

# Human-Robot Interaction

15-494 Cognitive Robotics  
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# Human-Robot Interaction Topics

- Awareness of humans
  - Person tracking
  - Face detection; gaze tracking
  - Face recognition
  - Human's “perspective” considerations
- Gesture recognition
  - pointing
  - hand motions
- Social interaction
  - Gaze as indicator of attention
  - Facial expressions (e.g., Kismet)
  - Sound effects (R2D2, AIBO) vs. speech
  - Use of displays (Looking Glass project)

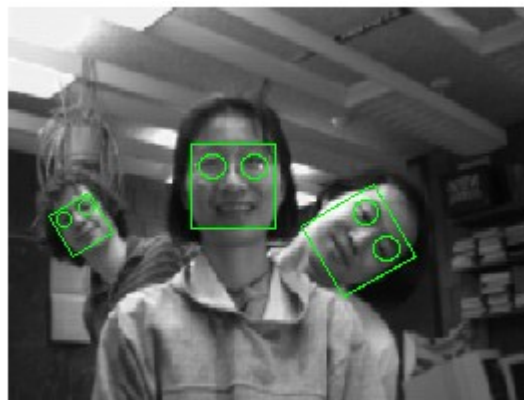
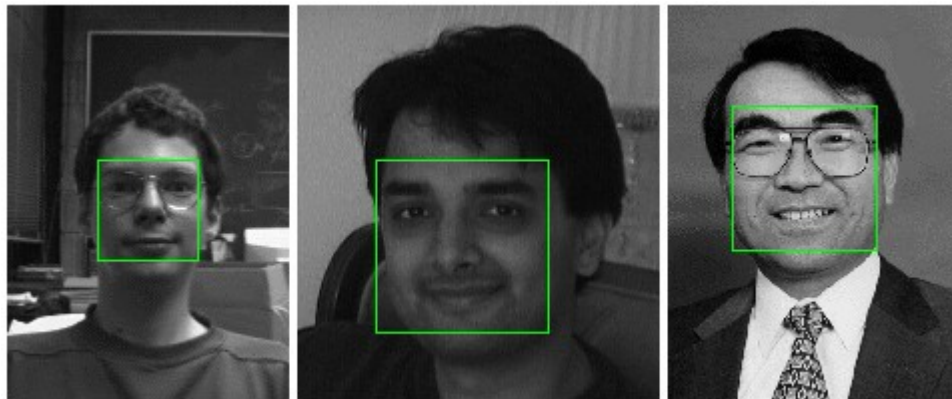
# Awareness 1: Person Tracking

- Be aware of human presence
  - Follow a human (robot assistant)
  - Avoid the humans
  - Interact with humans (museum tour guide robots)
- Use skin color; look for legs (rangefinder); etc.



# Awareness 2: Face Detection

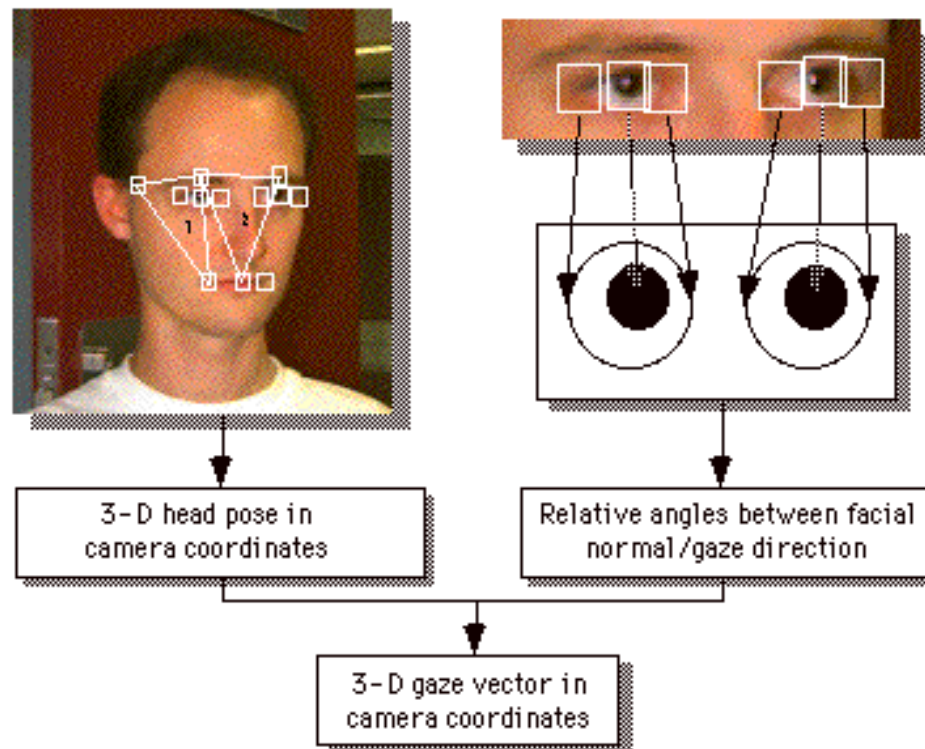
- Rowley, Baluja, and Kanade (1998) used a neural net:



(movie)

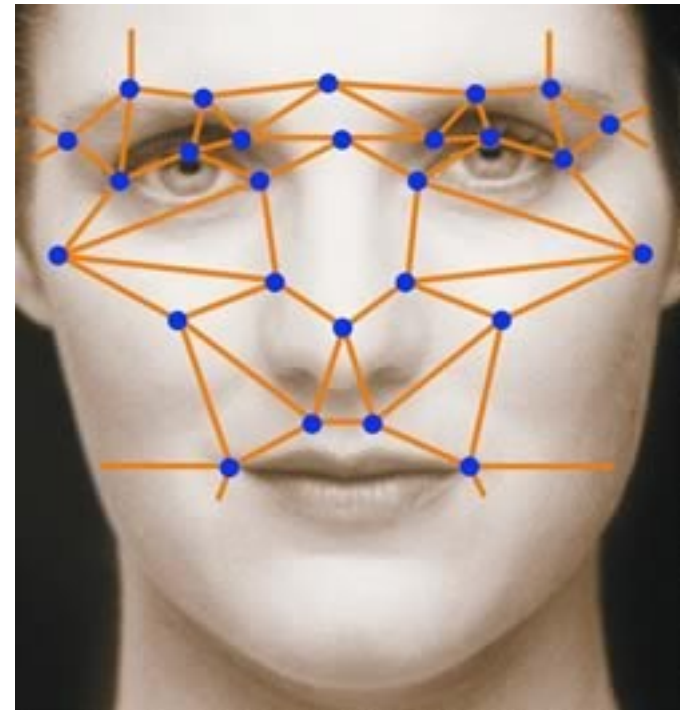
# Awareness 3: Gaze Tracking

- What is the human looking at?
- Gaze has high social significance among primates.
- For robots, hard to measure gaze at a distance.



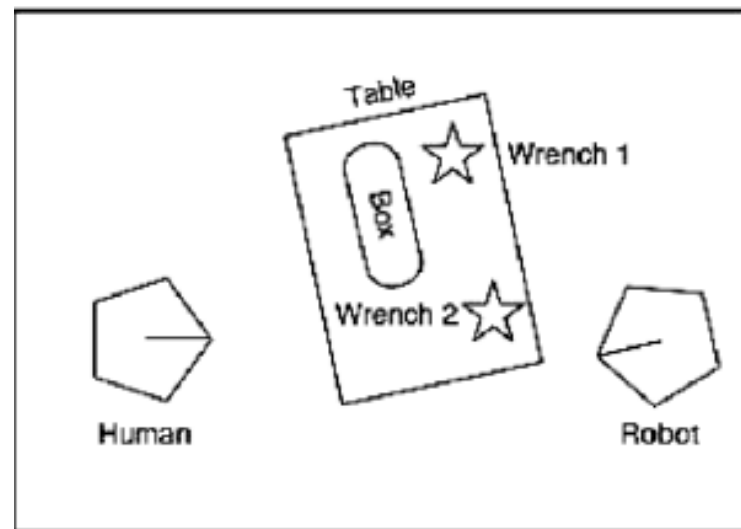
# Awareness 4: Face Recognition

- Which human is this?
- Lots of work in this area now for security applications.
- Sony's AIBO, QRIO have face recognition modules.



# Awareness 5: The Human's Perspective

- What can the human see from his present location?
- Trafton et al.: “Give me the wrench.”
- Robot sees two wrenches, but knows that the human can only see one.



# Gesture Recognition

- Pointing
  - Point at objects to designate them to the robot
  - Point in a direction, or towards a goal location
- Hand gestures
  - “Come here” / “Come closer” / “Back off”
  - “Stop”
  - “Put that there”



# Social Interaction

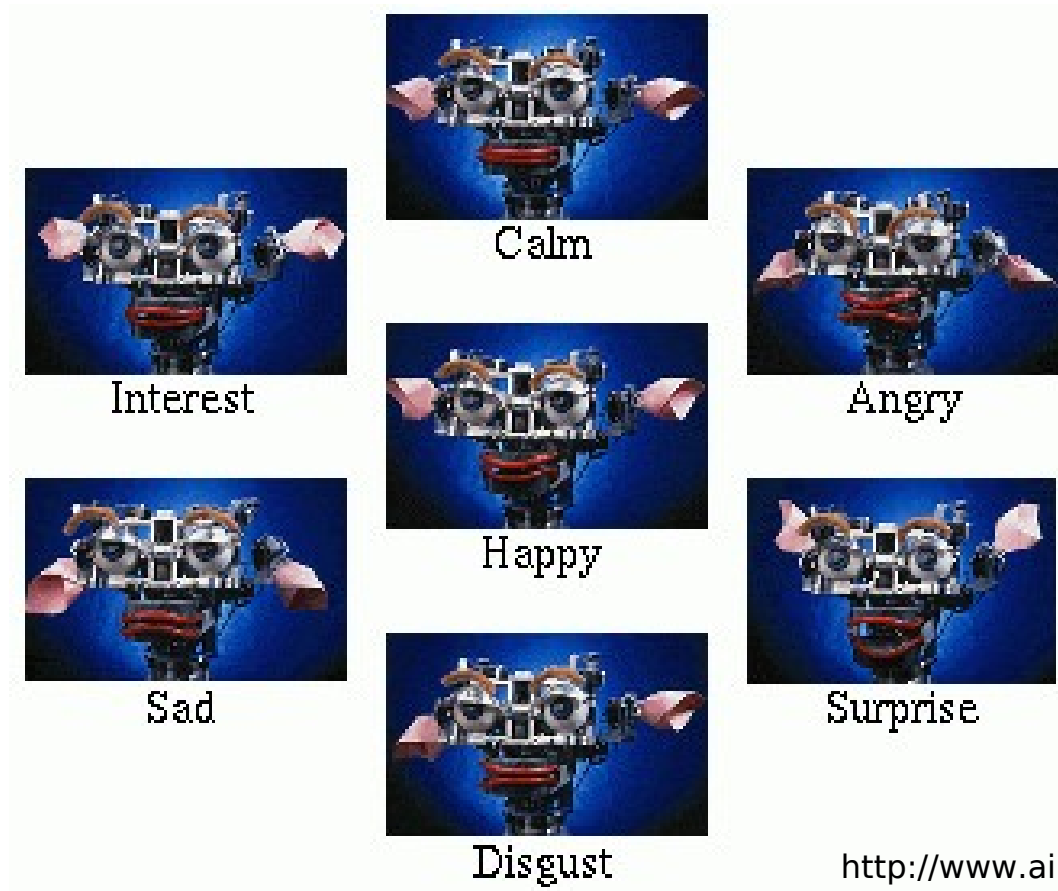
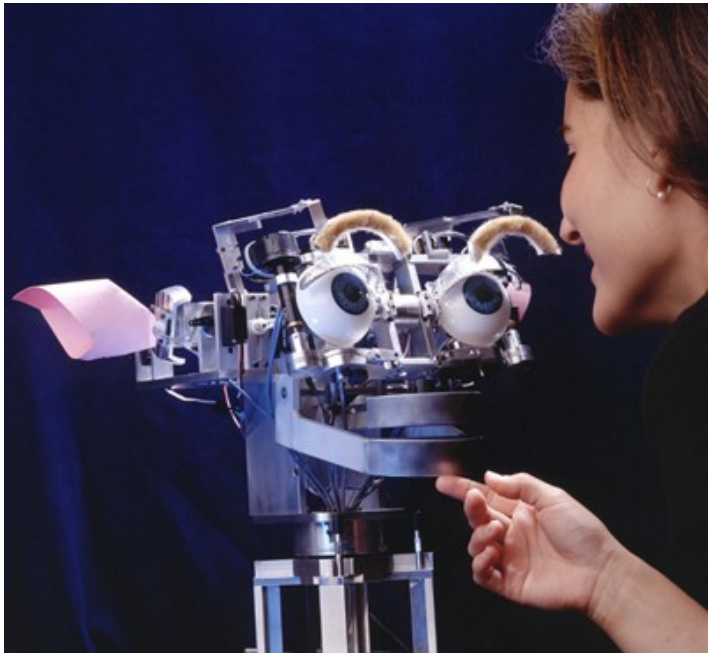
- Do robots need heads?
- What are heads used for?
  - Indicate focus of attention by gaze direction
  - Gestures such as nodding agreement
  - Anthropomorphism makes robots more acceptable to humans
- Headless robots are creepy.



DARPA Little Dog

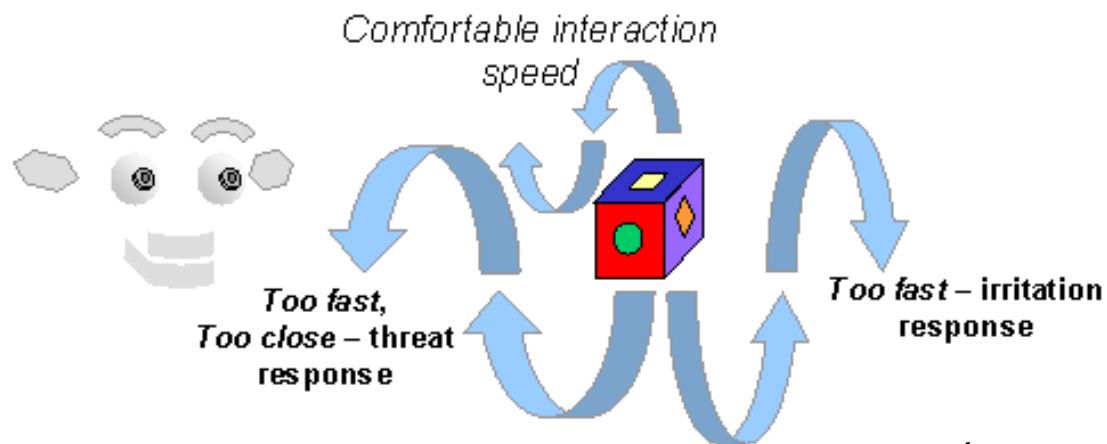
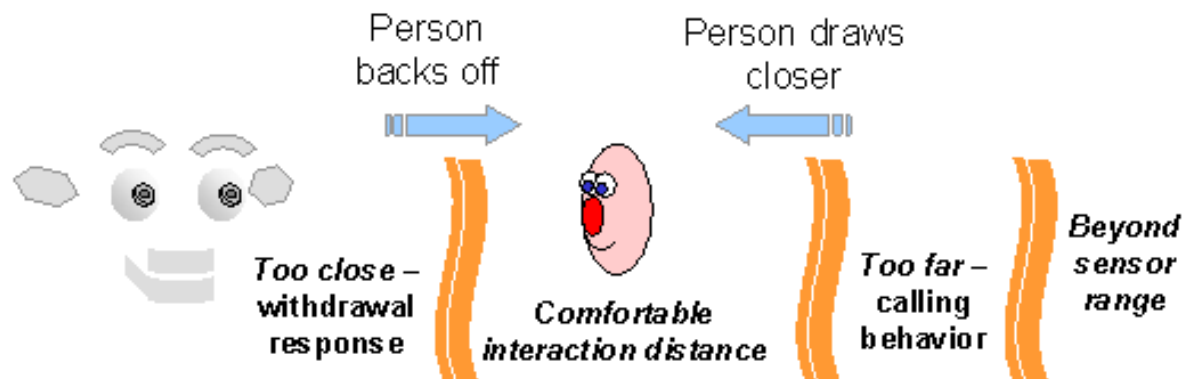
# Facial Expressions: Kismet

- Cynthia Breazeal, ca. 1999-2000



<http://www.ai.mit.edu/projects/sociable/facial-expression.html>

# Kismet Social Interactions



(see movies)

# Communicating with Humans

- Should robots talk?
  - R2D2 used sound effects to convey emotion
  - AIBO and Kismet do likewise
- Use of canned messages:
  - “Excuse me, you're blocking my path.”
  - Roboceptionist: “How may I help you?”
- Will people expect to be able to talk back?
  - Voice recognition gets harder when the robot is noisy.
- Use of lights to communicate status, mood.

# Communication via a Detached Display

- AIBO's Magic Looking Glass (Kirtane & Libby, 2005)
- Question: how can you use a robot-controlled flat-panel display to mediate human-robot interactions?

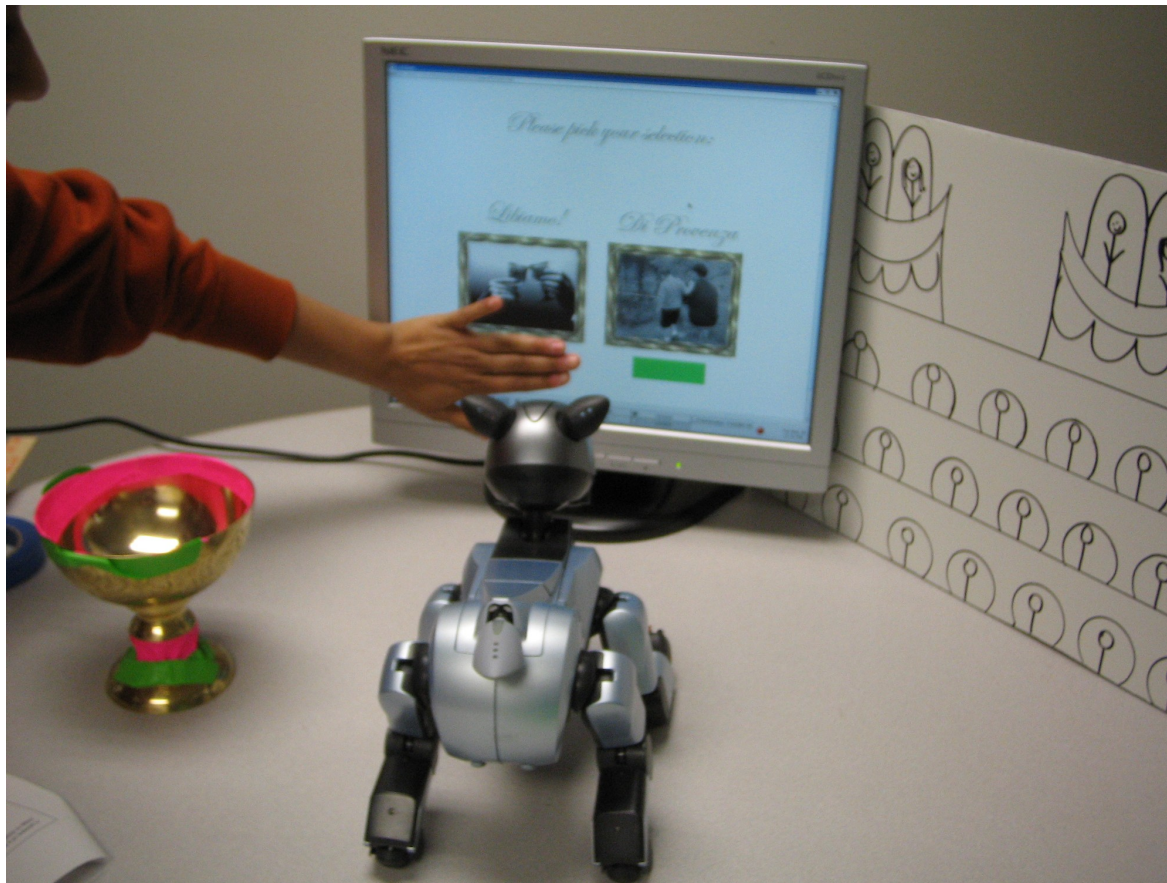


# Looking Glass Applications

- Display instructions for a game.
- Keep score.
- Display a landmark the AIBO can use for navigation.
- Display AIBO's view of the world.
- Serve as a backdrop for a dramatic presentation:
  - Display background scenery
  - Display objects the robot is talking about
  - Display another agent the robot can interact with

# Display as Input Device

- User points at display to indicate their choice.





# La Traviata





# Virtual Violetta



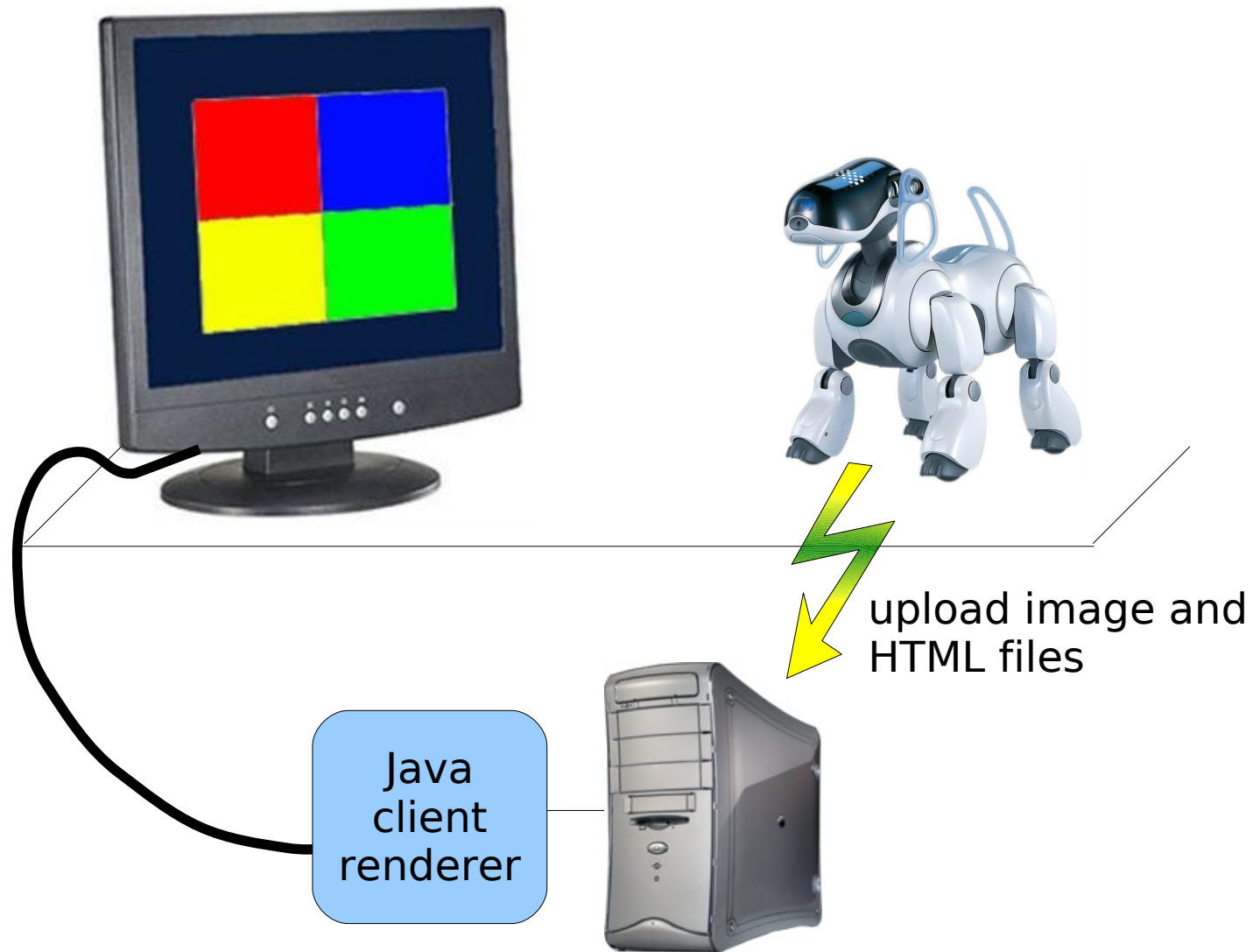
(movie)

# A Visual Joke

- At the end of the performance, the user's picture is inserted into an audience shot.



# How Looking Glass Works



# Looking Glass Example

```
#include "Behaviors/BehaviorBase.h"
#include "Wireless/LGmixin.h"

class LGdemo : public BehaviorBase, public LGmixin {
public:
    LGdemo() : BehaviorBase("LGdemo"), LGmixin() {}

    void DoStart() {
        BehaviorBase::DoStart();
        erouter->addListener(this,EventBase::textmsgEGID);
    }

    void processEvent(const EventBase &) {
        LGmixin::displayHtmlText(
            "<html><body>Hello world!</body></html>");
    }
};
```

# Looking Glass Functions

- `uploadFile(string filename)`
- `displayHtmlFile(string remoteFilename)`
- `displayImageFile(string remoteFilename)`
- `displayHtmlText(string text)`
- `uploadCameraImage(string remoteFilename)`
- `uploadSketch(Sketch<uchar> sketch,  
string remoteFilename)`