Expression & Gaze

(Reid Simmons)
Illah Nourbakhsh

Facial Expression

• What are facial expressions used for in human-human interaction?
Delsarte

- Francois Delsarte, a French dramatist in the 1800's, defined a Code of Expressions

FACS (Ekman)

- Facial Action Coding System
  - Evaluate muscular activity (action units) that produces changes in facial appearance
    - Appearance changes
    - Performance
    - Intensity scoring
  - Catalog combinations (action descriptors) that afford emotional expressions
FACS

- Strongly connected to muscular activity

Example Action Units (AU)

- Neutral face:

- AU4 (Brow Lowerer)

- AU1 (Inner Brow Raiser)

- AU1 + AU4
**Face Quiz**

Pure Emotions

Mixed Emotions

A Matrix of Mixed Emotions

http://www.mand3l.com/facemotion/survey
Expression Design Methodology (Shayganfar)

- Method for transferring FACS to robots
  - Predicts where confusion will exist

<table>
<thead>
<tr>
<th>Emotion</th>
<th>FACS</th>
<th>Translation</th>
<th>Improved Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happiness</td>
<td>Lip Corner Puller, Cheek Raiser</td>
<td>1-, 2-, 3-, 4-</td>
<td>7-, 8-, 6+, 11+</td>
</tr>
<tr>
<td>Sadness</td>
<td>Inner Brow Raiser, Brow Lowerer</td>
<td>7-, 8-</td>
<td>1+, 2+, 3+, 4+, 5+, 6-, 9+, 10-</td>
</tr>
<tr>
<td>Fear</td>
<td>Inner Brow Raiser, Outer Brow Raiser, Brow Lowerer</td>
<td>7-, 8-</td>
<td>1+, 2+, 3+, 4+, 6+, 11+</td>
</tr>
<tr>
<td>Disgust</td>
<td>Upper Lip Raiser</td>
<td>1+</td>
<td>7+, 5, 6, 9, 10+</td>
</tr>
<tr>
<td>Anger</td>
<td>Brow Lowerer, Upper Lid Raiser</td>
<td>7+, 8+</td>
<td>6-, 4-</td>
</tr>
<tr>
<td>Surprise</td>
<td>Inner Brow Raiser, Outer Brow Raiser, Jaw Drop</td>
<td>7-, 8-, 1+, 2+, 3-, 4-</td>
<td>6+, 11+</td>
</tr>
</tbody>
</table>

Expression Evaluation

- Hypothesized confusion matrix (improved model)

<table>
<thead>
<tr>
<th>Intended Emotion</th>
<th>Happiness</th>
<th>Sadness</th>
<th>Anger</th>
<th>Fear</th>
<th>Surprise</th>
<th>Disgust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Happiness</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Sadness</td>
<td>0</td>
<td>75</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Anger</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Fear</td>
<td>0</td>
<td>7</td>
<td>0</td>
<td>23</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Surprise</td>
<td>3</td>
<td>1</td>
<td>6</td>
<td>25</td>
<td>72</td>
<td>5</td>
</tr>
<tr>
<td>Disgust</td>
<td>0</td>
<td>12</td>
<td>18</td>
<td>12</td>
<td>1</td>
<td>42</td>
</tr>
</tbody>
</table>

- Evaluation results

- Good recognition
- Medium recognition
- Poor recognition

HRI: Expression/Gaze
Simmons, Nourbakhsh : Spring 2016
Expressive Motion

- What aspects of motion are important in expressing emotion?
- How can we parameterize expressive motion?

Laban Action Efforts

- Used by Actors and Choreographers
  - The “how” of motion
- Goal: Layer motion onto task behaviors to produce legible state expressions

<table>
<thead>
<tr>
<th>Space</th>
<th>Direct</th>
<th>Indirect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>Sudden</td>
<td>Sustained</td>
</tr>
<tr>
<td>Weight</td>
<td>Strong</td>
<td>Delicate</td>
</tr>
<tr>
<td>Flow</td>
<td>Bound</td>
<td>Free</td>
</tr>
</tbody>
</table>
Low DOF Expressive Motion

- Robots can be expressive even without arms!

Gaze

- What is gaze used for in human-human interaction?
**Gaze**

- Useful for establishing mutual attention
- People are good at following pointing gestures
- Cannot accurately tell gaze from 2D alone

**Gaze & Storytelling (Mutlu)**

- Look at participants to maintain engagement
- Vary gaze to emphasize semantic information
  - **Theme**: sets the tone and connects with previous utterance
  - **Rheme**: new information
  - “In the evening the old man came home”
- Theme: mostly look away; Rheme: gaze returns
Gaze & Storytelling: Set Up

Gaze pattern of professional storyteller

Gaze & Storytelling: Results

- Hypotheses
  1. Participants with more gaze will perform better at recalling the story
  2. Participants with more gaze will evaluate the robot more positively

As with many HRI experiments, results are not straightforward to interpret