Sensors, cameras, eye-tracking, tangibles, and other non-traditional hardware

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Working Definitions

- Sensors: Any device that detects and measures a physical property for a system. The property is then recorded by the system or used to drive a behaviour or action.
- Cameras: Any device that records visual images. The images are then used by the system to determine a state or behaviour, usually affective state or facial movements.
- Eye-tracking: Process of measuring the gaze (i.e., where the eyes are pointed or the motion of the eye[s] relative to the head.
- Facial recognition: Measuring the facial expressions of the user, including eyebrows and mouth, to assist in determining the affective state.
- Tangibles: Sensor-based interaction, where physical objects, such as bricks, toys or balls, are coupled with their digital representations. When user manipulates the physical object, this is detected by the system in some fashion causing a digital effect to occur. (Preece et al., 2011)
- Other non-traditional: Anything that is not a PC, screen, touchscreen, mouse, trackball, keyboard, trackpad or any of the above catetories.

Why Are They Used?

- Sensors: To gather data that allows interpretation of affective state via posture, physical activity levels, skin conductivity, heart-rate, pressure

on touch or mouse.

- Cameras: To monitor facial expressions and hand/body gestures for either determining affective state or controlling interactions. Can also be used for communicating actions to be taken via gestures.
- Eye-tracking/Facial recognition: To determine or assess affective state, metacognitive behaviour and attention levels. Can also be used for communicating actions to be taken via eye movements.
- Tangibles: To allow easier, more intuitive and more immersive control.
- Other non-standard hardware: Robots to allow users to treat system as a peer, allow tactile interactions and assist in establishing relationships between user and system.

Where Are They Used In Practice?

AutoTutor Emotions

In AutoTutor Emotions, the developers use upper-face tracking, via a camera, and pressure pads on the back and seat of the student's chair (D'Mello et al., 2005). The upper-face tracking is to monitor the eyes and eyebrows to determine facial expressions, a key predictor of affective state. The pressure pads on the chair are to monitor the student's posture patterns and predict how aroused and attentive the student is.

This sensory data is used to make inferences about the student's affective state. These inferences, combined with production rules, suggest appropriate student feedback to regulate certain affective states (e.g., boredom, frustration, confusion and flow)and possible next actions for the tutor to take.

Robovie

Robovie is a robot used with Japanese children to expose them to the English language. The robot only communicated and could understand English (Kanda et al., 2004).

The robot includes sensors for wireless tagging, ultrasonic, audio and vision. Each child is identified by wireless tagging. The ultrasonic sensor was used to locate and check the proximity of users. Finally, the audio sensor was used for processing the speech directed at the robot.

A robot was used to provide a tangible interface and allow children to treat the robot/tutor as a peer. The robot helps the child establish a relationship by being tactile towards them and encouraging the likes of games, hugging and shaking hands.

Project LISTEN's Reading Tutor

With Project LISTEN's Reading Tutor, the researchers used electroencephalgram (EEG) to study the feasibility of inferring cognitive load during reading tasks (Mostow et al., 2011).

The sensor used was a NeuroSky "MindSet". One of the major applications of this device is intelligent tutoring systems.

The EEG signals measure attention levels from brain activity. This data is collected whilst the student is reading a sentence and then used to train a model of student cognitive load.

Happy child with sensors

References

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