Multimodal Interfaces and Affective Computing

IS4300

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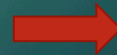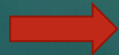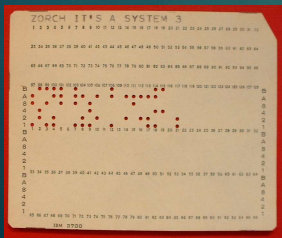
What is a Multimodal Interface?

► Interfaces that allows for users to interact through multiple modalities

► Examples:
  ► Augmented Reality
  ► Virtual Reality
  ► Speech Recognition
  ► Tangible Interfaces
  ► Gestural interfaces

Why should we care?

- ▶ Different interfaces excel in different scenarios
- ▶ Interfaces can accommodate users with different abilities/disabilities

Multimodal Interface Example:

- ▶ Sixth Sense – Pranav Mistry

Natural vs. Artificial Interfaces

▶ Natural user interfaces
  ▶ Emulates naturally occurring interactions (I.E. Face to Face conversations)
  ▶ Recognizes and Produces messages across a variety of channels
▶ Artificial interfaces
  ▶ Extends standard computer interactions with new interface modalities

Interaction Terms

▶ Message:
  ▶ What are you trying to get across to your user?
▶ Medium
  ▶ How are you delivering the message to the user?
▶ Modality
  ▶ What senses are being used by the user to receive the message?

Augmented Reality

- ▶ Systems that augment the user's view of the world by providing additional information
- ▶ Most commonly done through visual stimuli
- ▶ Heavily dependent on the fields of computer vision and object recognition
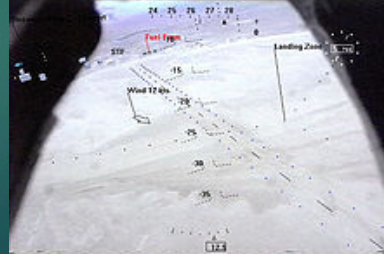
Virtual Reality

- ▶ Systems that fully immerse a user in a virtual environment
- ▶ Commonly done through Head Mounted Displays (HMD) and Data Gloves
- ▶ Very hardware dependent

Virtual Reality Example

Challenges of Augmented/Virtual Reality

► System Reaction Time
  ► Respond too slow and it will be non-immersive/sickening to users
► Poor Field of View
  ► Experiencing a lower than normal field of view can cause motion sickness in users
► Creating/integrating elements into the environment
  ► Scale of the world has to be accounted for
► Manipulation Techniques
  ► Without the use of a data glove or gestural interface, the user may have trouble interacting with the interface.

Sound Based Interfaces

- ▶ If done correctly it can reduce:
  - ▶ Cognitive load
  - ▶ The amount of information that needs to be displayed on the screen
  - ▶ Visual attention grabbers (I.E. flashing pop-ups)
- ▶ If done incorrectly…

Speech Recognition Systems

- ▶ Pros:
  - ▶ Allow for natural, voice based interactions
  - ▶ Can require little training on the user's part to use
- ▶ Cons:
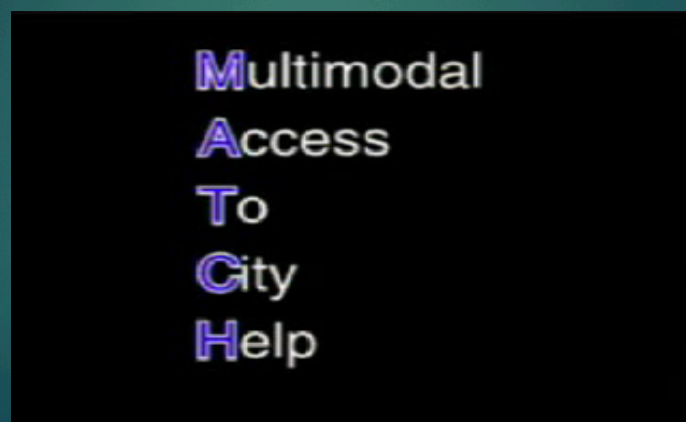 - ▶ Inaccurate
  - ▶ Can be computationally heavy, resulting in delayed interactions
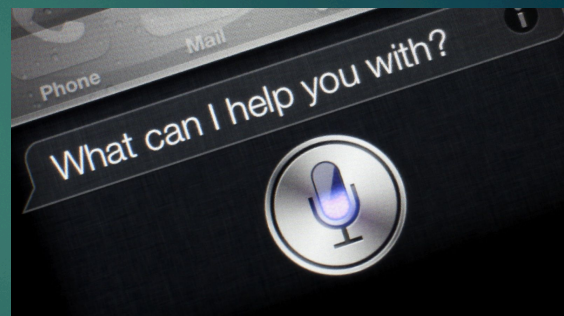
Speech Based Interfaces

▶ Put That There (Chris Schmandt – 1979)
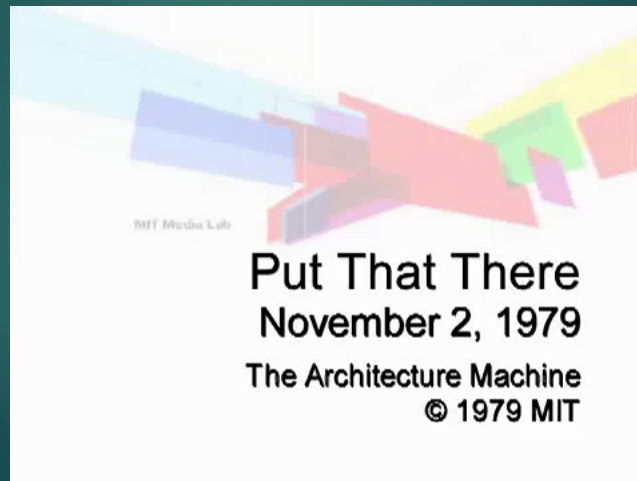
Navigational interfaces

MATCH: an architecture for multimodal dialogue systems
- Johnston et al - 2001

Tangible Interfaces

- ▶ Interfaces with physical components
- ▶ Allows for haptic feedback
- ▶ Allows users to understand physical relationships between objects

Tangible Interfaces

Gestural Interfaces

- ▶ Interfaces that use multi-touch or physical movement to control
- ▶ Highly dependent on precise touch interfaces or computer vision
- ▶ Requires additional hardware

Multimodal Discussion

- ▶ Imagine you were given an unlimited budget to designing a tour guide system for incoming Northeastern students
  - ▶ How would you incorporate multimodal interfaces into the system?
  - ▶ What challenges would you face designing this system?

Affective Computing

Why should we care about Emotions?

Why should computers care about Emotions?

Why should computers care about Emotions?

What is Affective Computing?

▶ "Computing that relates to, arises from, or influences the users emotions" – Picard 1995
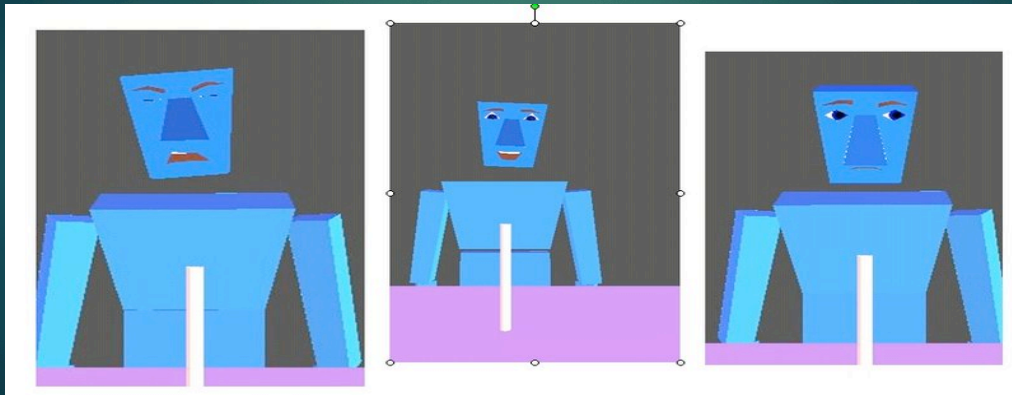
Types of Affective Computing

▶ Systems that elicit affect
  ▶ Systems that use cognitive models to understand the user's emotional state
▶ Systems that recognize affect
  ▶ Commonly done through sensors
▶ Systems that react to affect
  ▶ Systems that behavior differently based your emotional state
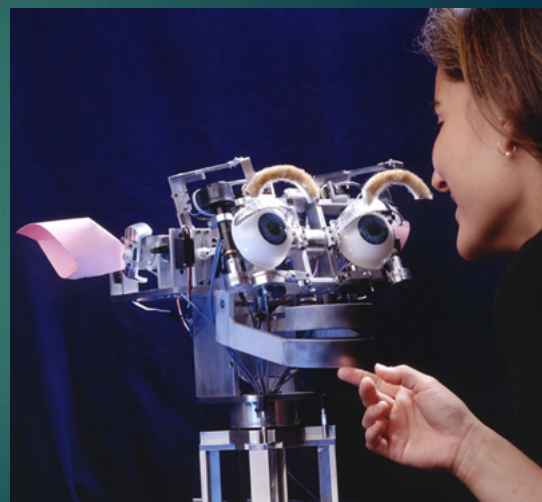
So, Why do we care again?

▶ Klein, J., Moon, Y., & Picard, R. W. (2002). This computer responds to user frustration:: Theory, design, and results. *Interacting with computers*, *14*(2), 119-140.

  ▶ Game designed to elicit frustration

  ▶ "Questionnnaire" either:

    ▶ Ignored them

    ▶ Let them vent

    ▶ Empathized with them

"I know exactly how you feel."
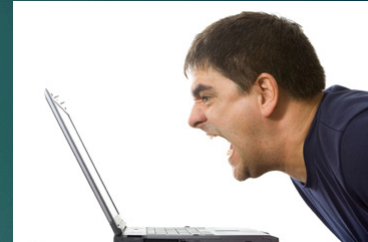
How do we classify Emotion?

▶ *Ekman's list of basic emotions:*

  ▶ *Anger*

  ▶ *Disgust*

  ▶ *Fear*

  ▶ *Happiness*

  ▶ *Sadness*
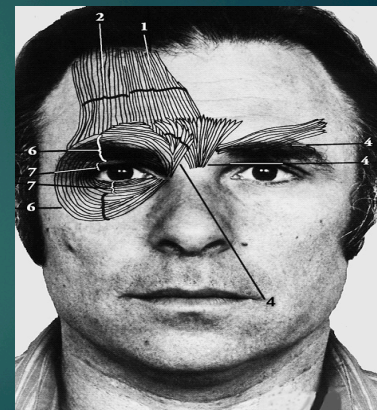
  ▶ *Surprise*

How do we classify Emotion?

▶ Classified through **Valence** and **Arousal** via the **Circumplex Model**
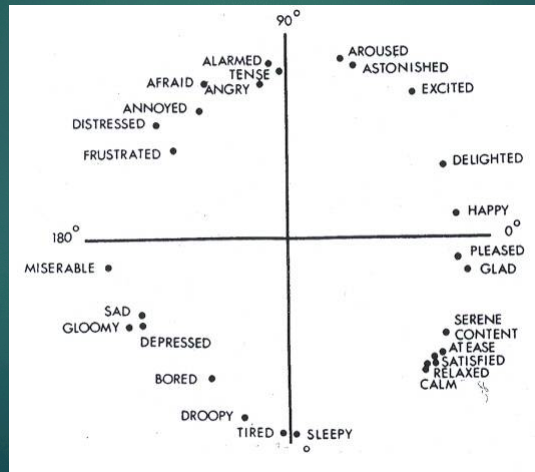
Detecting Emotion:
Facial Expressions

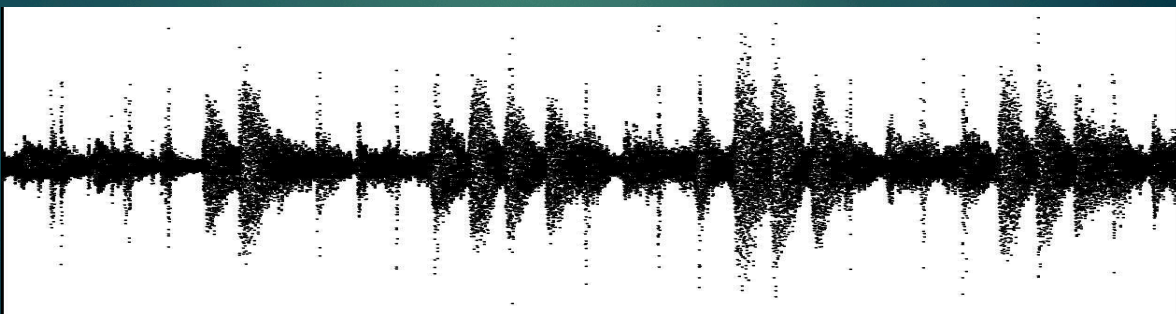▶ *Ekman's Facial Action Coding System*

Detecting Emotion:
Facial Expressions

Detecting Emotion:
Audio Processing

Audio data can be analyzed to detect emotions:

▶ Variance in voice energy
▶ Amount of breathing

Detecting emotion: Physiological Sensors

▶ Heart Rate
▶ Skin Conductance
▶ EKG
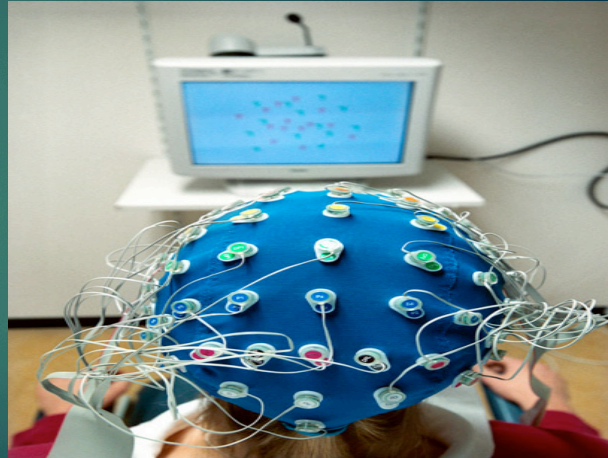
Detecting Emotion: Other techniques

▶ **Posture**
▶ **Just ask!**
  ▶ *Via Likert Scale Measures*
  ▶ *Via Circumplex Model*

joy   accepted   aware   angry

sadness   rejected   surprised   fearful

okay

good

bad

great

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What do we do after we know their emotional state?

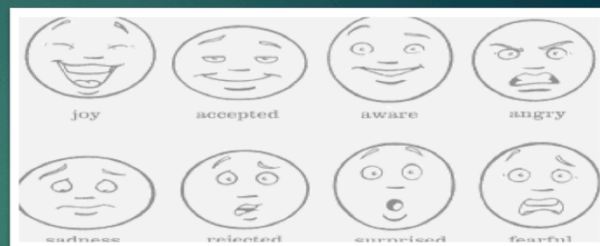▶ Burleson, W. (2006). *Affective learning companions: strategies for empathetic agents with real-time multimodal affective sensing to foster meta-cognitive and meta-affective approaches to learning, motivation, and perseverance* (Doctoral dissertation, Massachusetts Institute of Technology).

  ▶ Mirroring Emotions

What else can we do with their emotional state?

▶ Longitudinal Affect Computing – Ring, Bickmore, Schulman, IVA 2012

  ▶ Interacted with an embodied conversational agent for a month

  ▶ One of two dialogue variants used to ask participants to take a walk

What about displaying emotions?

- ***Length of Smile Apex as Indicator of Faked Expression, McDaniel & Si, IVA 2014***
- Systemically exploring the display of fake and natural smiles in virtual agents
- 6 smile variations
  - Adjusted Duration of the smile at different points

What would you do?

- Gather into team groups
  - Talk about how you could use affective interfaces in your project

Your groups ideas

- Discuss!

Paper Reading

Questions?