Footstep Classifier

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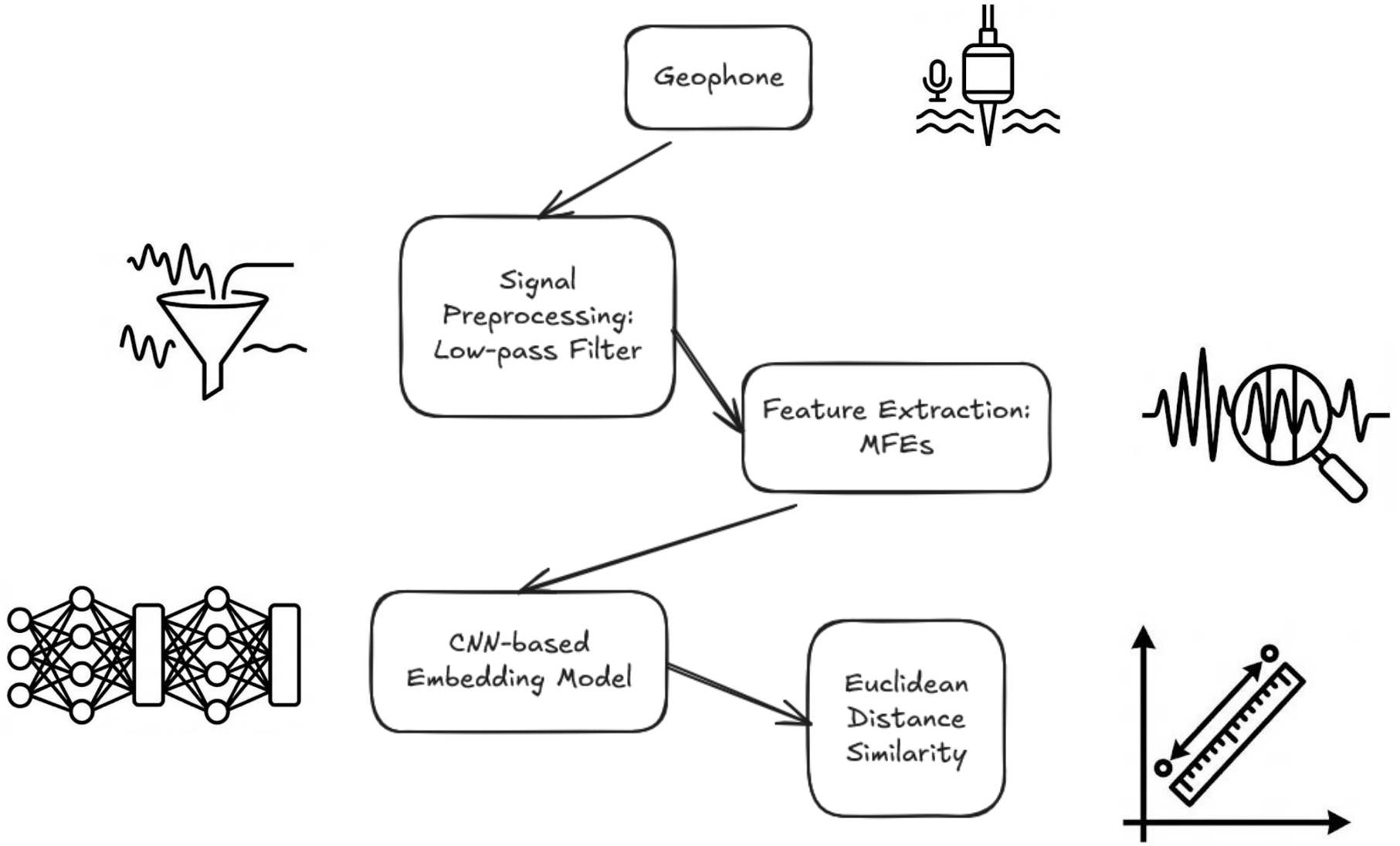
Abstract

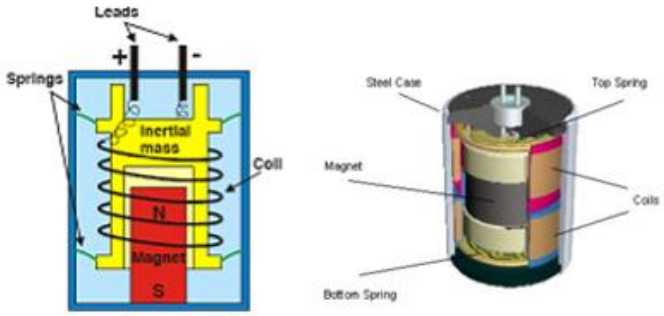
- **Objective:** Using off-body sensors, classify footsteps to identify people
- **Motivation:** Cool
- **Target Use Case:** Security
- **Embedded ML Rationale:** Low cost, low latency, private solution

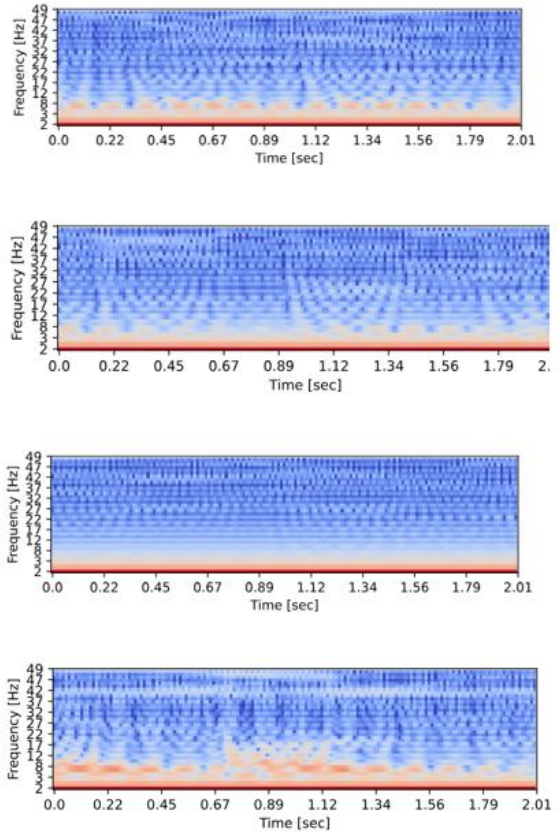
Architecture



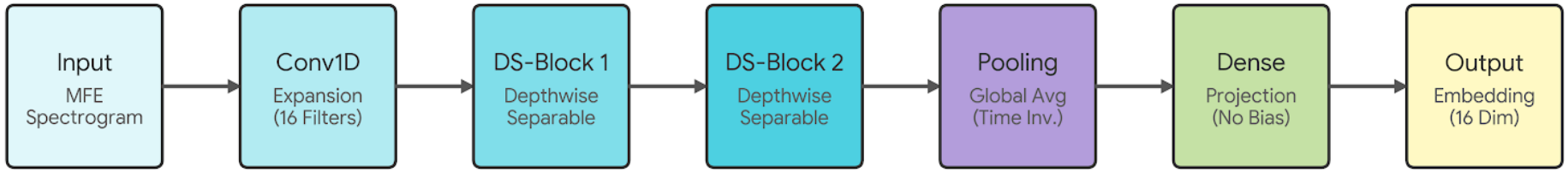
Data Collection

- **Sensor:** Custom geophone
- **Preprocessing:** Mel-filterbank energy features
  - Top-bottom: Andrew, Andy, None, Other

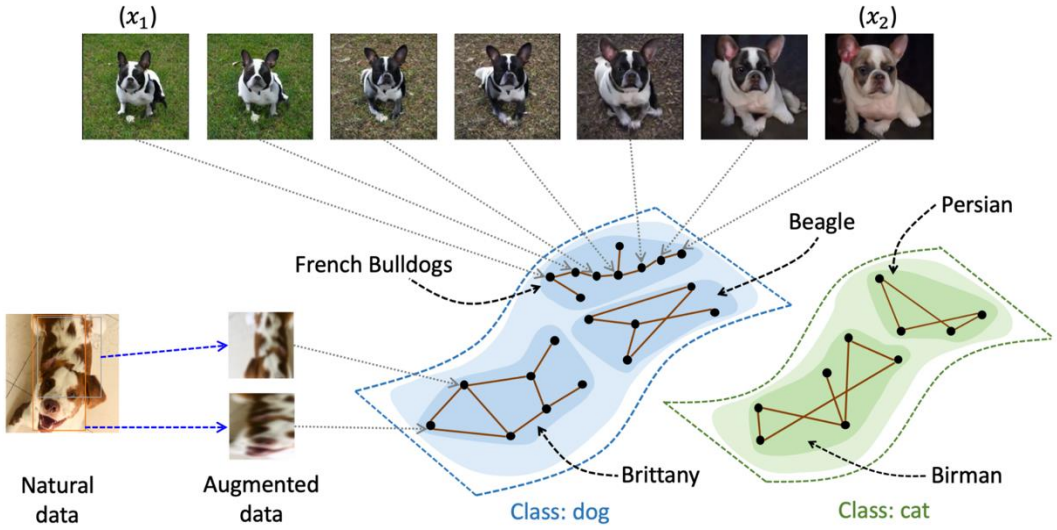


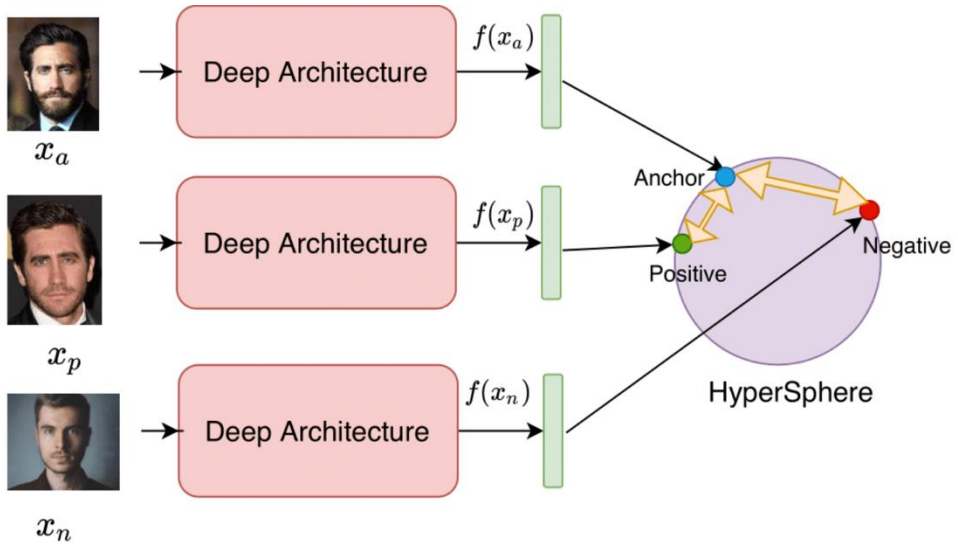


Model



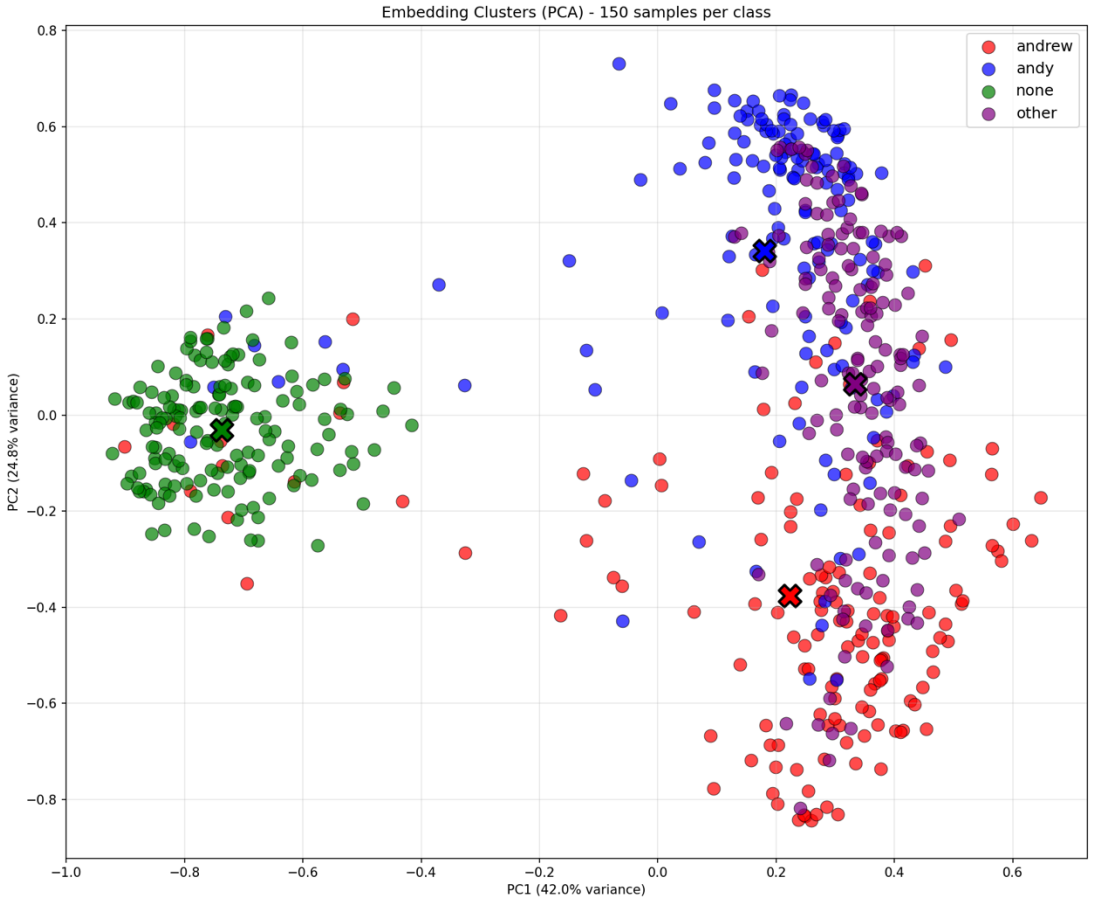
- Uses metric learning to generate embeddings from signal
- Trained using triplet loss

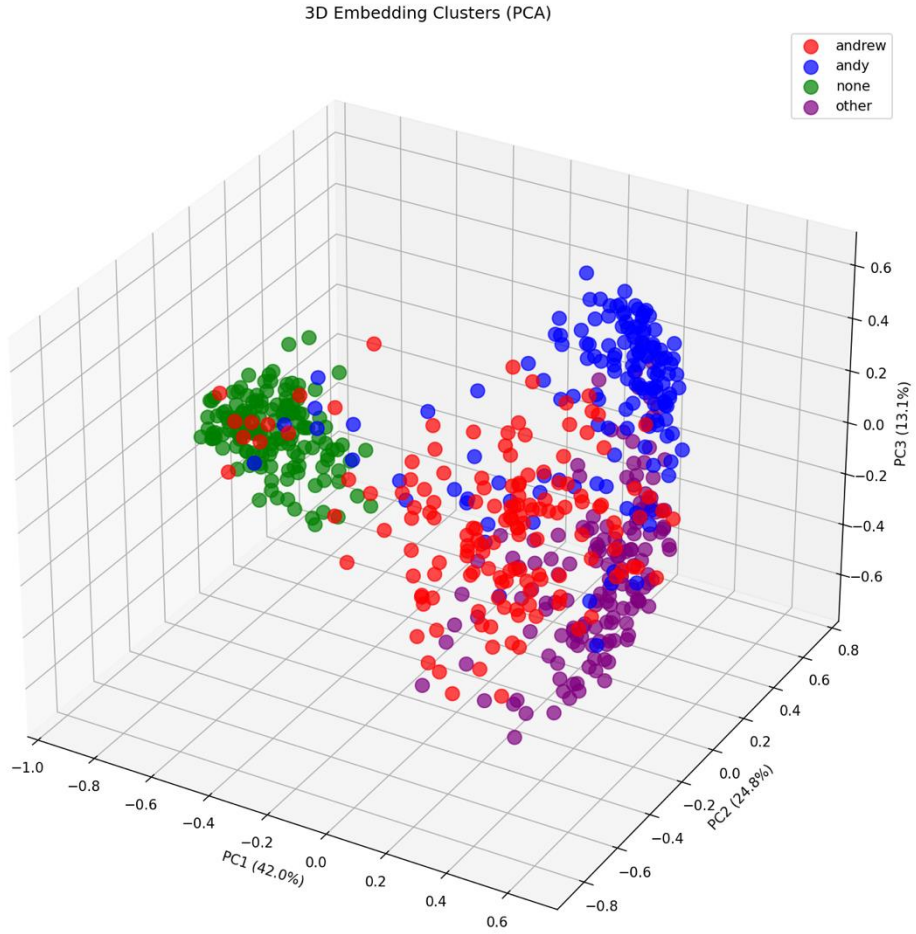




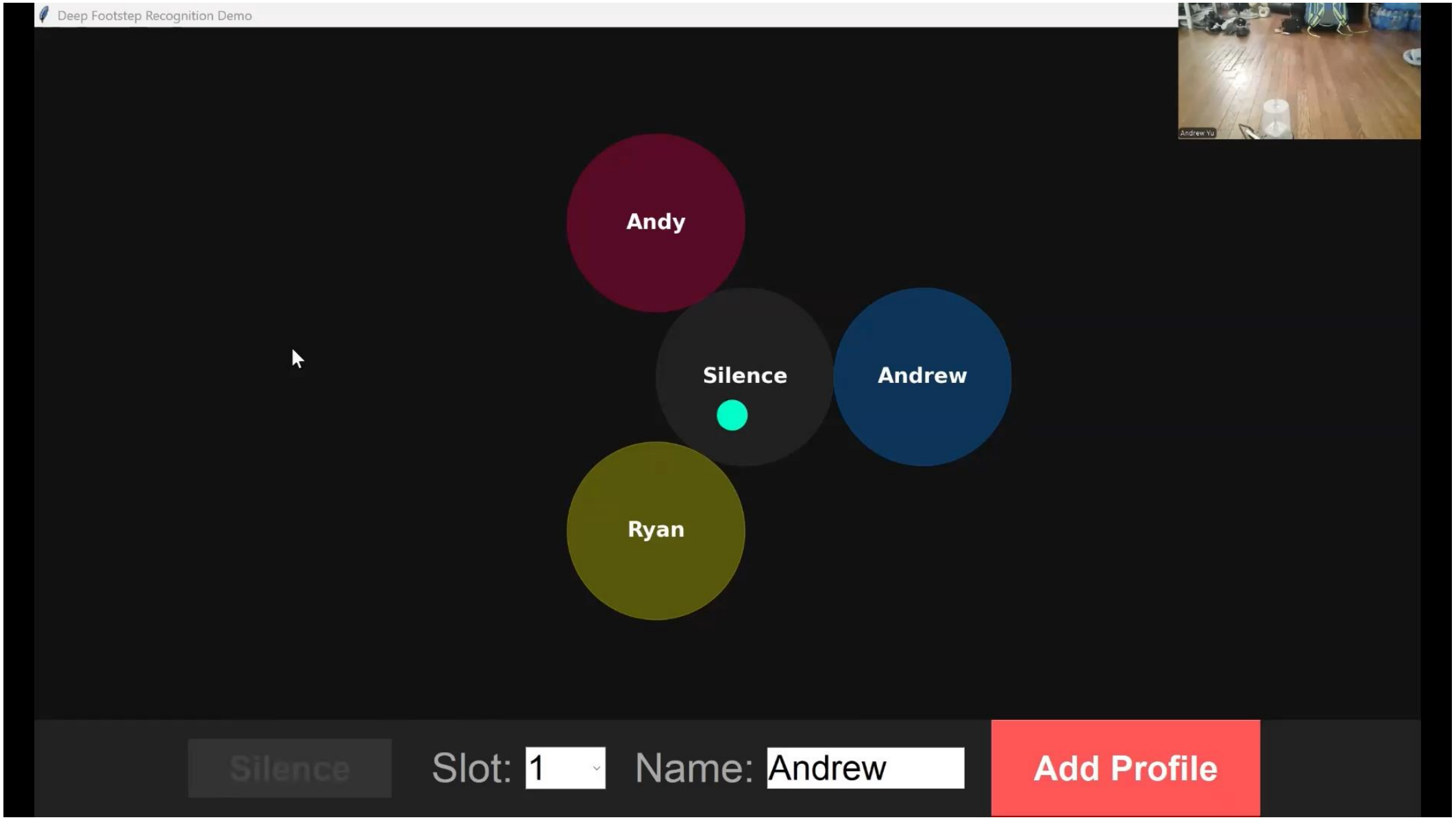
Results

- Strong clustering of None
- Weak clustering of Other

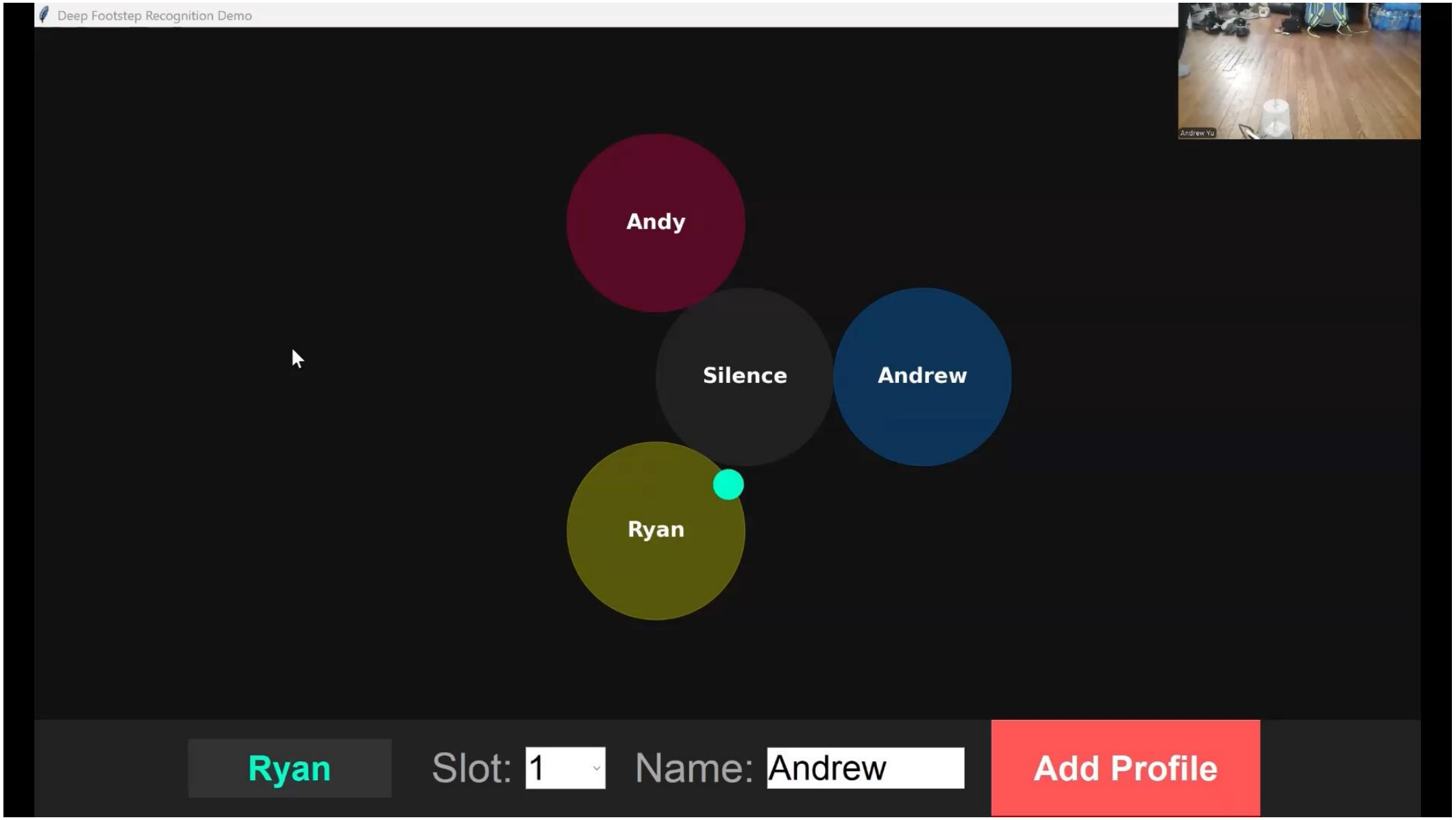




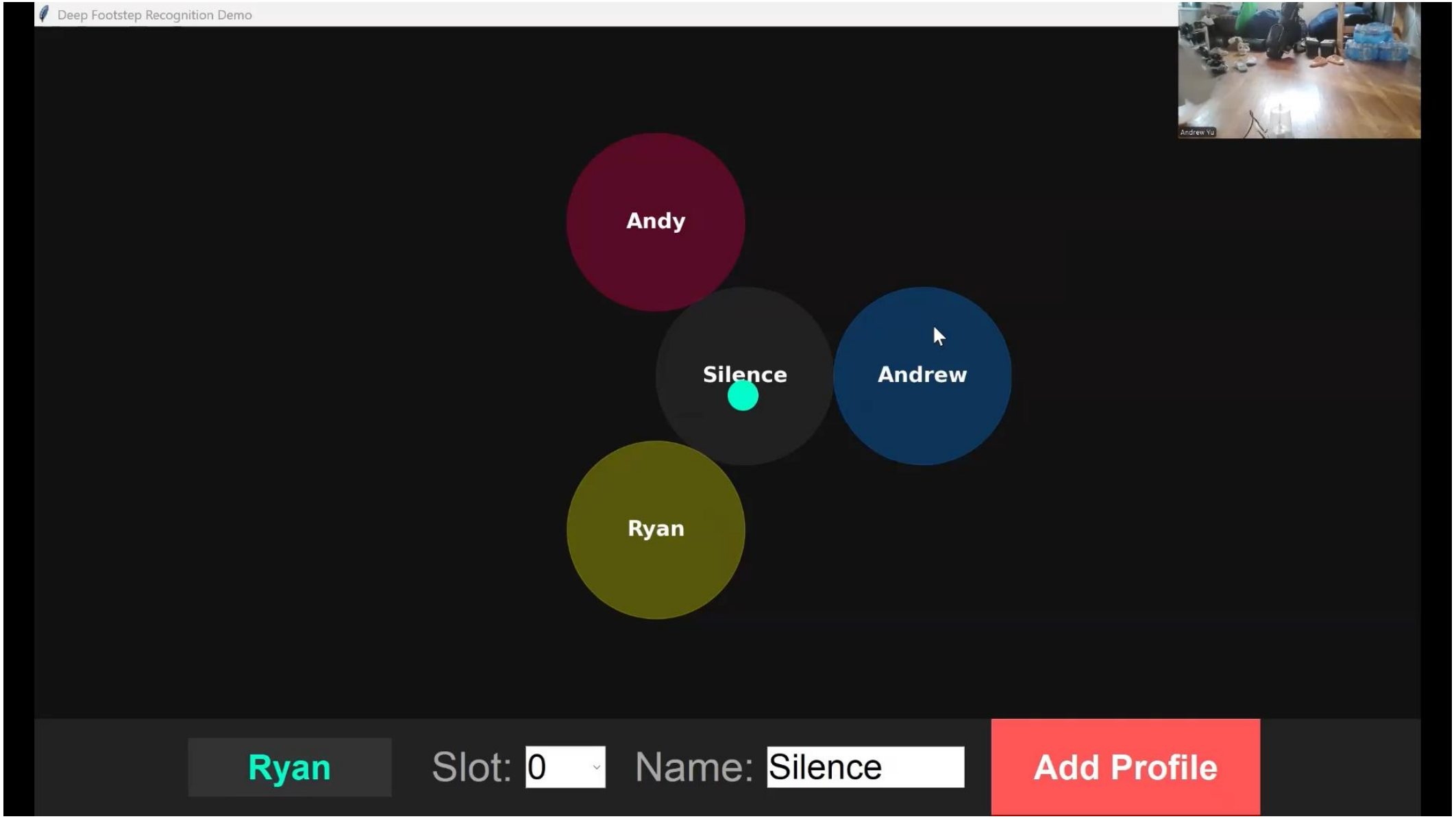
Inference: Andrew (Training Data)



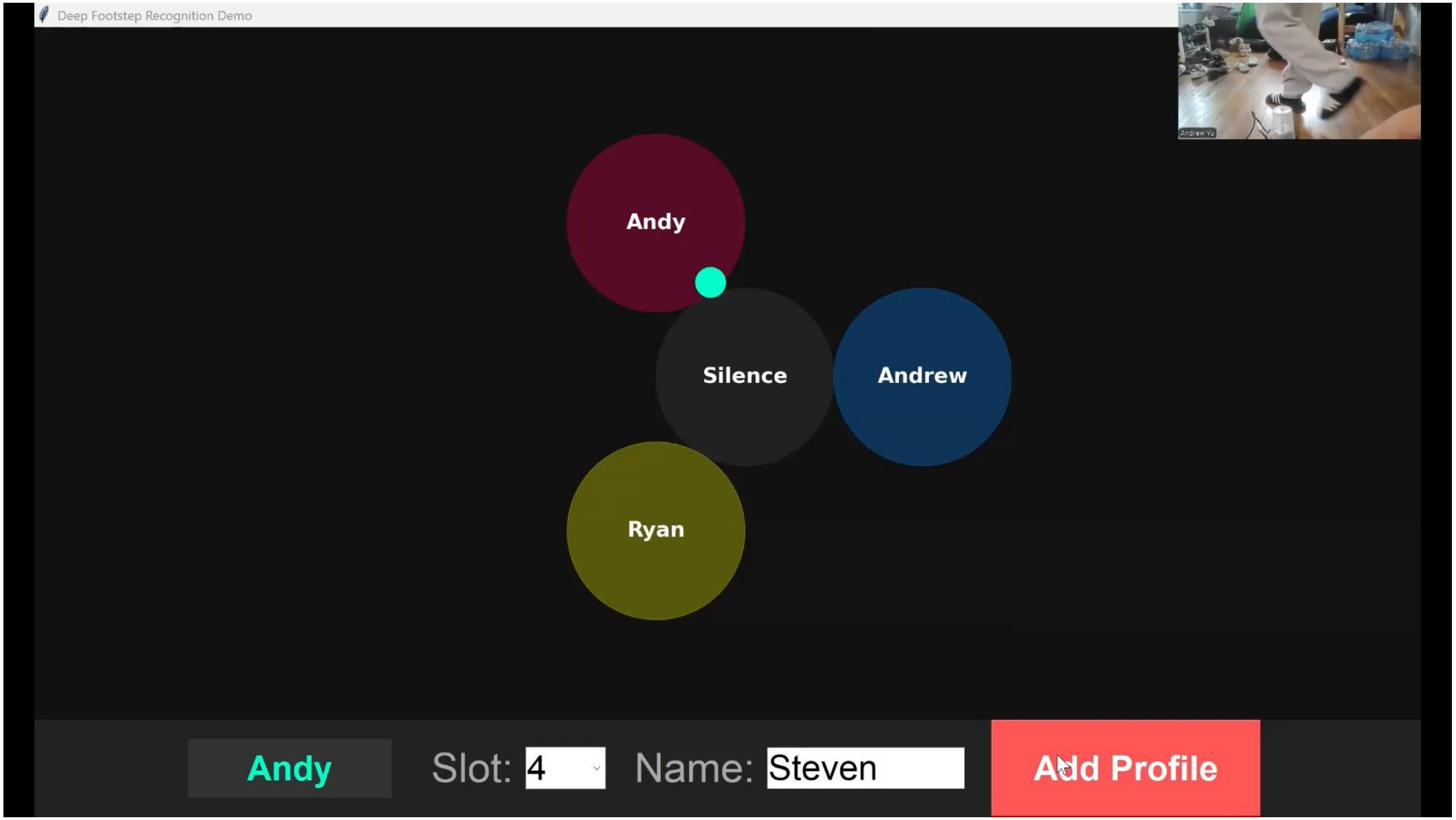
Inference: Ryan (Not Training Data)



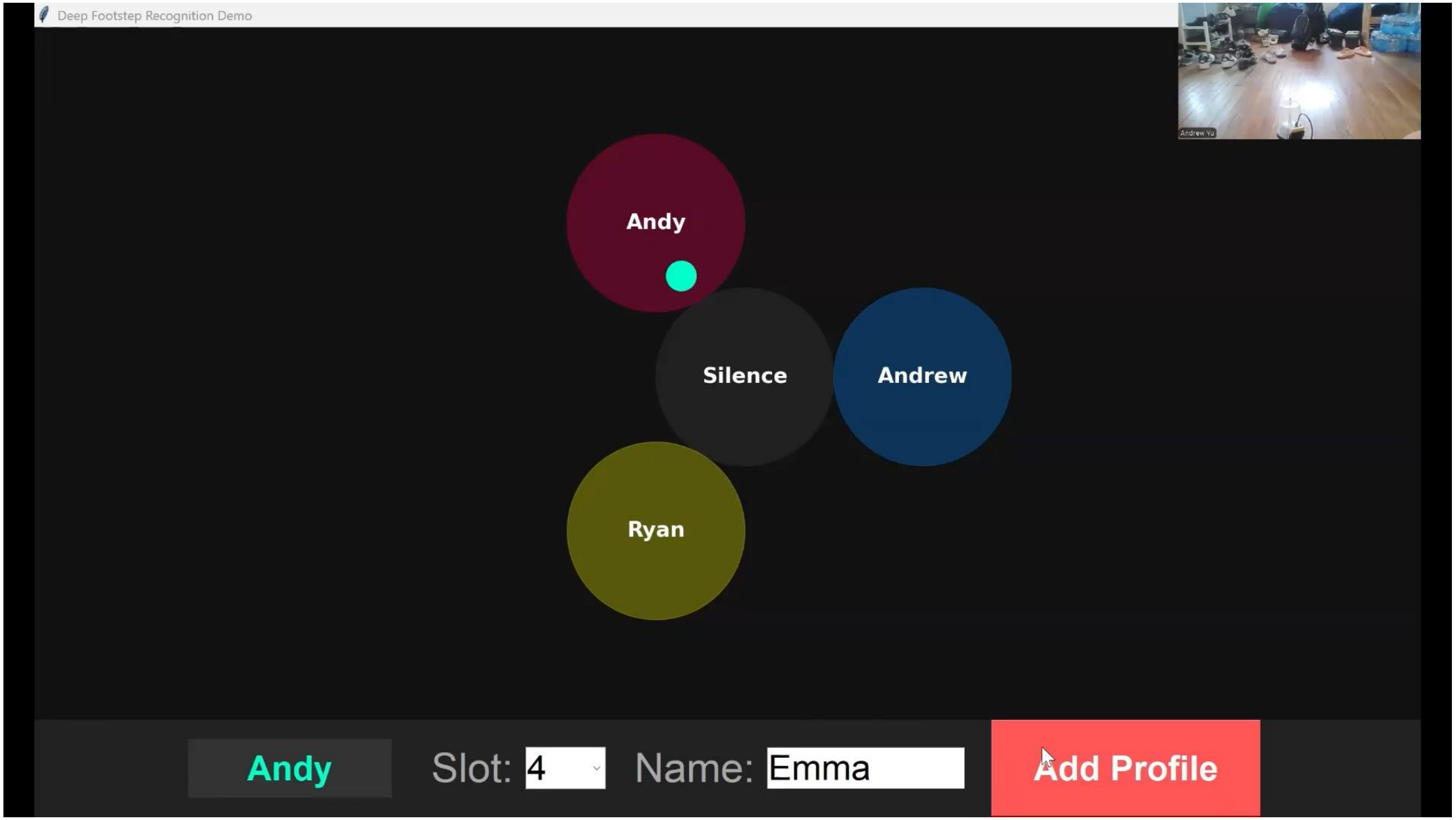
Inference: Andy (Training Data)



Inference: Steven (Not Training Data)



Inference: Emma (Not Training Data)



Challenges

Sensor:

- Originally had piezoelectric disk which had poor sensitivity
- Custom sensor was very experimental

Model:

- Classification struggled to generalize different domains
- Initial embedding model based on ResNet used too much memory
- Clustering isn’t super strong