# Continuous Facial Expression Recognition for Affective Interaction with Virtual Avatar

Zhengkun Shang, Jyoti Joshi, Jesse Hoey

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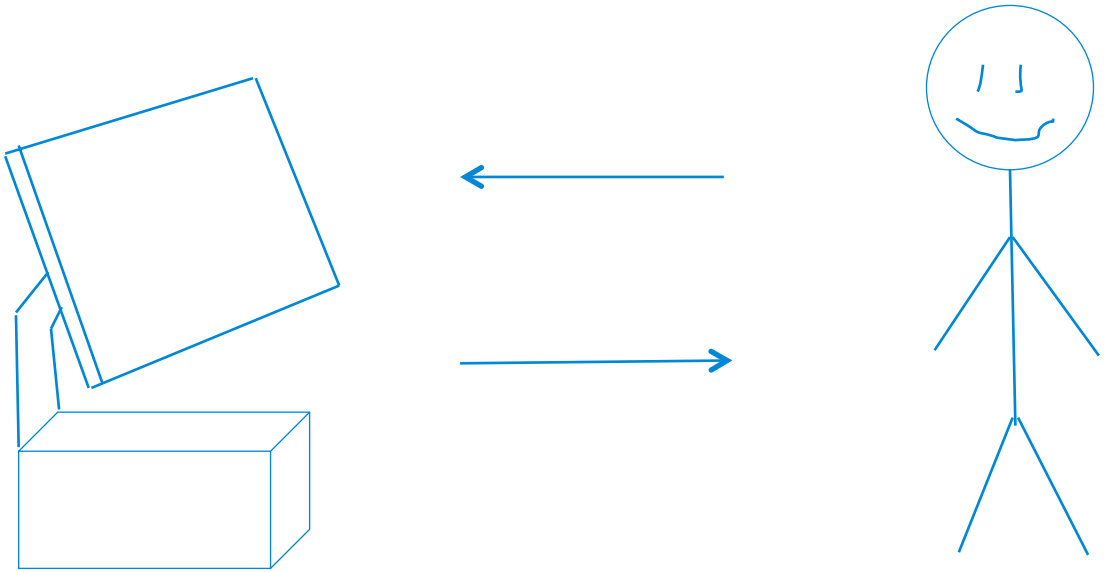
# MOTIVATION



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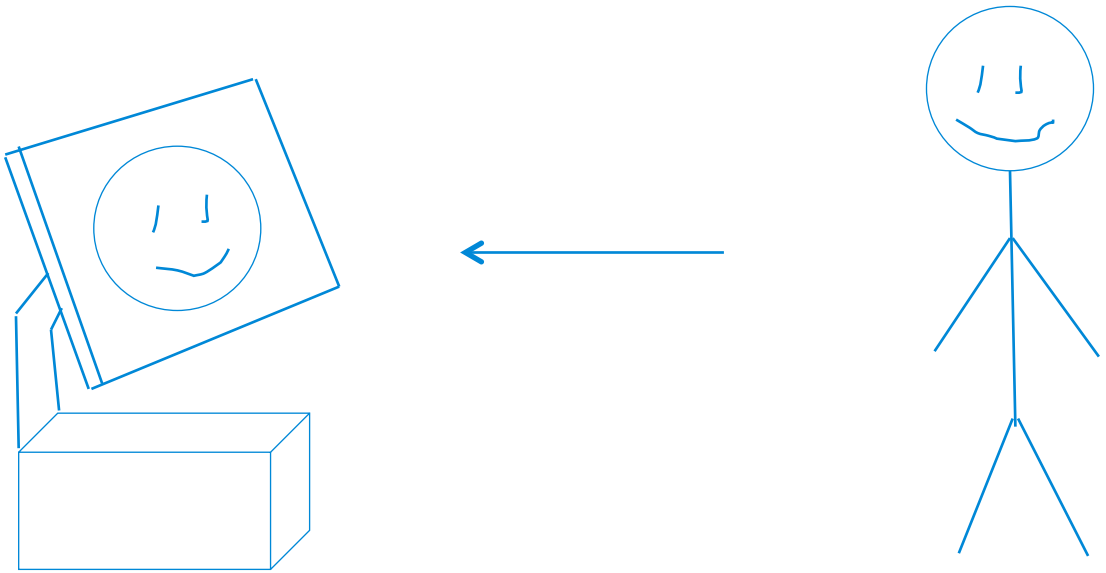

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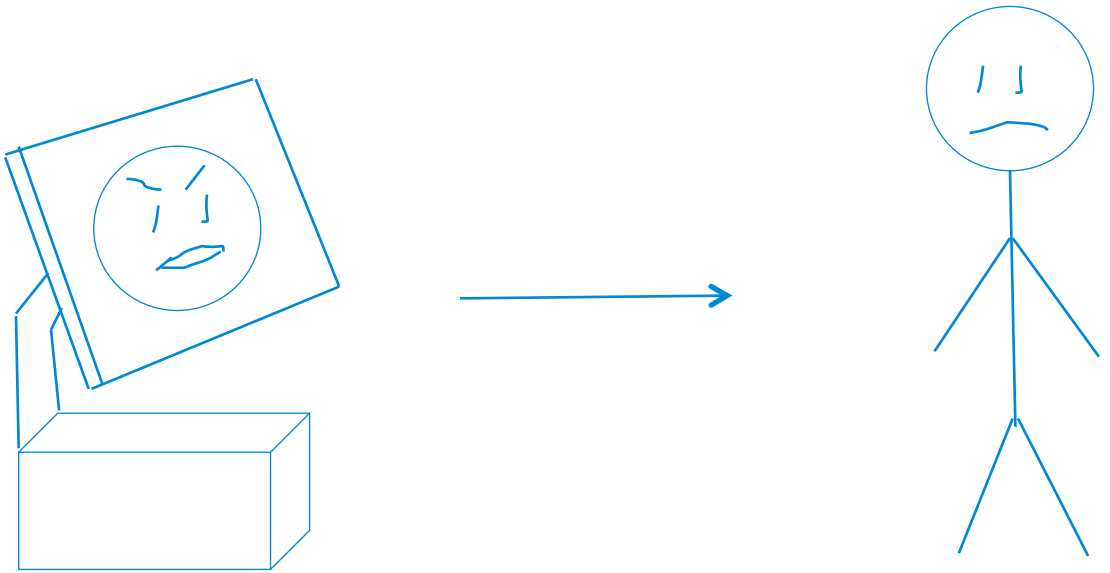


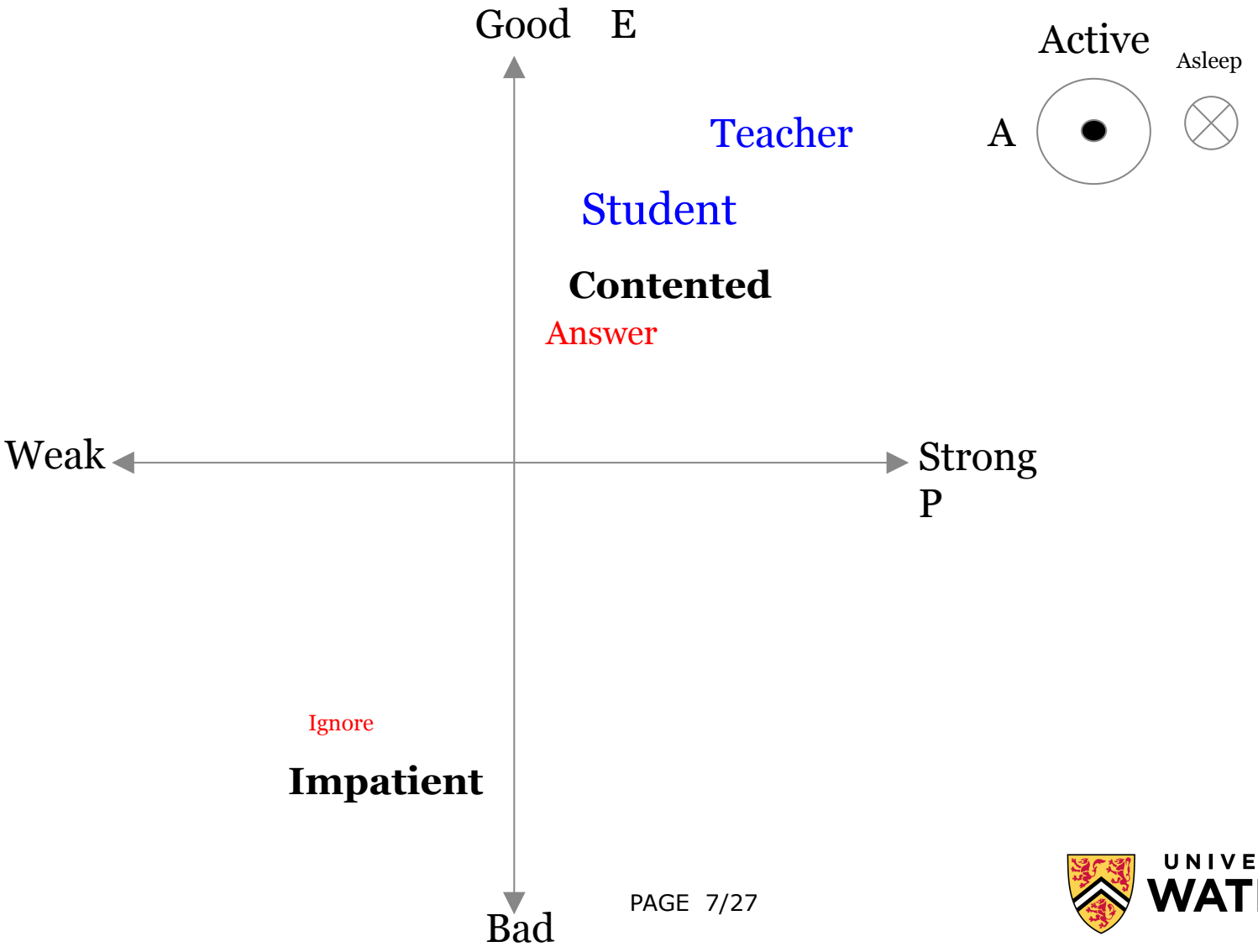
# What We Did?

- Estimated emotion in 3D continuous space from different features of facial expressions
- Used a probabilistic framework to simulate the interaction of a user and behavior-styled avatars

# Affect Control Theory - EPA Space

- Evaluation: how positive
- Potency: how powerful
- Activity: how active

# Affect Control Theory - EPA Space



# BayesACT

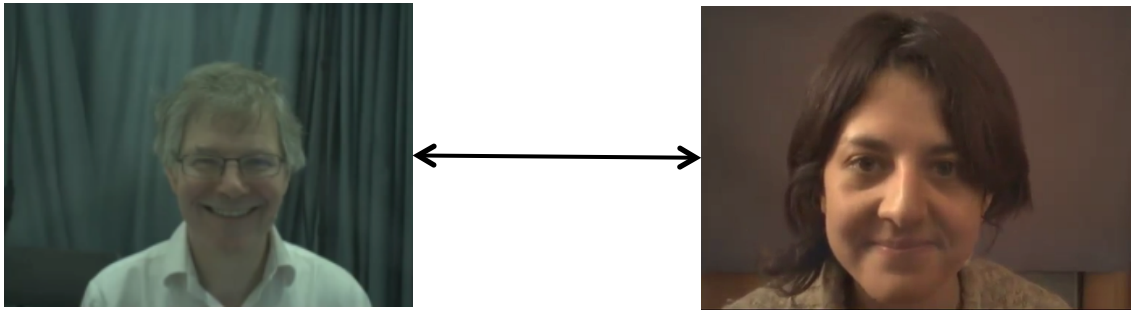
- A generalization of Affect Control Theory
  - keeps multiple hypothesis about both identities and behaviors as a probability distribution
- A sequential Bayesian model
  - estimates and updates variables over time from actions and observations

More information on BayesACT can be found at bayesact.ca

# Dataset

**Semaine Database** provides annotations for 93 videos

- Valence (Evaluation)
- Power (Potency)
- Arousal (Activity)

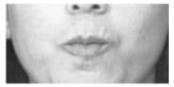
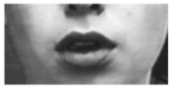


Avatar
(Happy/Sad/Sensible/Angry)

User

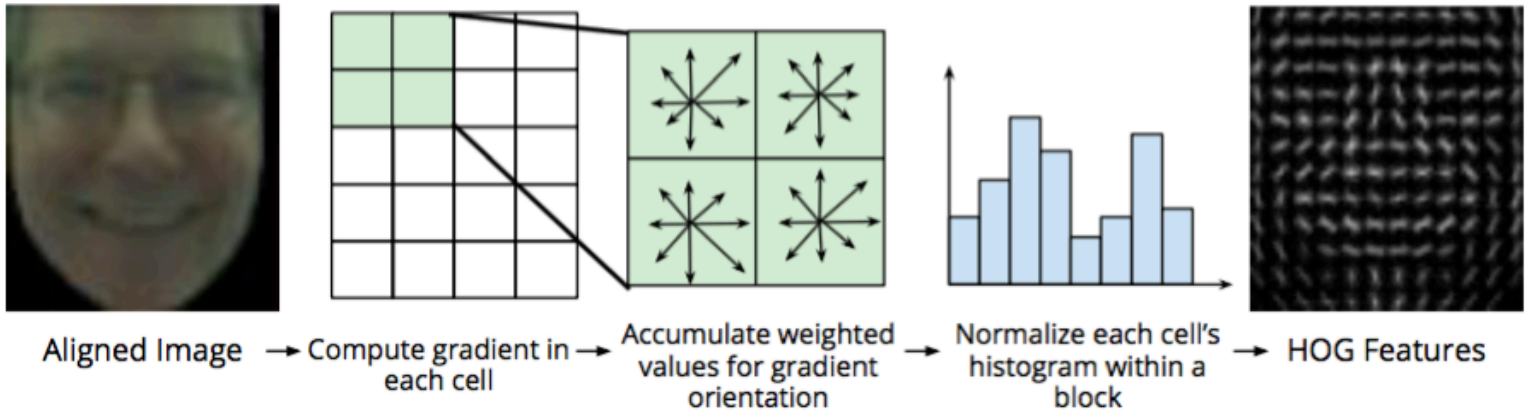
# Features

- Action Units
- Histogram of Oriented Gradient (HOG)
- Felzenszwalb's HOG (FHOG)

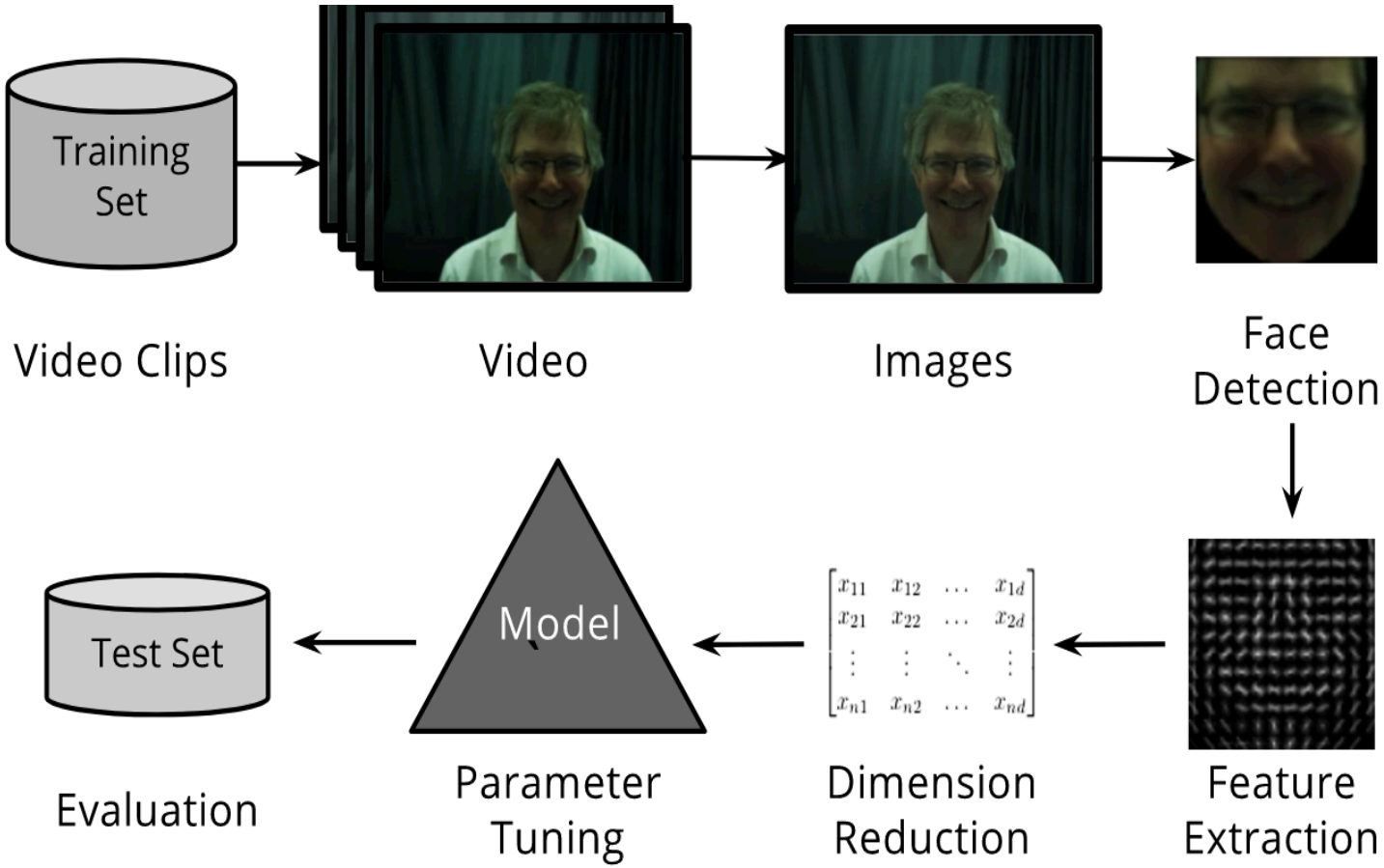
| | | | | |
|---|---|---|---|---|
| AU1  Inner Brow Raiser | AU2  Outer Brow Raiser | AU4  Brow Lowerer | AU5  Upper Lid Raiser | AU6  Cheek Raiser |
| AU7  Lid Tightener | AU9  Nose Wrinkler | AU10  Upper Lip Raiser | AU12  Lip Corner Puller | AU14  Dimpler |
| AU15  Lip Corner Depressor | AU17  Chin Raiser | AU20  Lip Stretcher | AU23  Lip Tightener | AU25  Lips Part |
| AU26  Jaw Drop | AU45  Blink | | | |

# Features

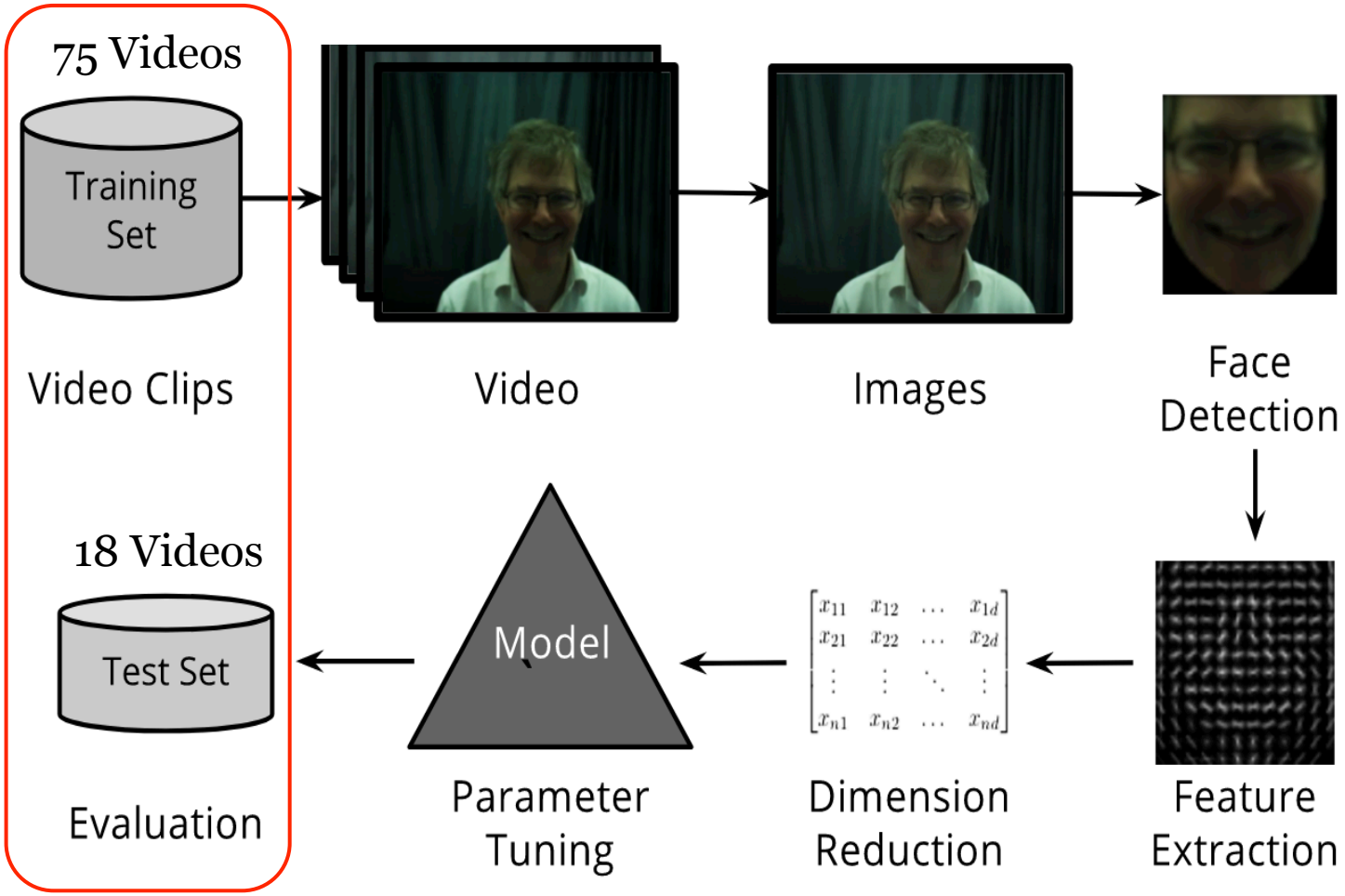
- Action Units
- Histogram of Oriented Gradient (HOG)
- Felzenszwalb's HOG (FHOG)



# Procedures



# Step 1: Split videos to training set and test set



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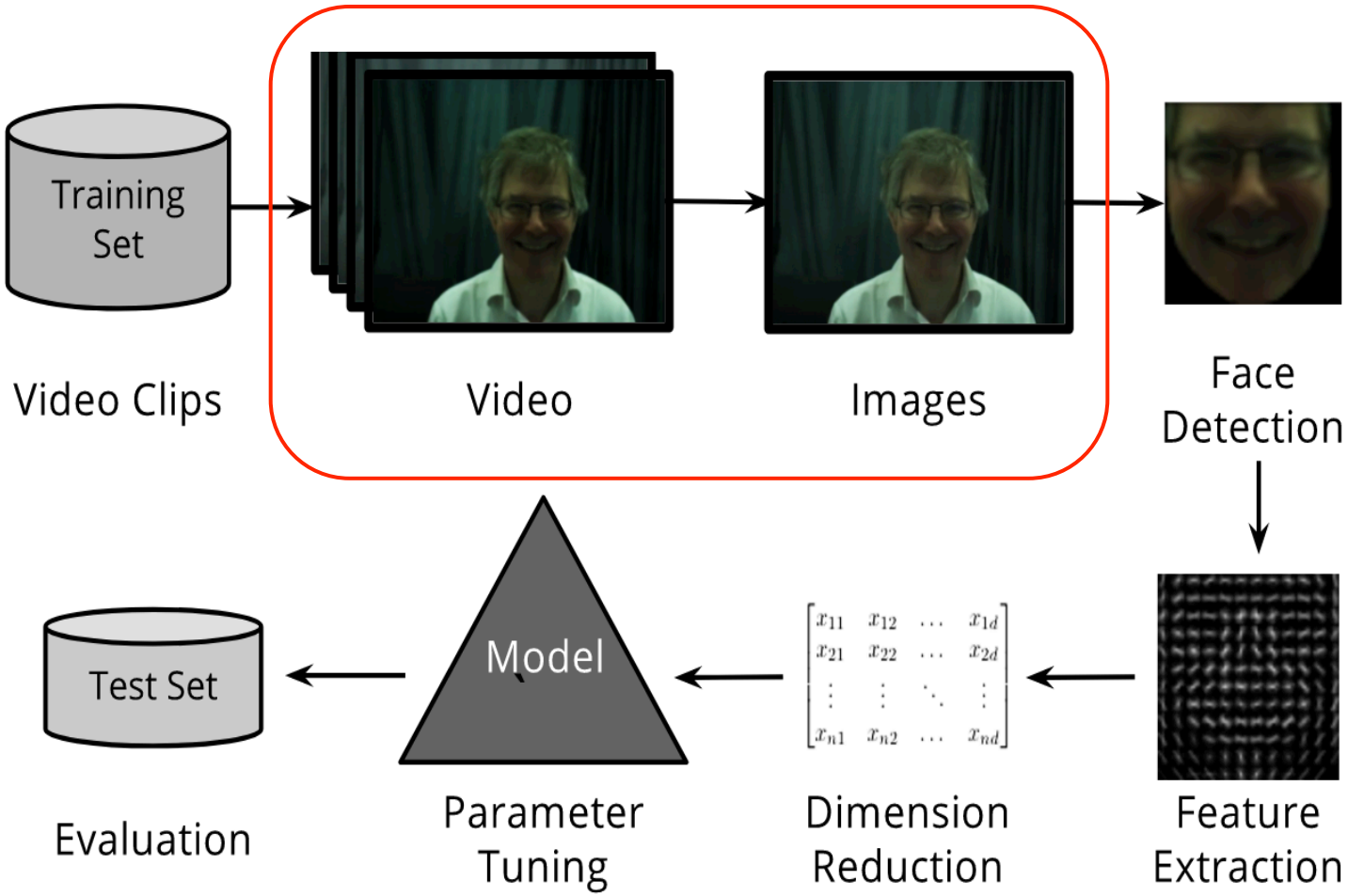
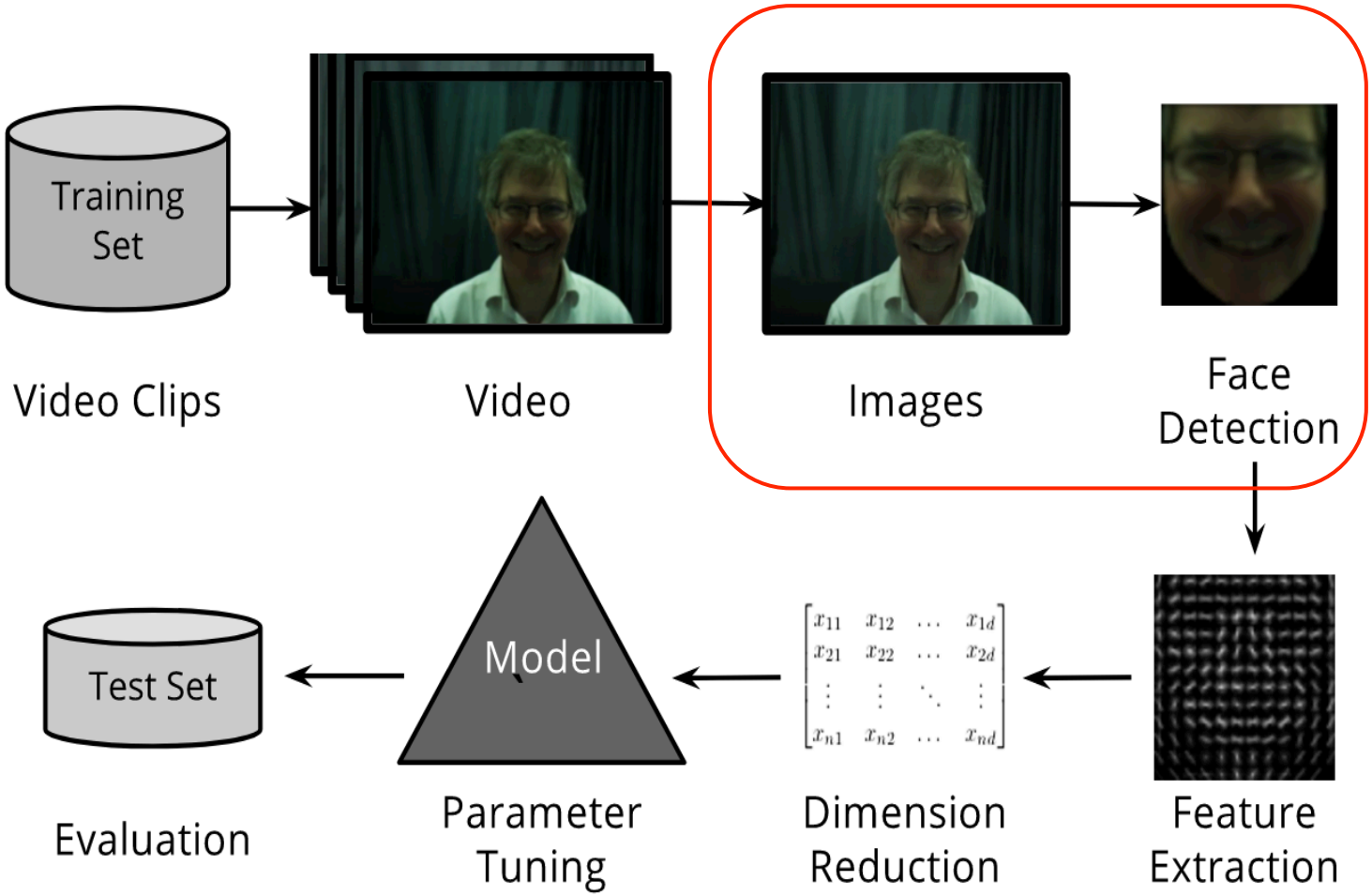
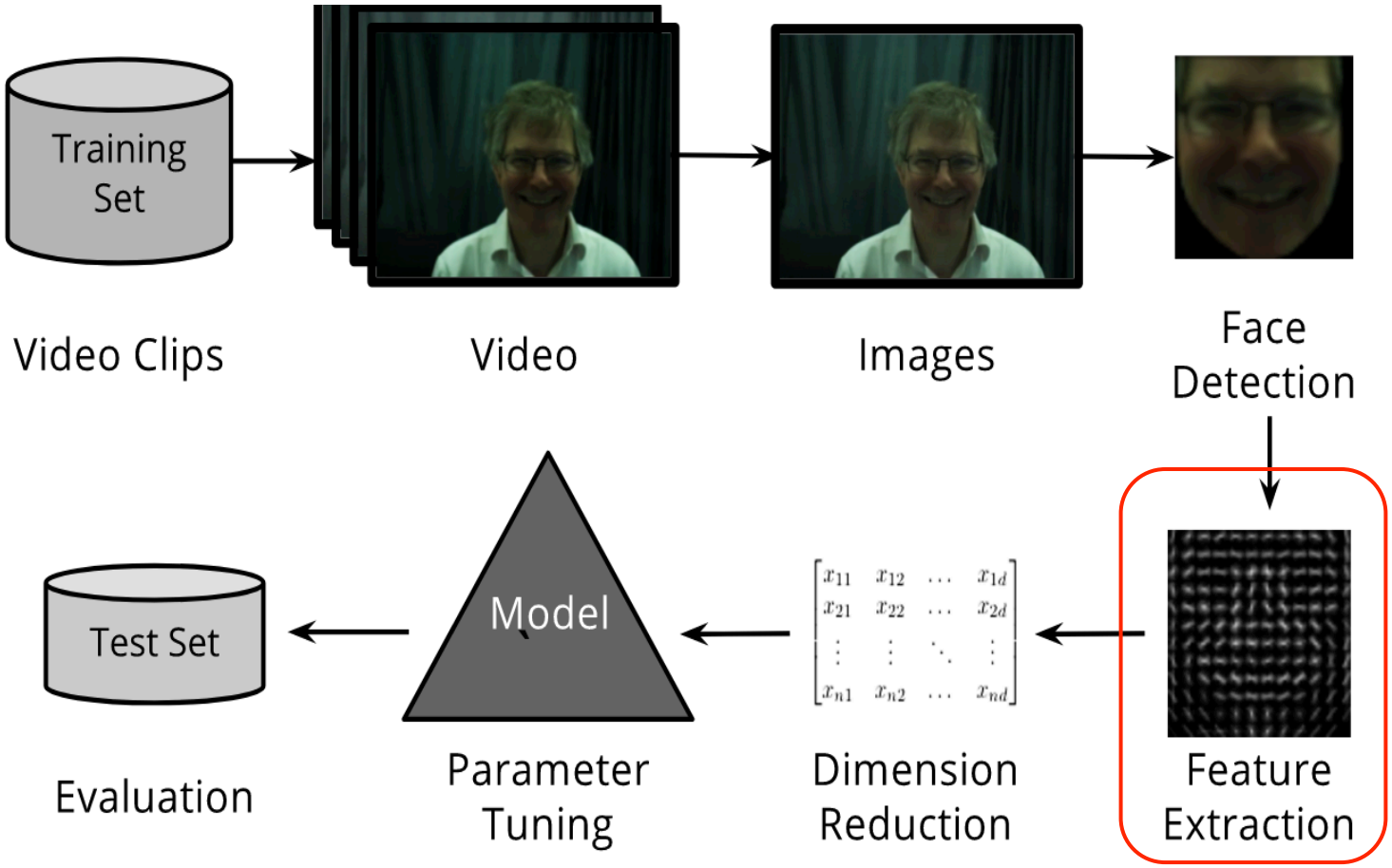
# Step 2: Downsample images



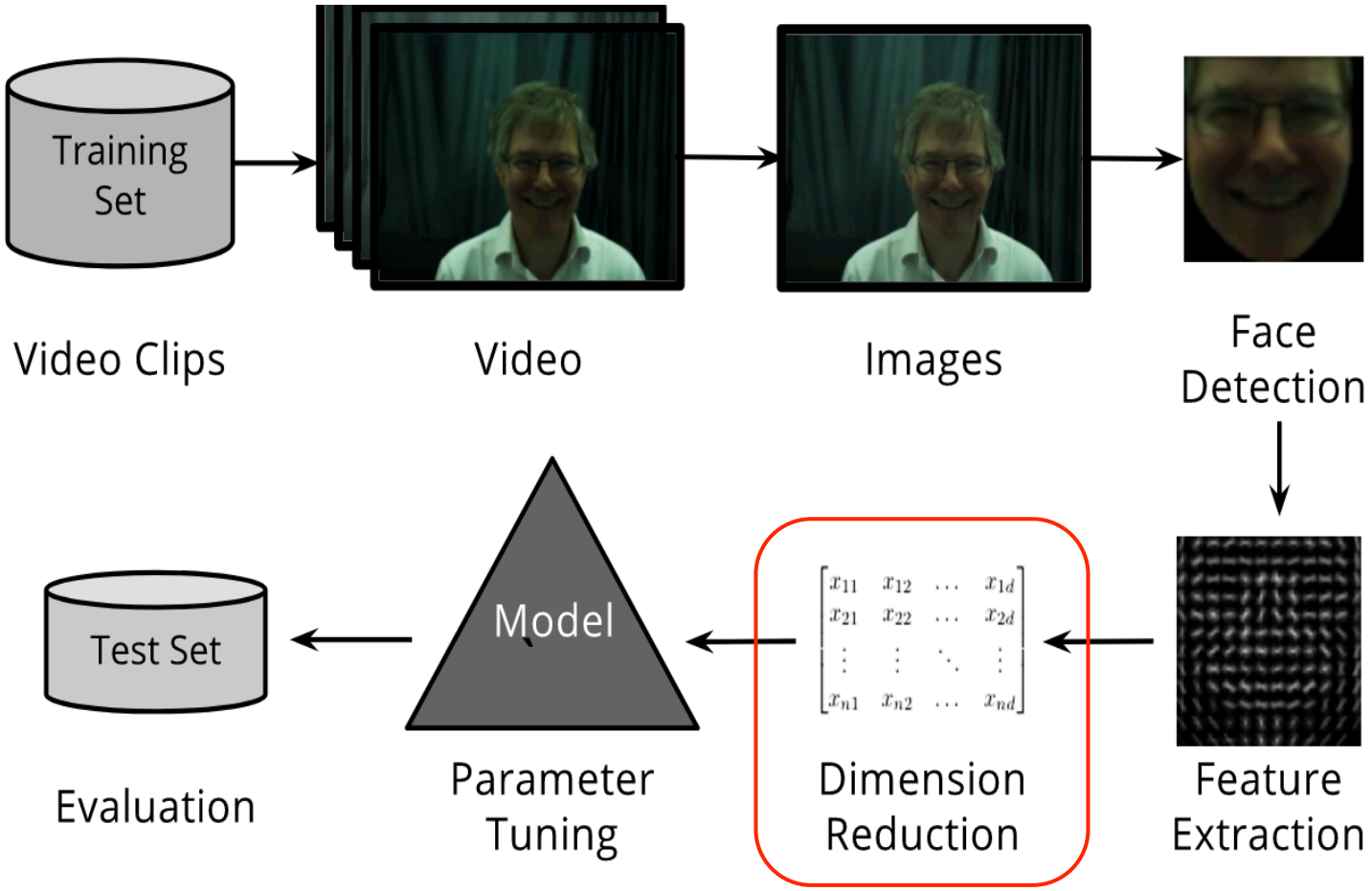
# Step 3: Get aligned face from each image



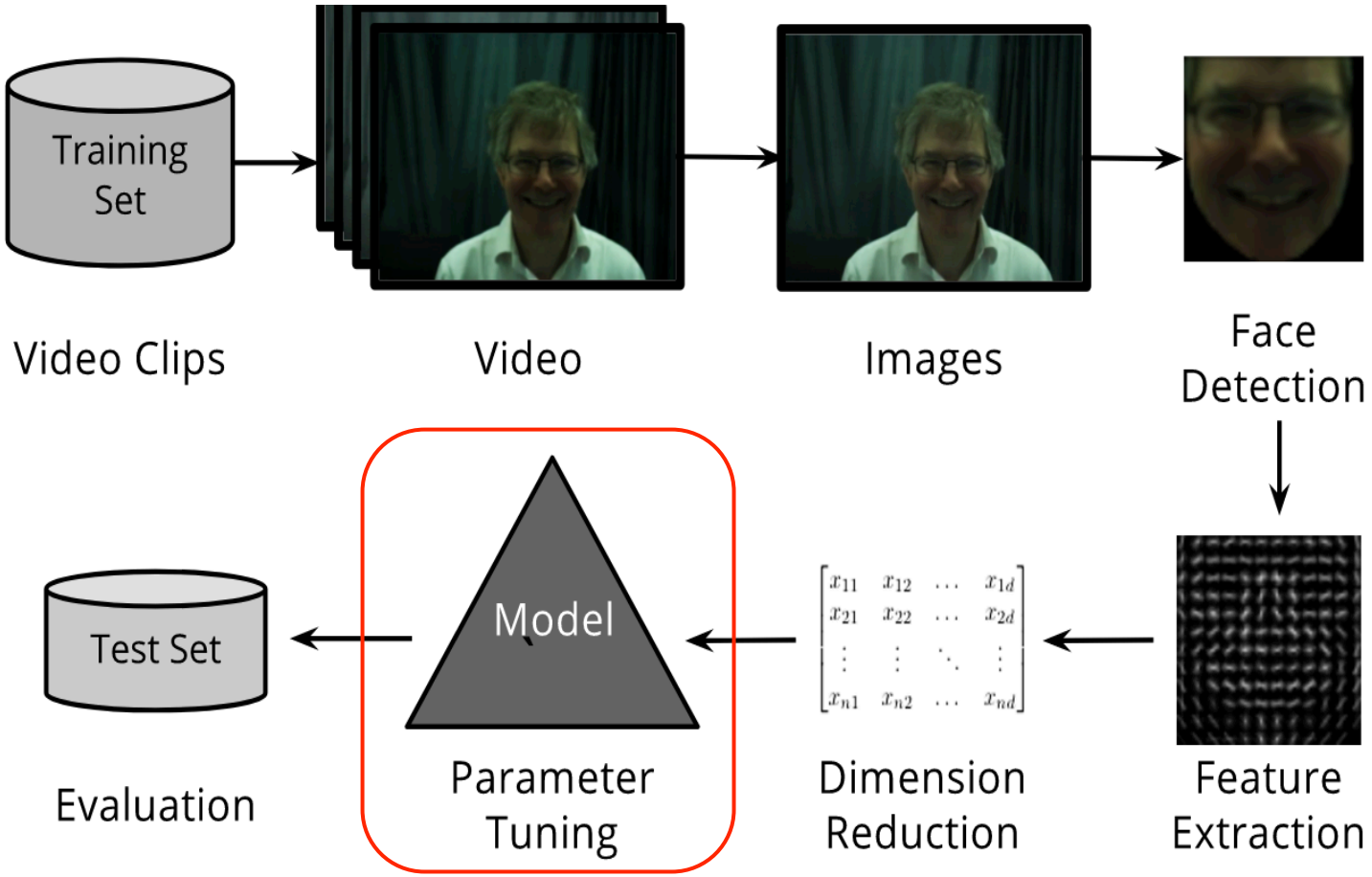
# Step 4: Extract three feature descriptors



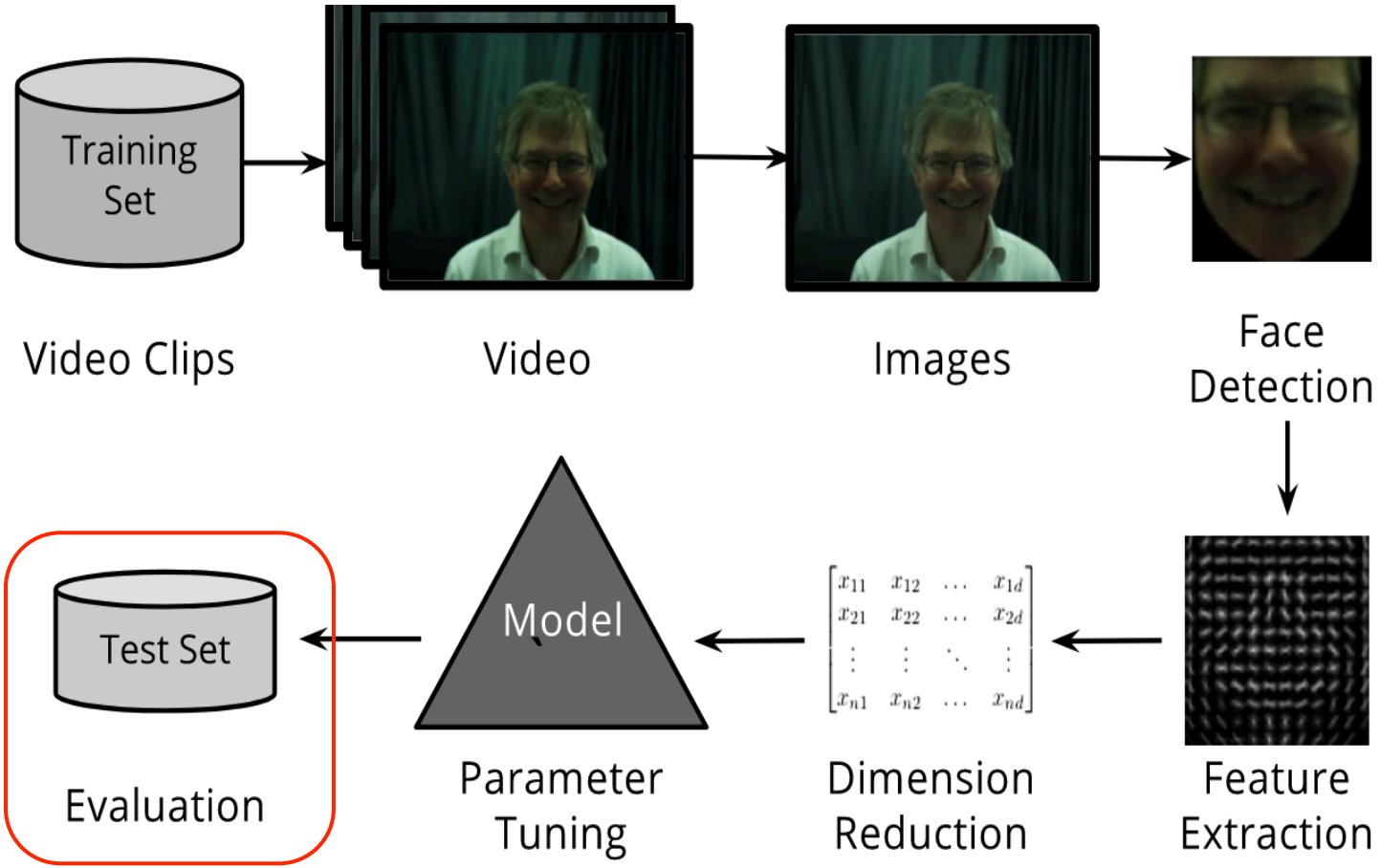
# Step 5: Reduce dimensions with PCA



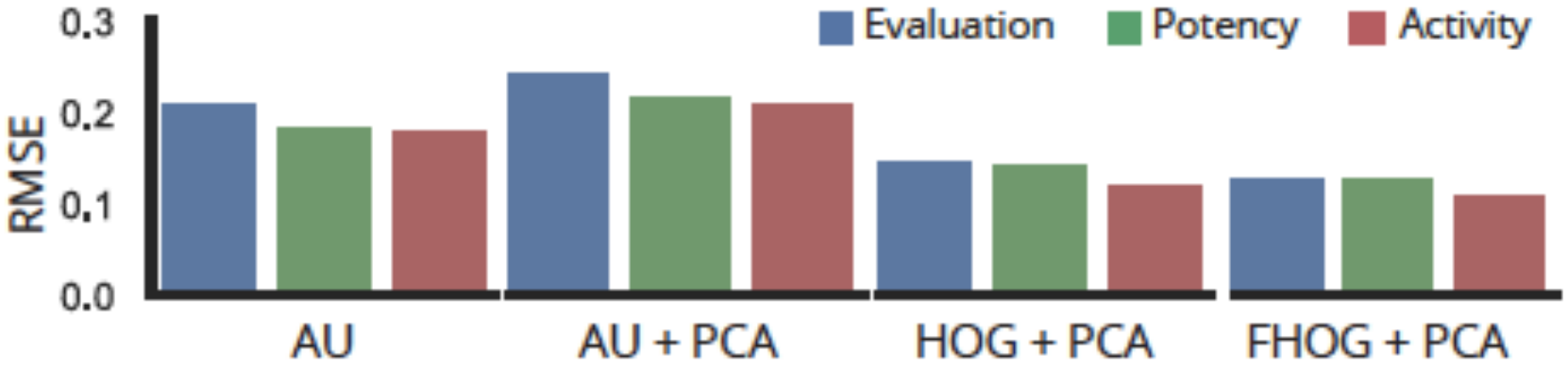
# Step 6: Train EPA models



# Step 7: Evaluate in the test set



# Results



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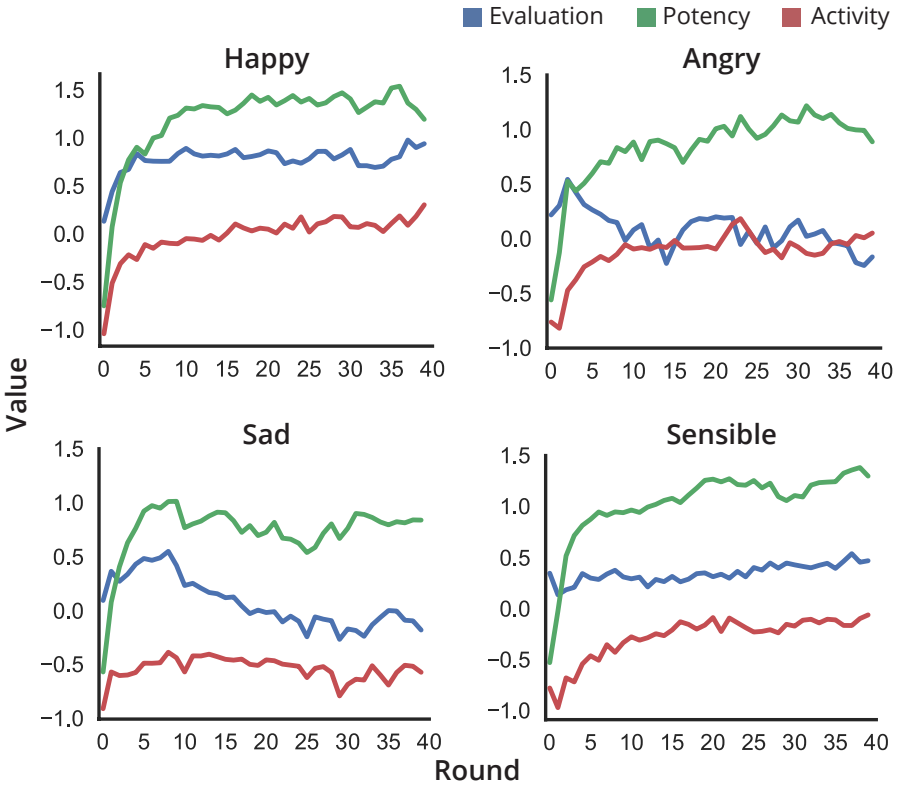
# BayesACT Simulations

- Input:
  - Actor/Object: user, avatar as “student”
  - Action: “talk to”
  - User’s emotion: facial EPA values
- Output:
  - user / avatar’s emotion in both EPA values and labels
- 40 rounds with values at every five seconds in the 18 test videos

# BayesACT Simulations - Emotion Changes

## Avatar's posterior estimate of user's emotion



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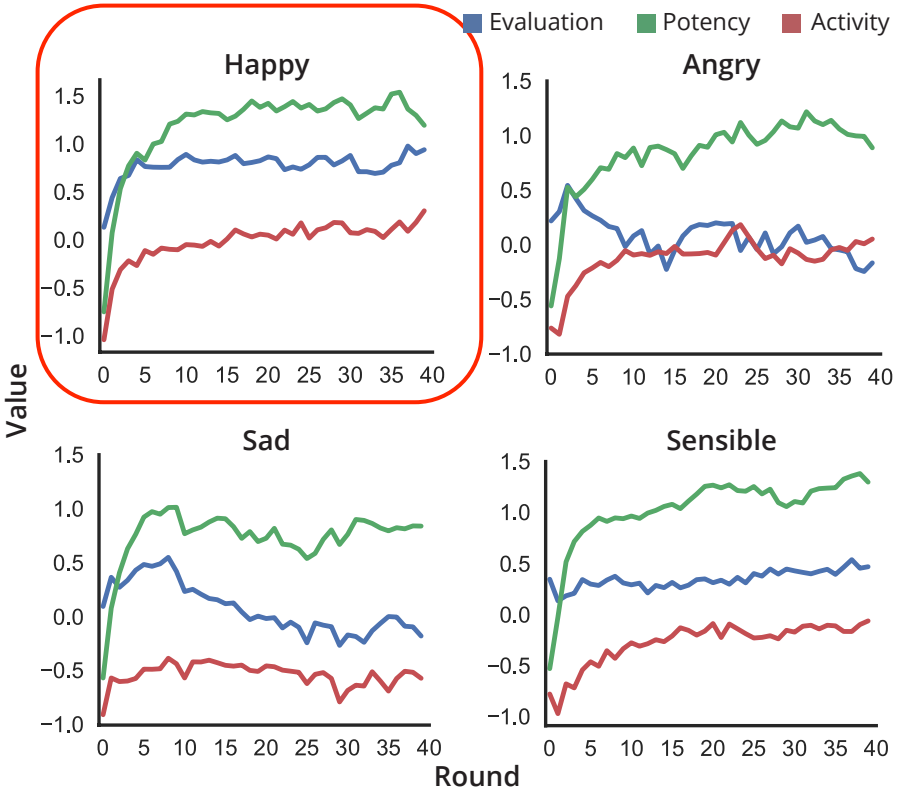




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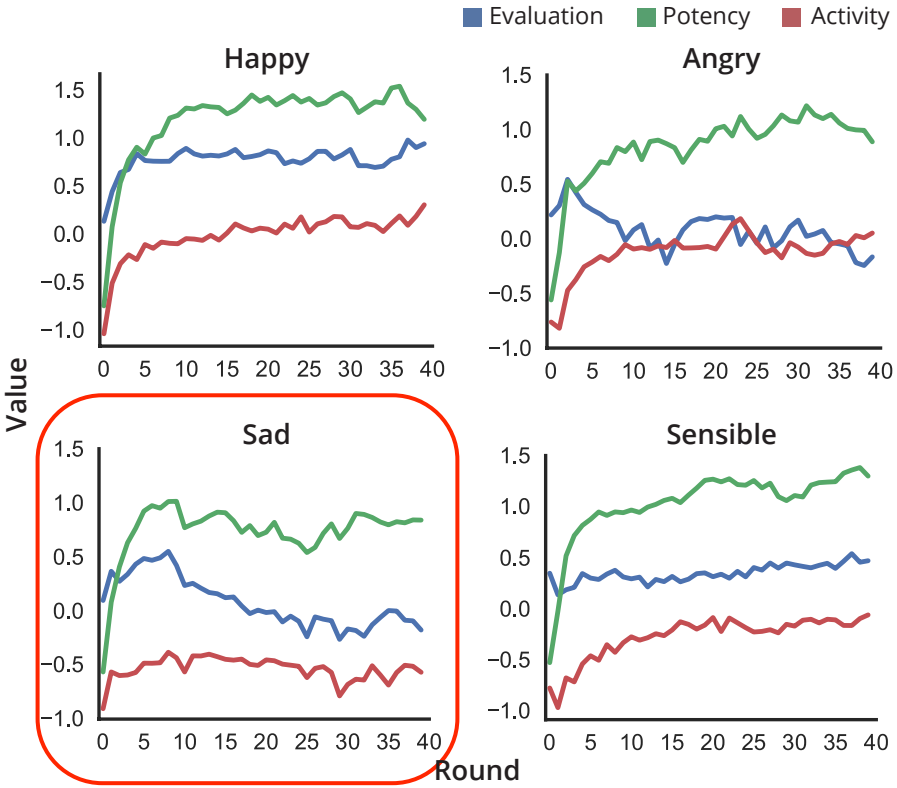




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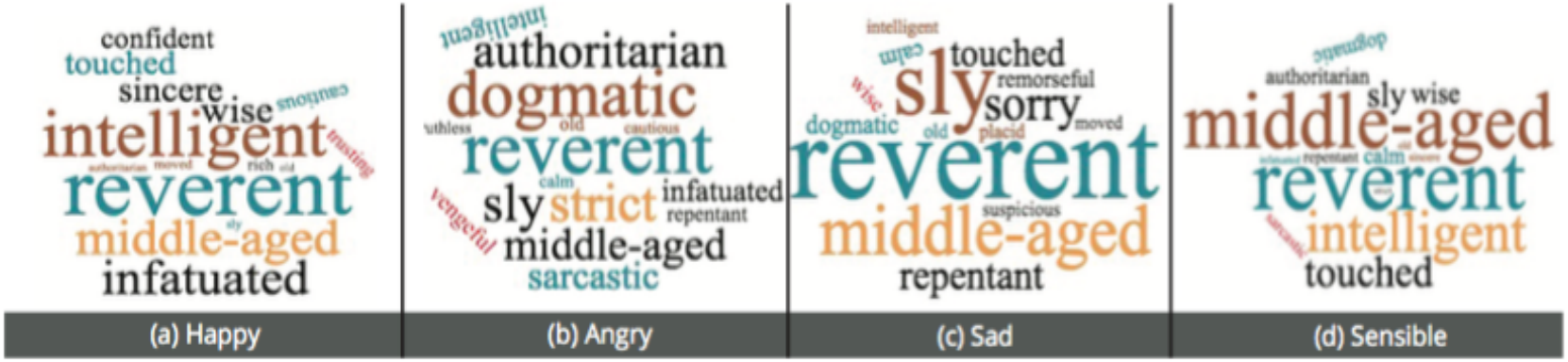
# BayesACT Simulations - Word Clouds

Top 15 labels that describe the user's feeling when talking to different emotional avatars



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# Conclusion

- Create an automatic affect recognizer that continuously predicts user emotions in the EPA space
- Demonstrate the feasibility of using BayesACT to simulate interactions between a user and distinct behavior-styled avatars

# Thank you!

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