Signal Processing and Feature-Based Classification for Canine Application

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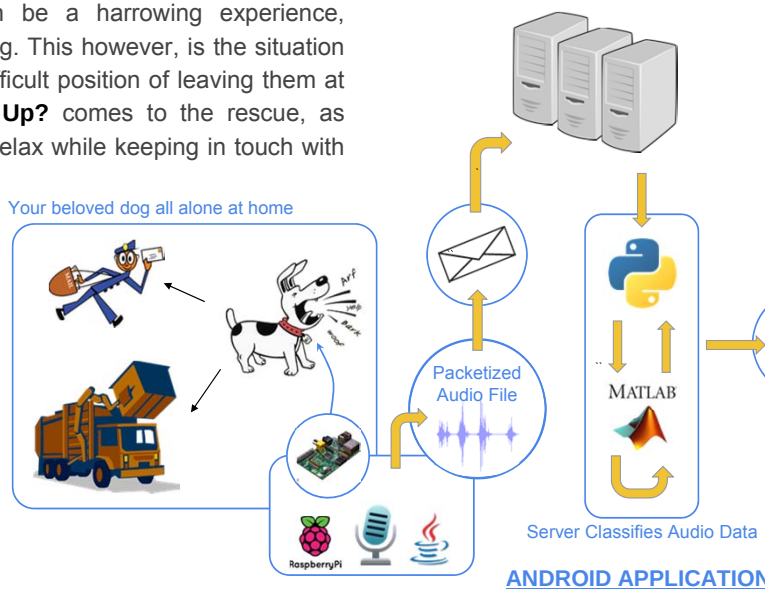
MOTIVATION

Leaving your beloved pets at home can be a harrowing experience, especially if they are maladjusted to you leaving. This however, is the situation that nearly all pet owners are placed in, the difficult position of leaving them at home unattended. This is where ***WOOOF*'s Up?** comes to the rescue, as owners are no longer left in the dark and can relax while keeping in touch with their furry friends.



WHAT IS *WOOOF*'s UP?

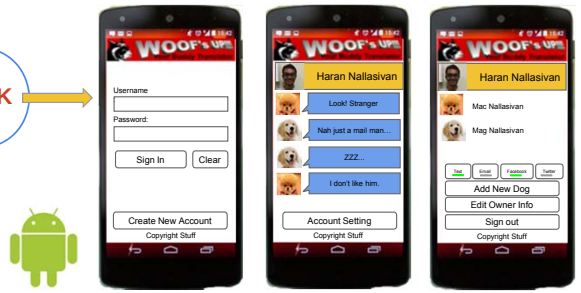
- ***WOOOF's Up*** monitors your dog's status
- It detects activity using audio data
- Notifications or alerts are then sent to your smartphone

RASPBERRY-Pi RECORDER

- Serves as a proof-of-concept
- Continuously detects activity
- Sends audio data packets to server
- Compact collar-mountable device
- Runs on Raspbian and Java Virtual Machine (JVM)

SERVER

- Services Raspberry Pi recorder connections
  - Audio packets received classified in MATLAB
  - Messages and notifications are then hashed to indexes identified by recorders' IP address
- Python 2.7.8 (32-bit) script exclusively on Windows
- Service Android application queries
  - Scan for network connected collars
  - Send back updated messages and notifications



ANDROID APPLICATION

- Scans and pairs with Raspberry Pi collar recorder within the same network
- Requests server for update messages and notifications

AUDIO CLASSIFICATION and FEATURES EXTRACTION

SUPPORT VECTOR MACHINE CLASSIFICATION

- Uses *N*-dimensional vector geometry
- *Training* data to establish class boundaries
  - Boundaries used to predict for *test* data
- 4 SVMs, two for high-pitch dogs, two for low
- Spectral Entropy threshold separate high vs. low
- For each subjective pitch determination:
  - Bark vs Other Sound
  - Whine vs Growl

TRAINING SAMPLES

- Max (right)
  - 4 year old peekapoo
- Internet downloads
  - Cover base for larger breeds

ACCURACY

- **High Pitch Classifier: 88 % (good performance)**
  - Growls - 79% Whines - 92 % Barks - 92 %
- **Low Pitch Classifier: 34% (poor performance)**
  - Growls - 100% Whines - 100% Barks - 0%

FEATURES USED FOR CLASSIFICATION

Small Dog (High Pitched)

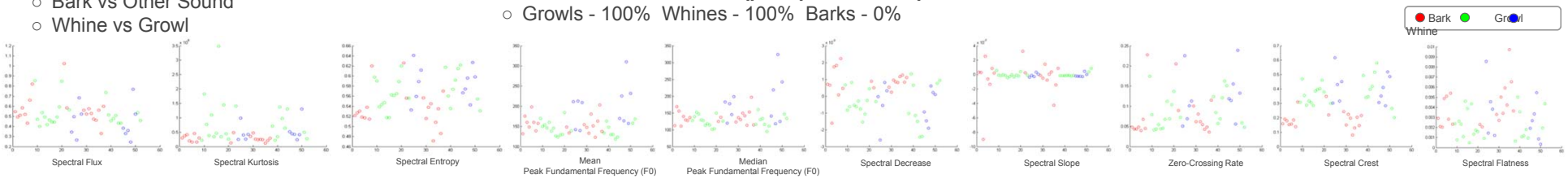
Bark vs Others
- Spectral Centroid
- Spectral Entropy
- Spectral Slope
- Spectral Decrease

Growl vs Whine
- F0 Mean
- F0 Median
- Spectral Centroid
- Spectral Flatness
- Spectral Spread

Large Dog (Low Pitched)

Bark vs Others
- Spectral Centroid
- Spectral Crest
- Spectral Decrease
- Spectral Entropy
- Spectral Flatness
- Zero Crossing Rate

Growl vs Whine
- Spectral Centroid
- F0 Mean
- F0 Median
- Spectral Flux
- Spectral Kurtosis
- Spectral Slope



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