The UT Austin Villa Home Assistant Robot

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Distinguishing Features

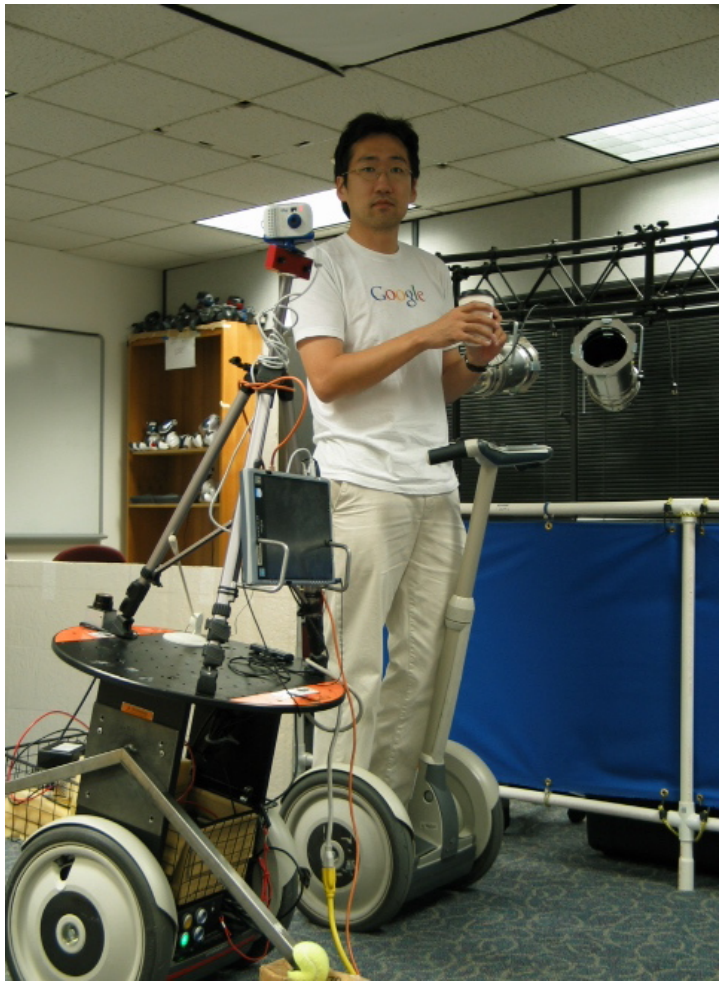
- Two-wheeled mobility
- Focus on person recognition
  - Person identification critical for human-robot interaction

Two-Wheeled Mobility

- Segway Robotic Mobility Platform
  - Self-balancing 2-wheeled robot
  - USB interface
    - receives motion commands to turn (in rad/sec) and go forward or back (m/sec)
    - communicates odometry and pitch information

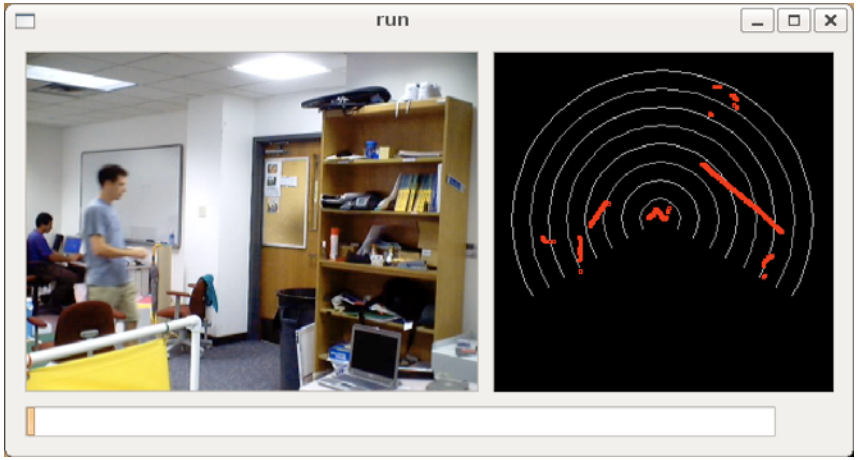
The Segway

- Versatile mobility
  - Rugged traversability
  - Circular footprint: 32 cm radius
- Safety
  - Human Segway rigorously safety tested
  - RMP has similar safety features
    - Auto shut-off
    - Emergency kill rope
    - Limited speed



Added Components

- Hybrid sensing
  - Laser Range Finder: Hokuyo URG-04LX
  - USB Webcam
  - Stereo Camera from Videre Design



- Auxiliary battery power, speakers, and microphone
- Tablet PC (1.2 GHz Intel Pentium M CPU)
  - Human-friendly stylus interfaces

Face Recognition

- Challenge for mobile robotics
  - Changing perspectives
  - Uncontrolled illumination
  - Camera in motion
  - Quick identification with limited computation
- Who Is Who task – top scorer
  - Robot meets and later recognizes 4 people

Training

- 50 sample face images (< 30 seconds)
- Training Steps
  1. Face detection [Viola and Jones 1992]
     - Bounding box is placed around face in image
  2. SIFT feature extraction [Lowe 2004]
  3. Facial feature set created
     - common features retained

Recognition

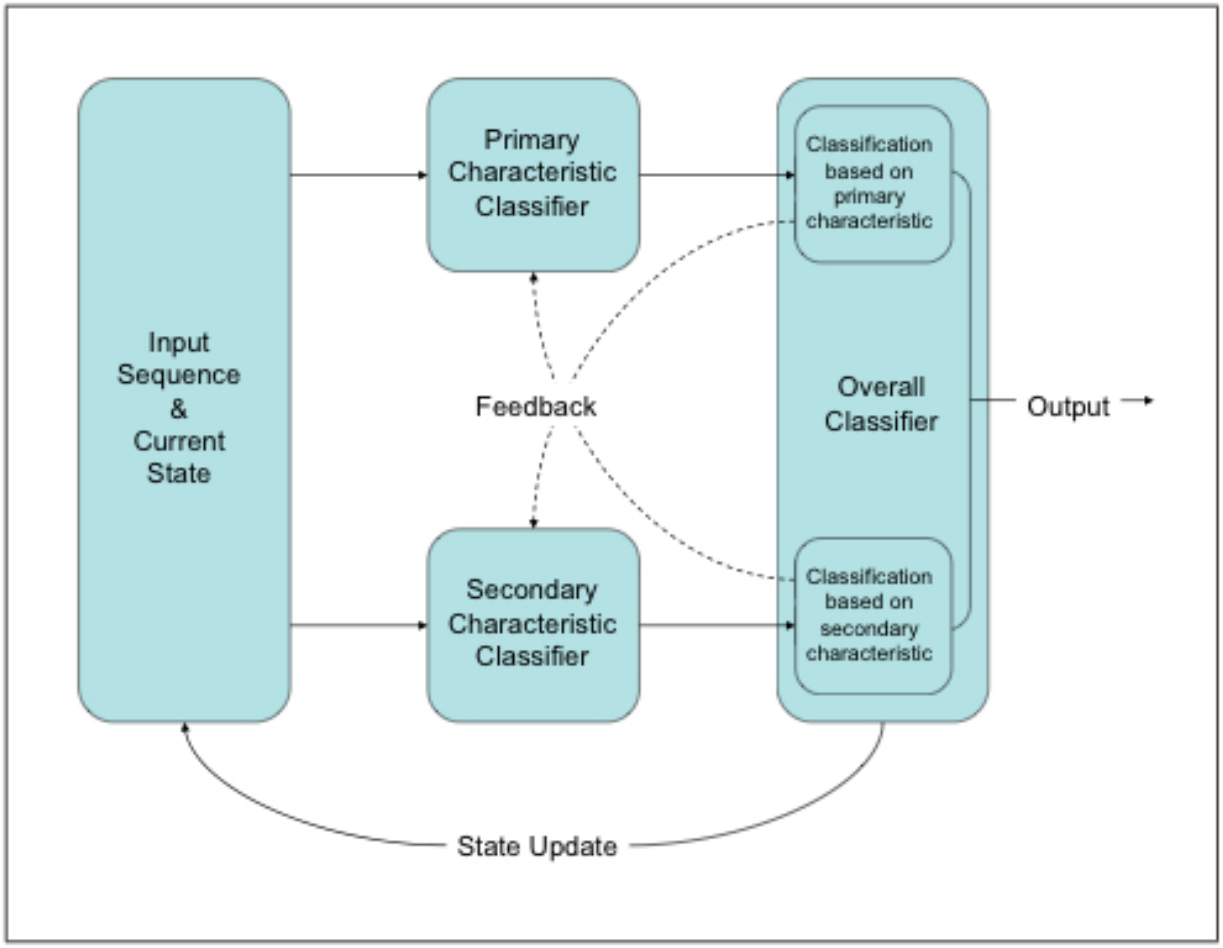
- Testing Steps
  1. Face detection, feature extraction as before
  2. Compare features to training sets
     - Classify based on number of matches

(a) same person

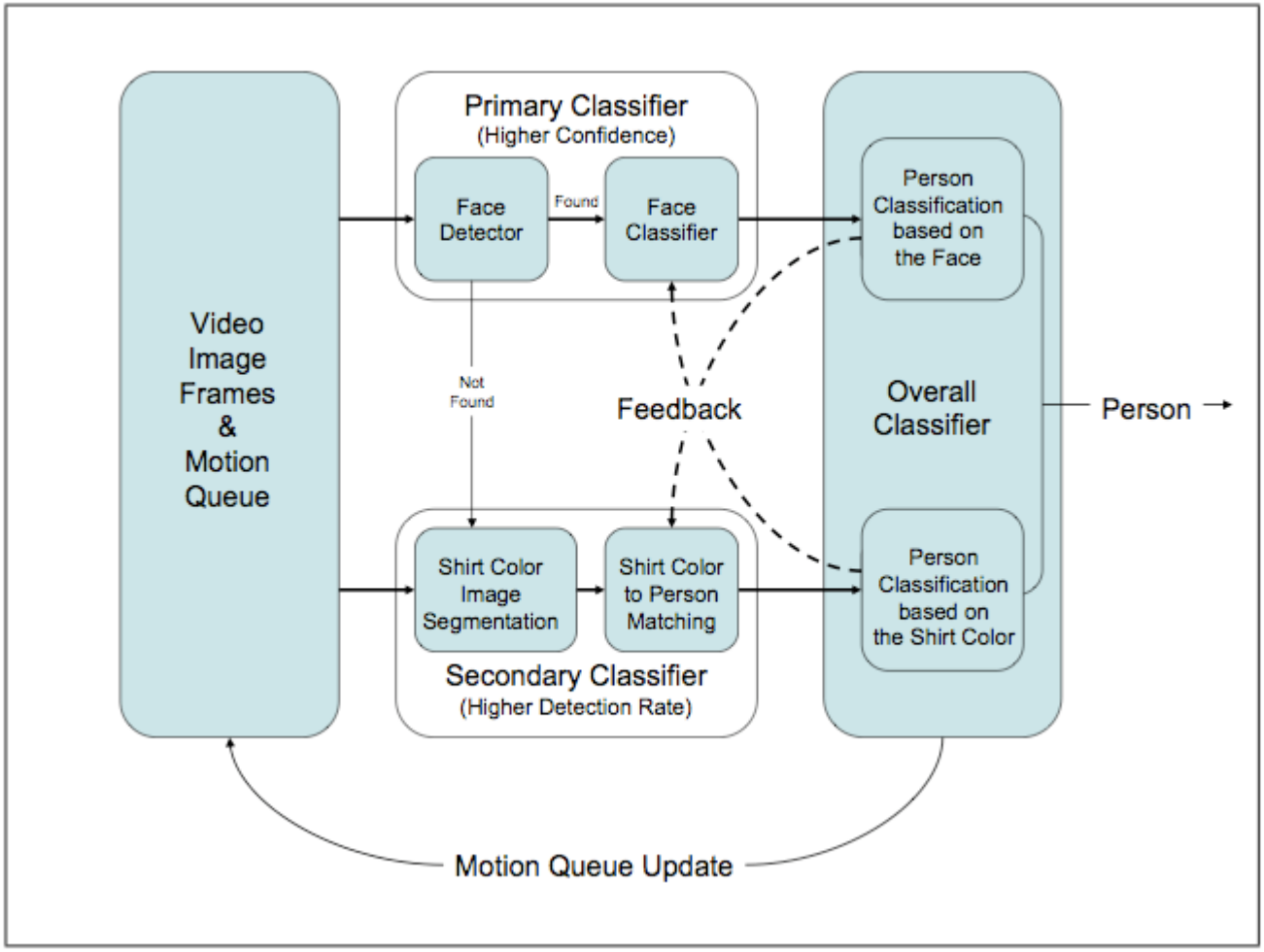
(b) different people

- Repeat over 10 sample images
  - Provides confidence parameter

Secondary Characteristic Tracking

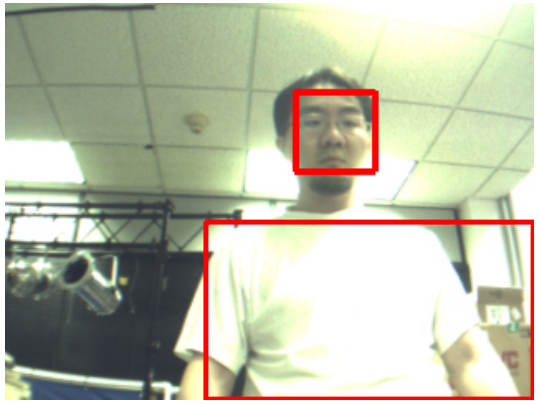


Instantiation: Faces and Shirts



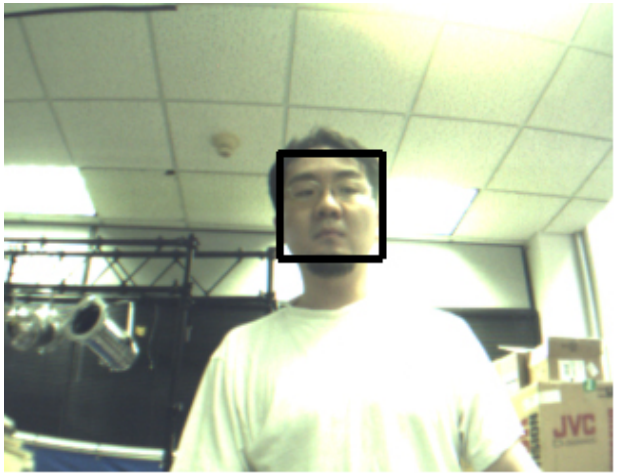
Inter-Classifier Feedback

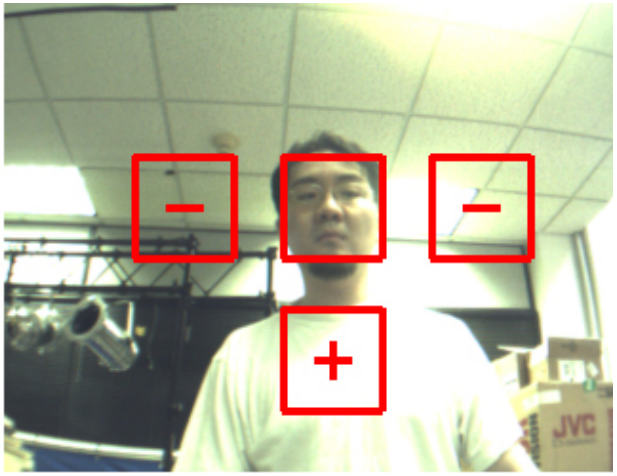
- Primary classifier
  - Features uniquely identifying an object
  - Hard to detect, computationally expensive, sensitive to noise
  - **Face classifier** for person classification

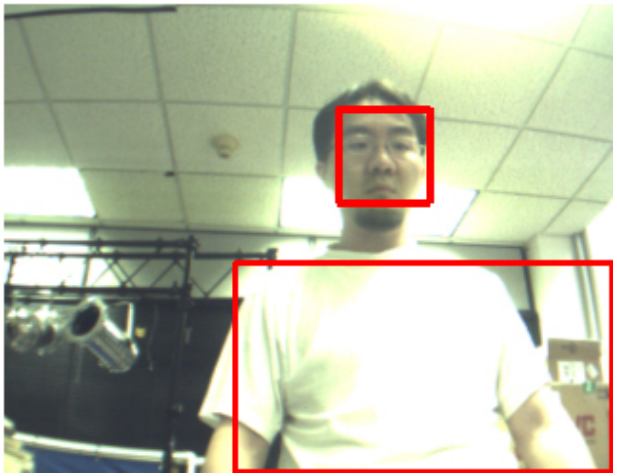


- Secondary classifier
  - Features identifying an object, but mapping not 1-to-1
  - Easy to detect, computationally cheap, robust to noise
  - **Shirt classifier** for person classification

Sampling and Classification



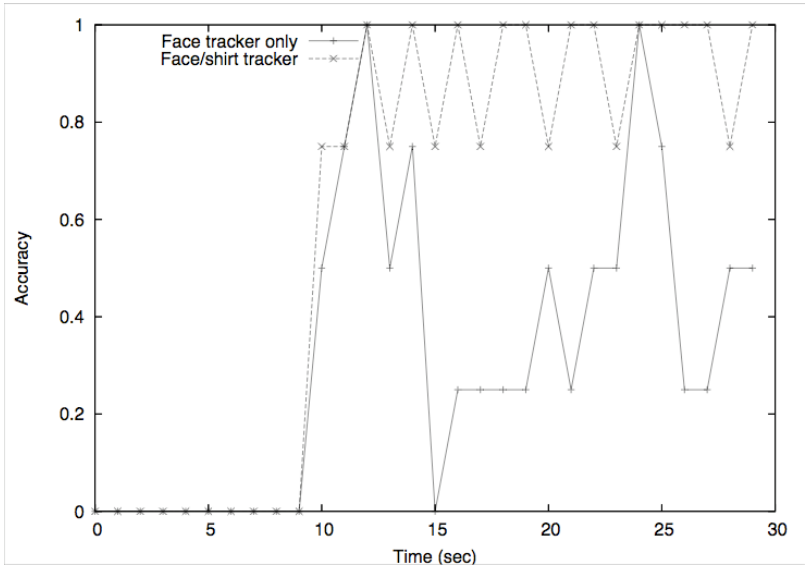




Changing Shirts

Results

- Improved accuracy



- Improved performance