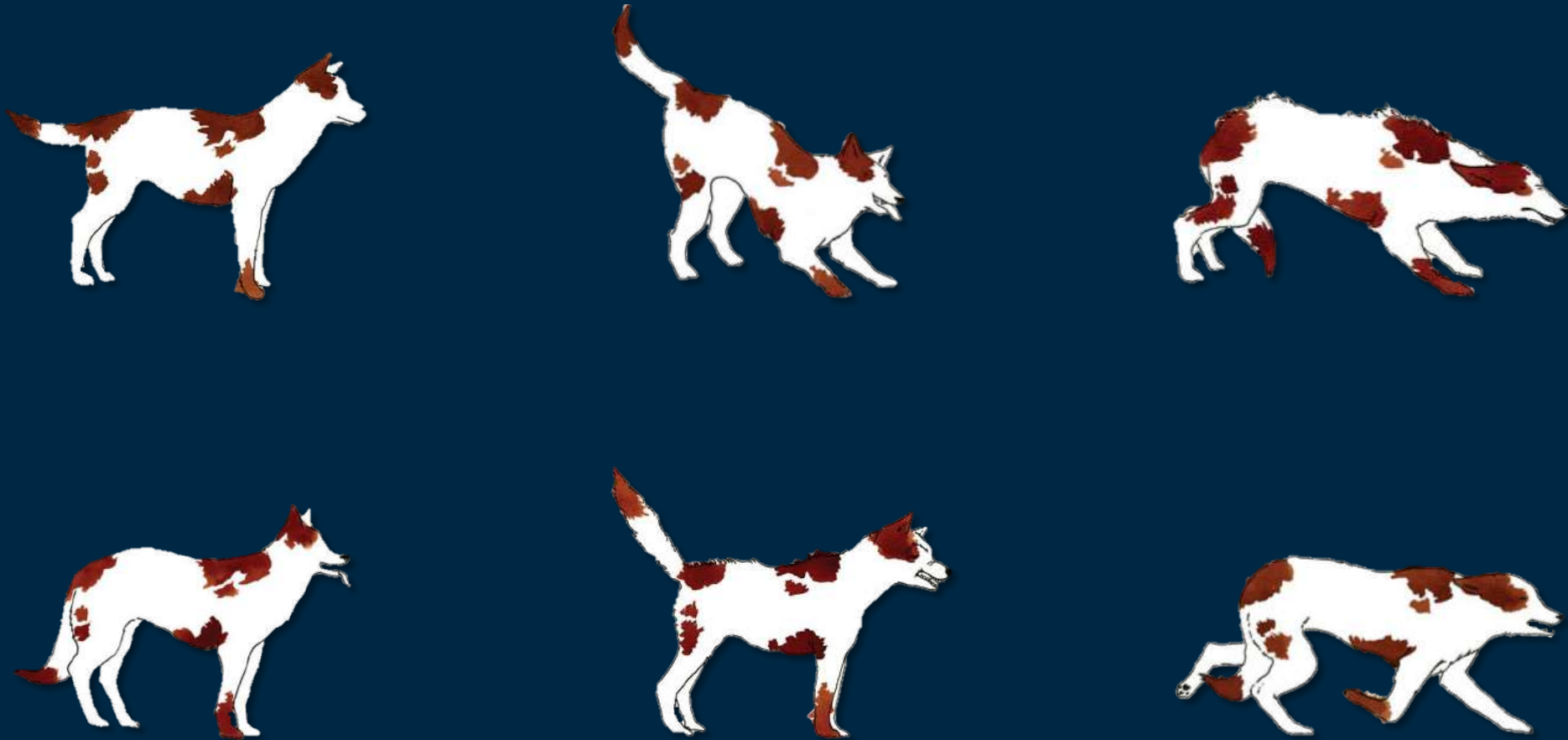
100 Images





Dog Keypoint Detector

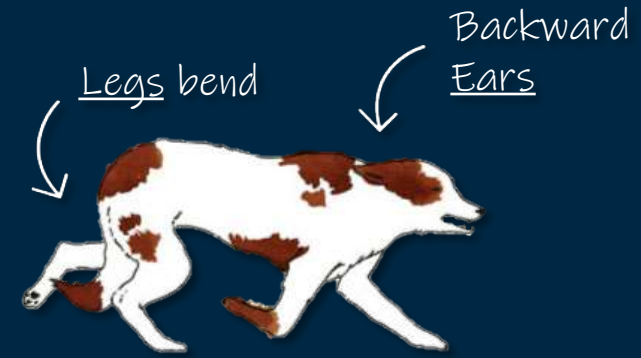
Dog Body Language / Dog Poses





Dog Keypoint Detector

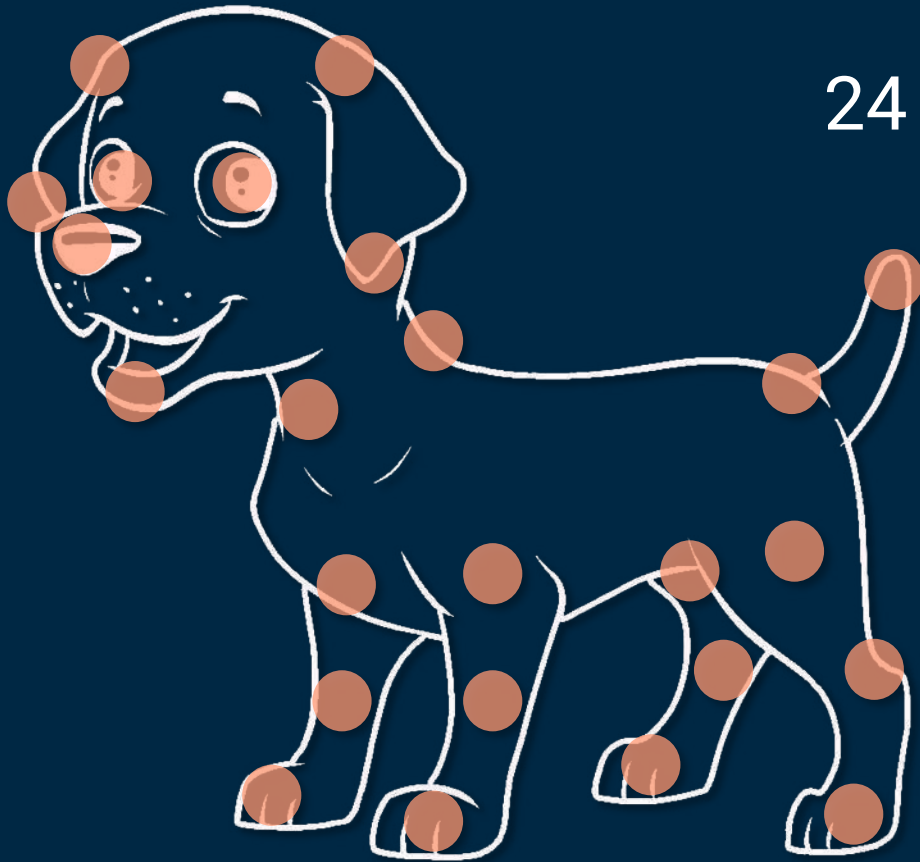
Dog Body Language / Dog Poses





Dog Keypoint Detector

Identifying Necessary Keypoints



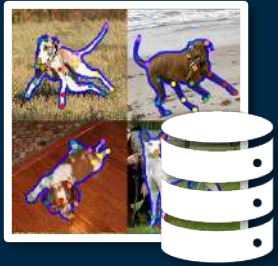
24 Keypoints for Identifying:

- Ear Position
- Head Position
- Mouth Condition
- Bodyweight Distribution
- Leg Bending Degree
- Tail Position



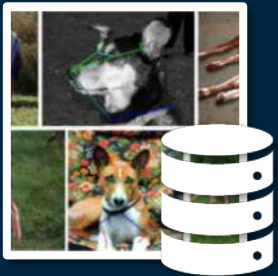
Dog Keypoint Detector

Training a Dog Keypoint Detector with DeepLabCut



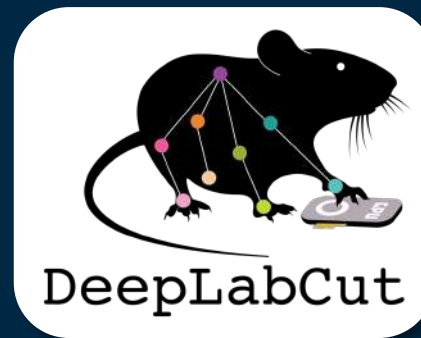
Stanford Extra
Data Set

12 000 Images



Animal Pose
Data Set

1809 Images

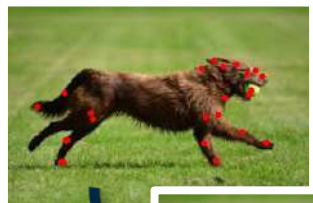




Predictive Model

Training a Neural Network for Emotion Recognition

Small Preprocessing



Detected Coordinates

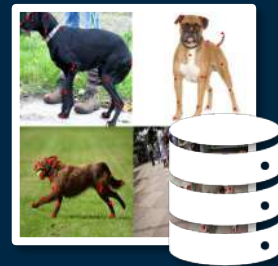


Scale to Square



Mirror Coordinates
if Dog Looks to the Right

Preprocessed
Emotion Data Set



Neural Net

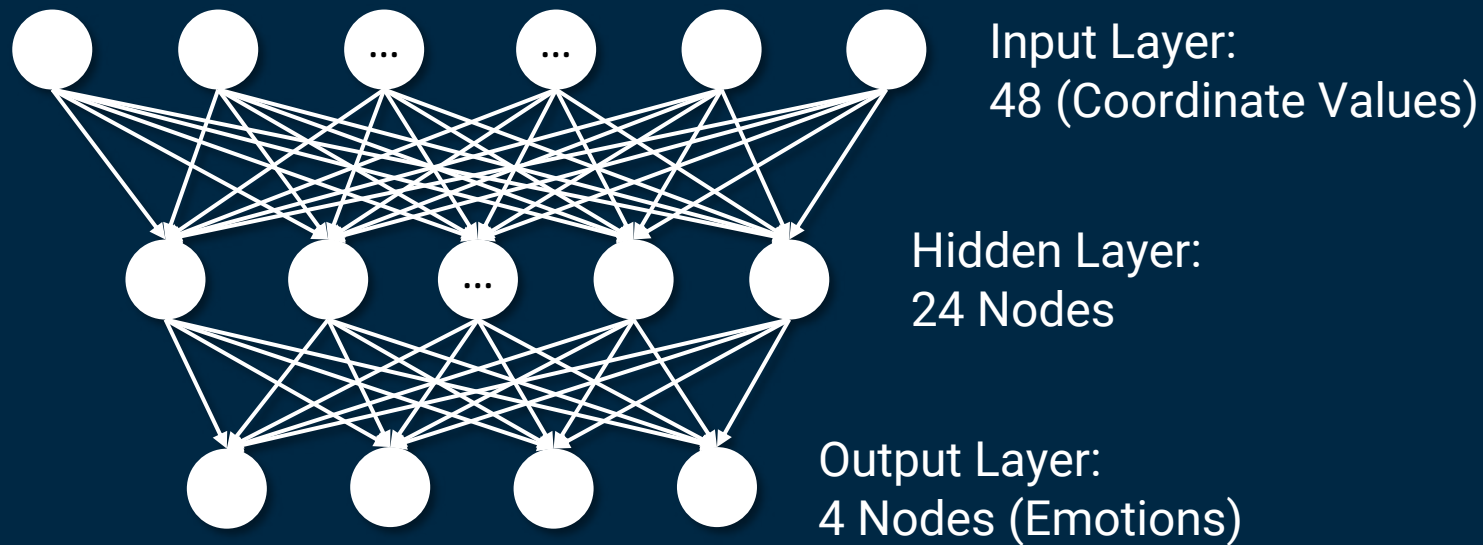




Predictive Model

Resulting Neural Network

Best NN of 108 NNs Tested in Grid Search:



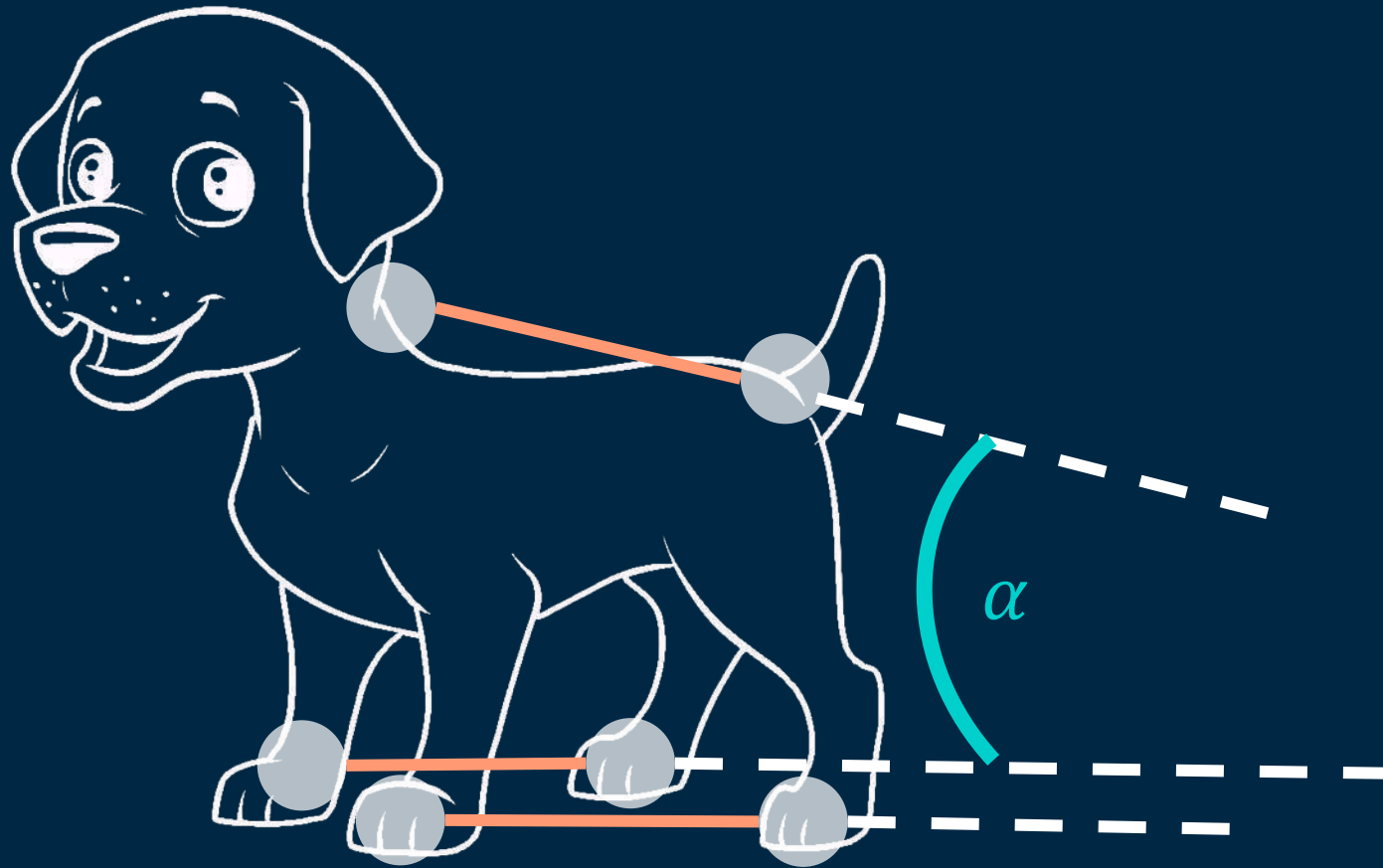
67.5%
Accuracy on
Test Set





Explanatory Model

Calculating Pose Metrics from Coordinates



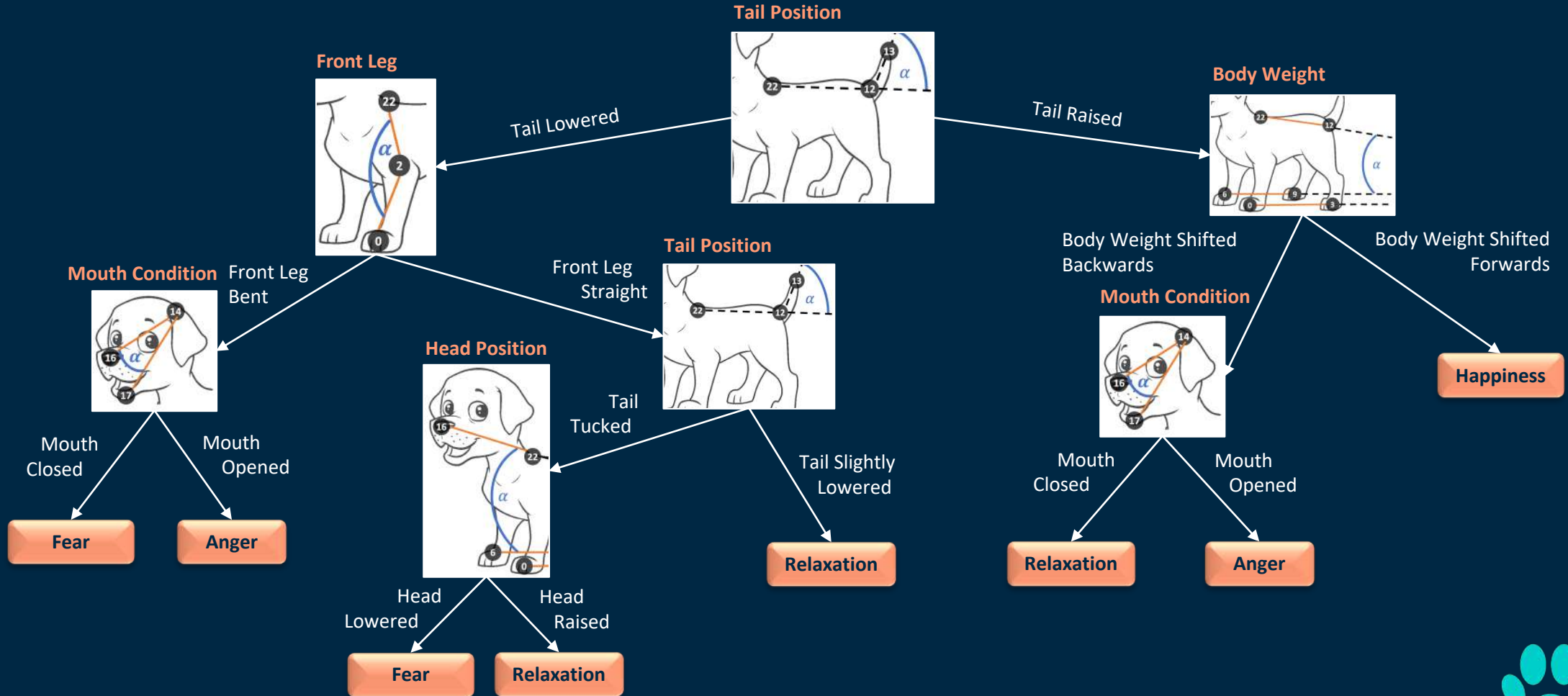


Explanatory Model

Visualized Decision Tree

62.5%

Accuracy on
Test Set





Web App



Frontend



Backend



Discussion

Future Work / Improvement Possibilities:

- Size and Quality of Emotion Data Set
- Extent of Grid Search
- Amount of Input Data: Facial Movements & Dynamic Body Signals

Conclusion:

The project shows promising results for machine learning dog emotion recognition, especially regarding the small size of the training data set.



THANKS

Do you have any questions?



Literature

- Coren, S. (2013, March 14). *Which Emotions Do Dogs Actually Experience?* Psychology Today. <http://www.psychologytoday.com/blog/canine-corner/201303/which-emotions-do-dogs-actually-experience>
- Kujala, M. (2018). Canine emotions: Guidelines for research. *Animal Sentience*, 2(14). <https://animalstudiesrepository.org/animalsent/vol2/iss14/18>
- DeepLabCut. (n.d.). *DeepLabCut Model Zoo! –Adaptive motor control lab*. Retrieved November 27, 2020, from <http://www.mousemotorlab.org/dlc-modelzoo>
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