Human Computer Interaction

Internet-of-Things (IoT)

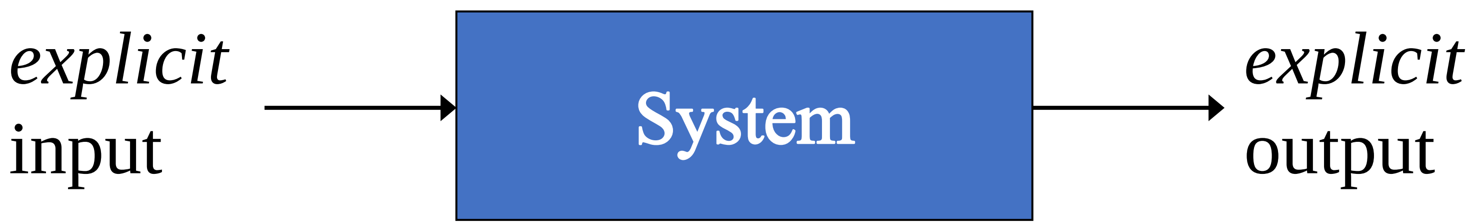
COCOS20

Smart Objects

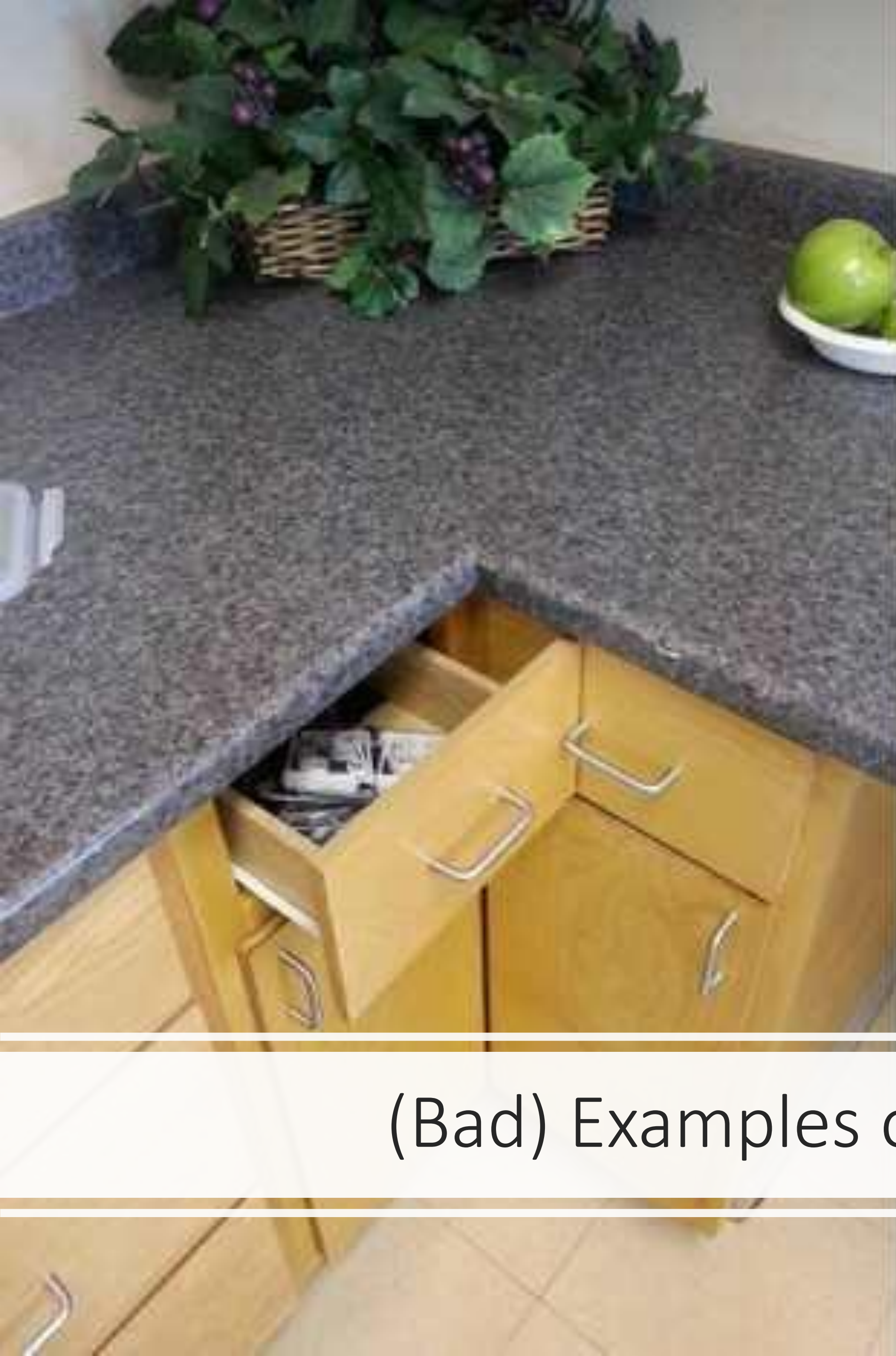
Smart Refrigerator

- Objects that are able to **sense** the environment, **interpret** the environment, **self-configure**, **interact** with other objects and exchange information with people

Traditional Computing System: HCI



*"**Human-computer interaction** is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them."* -- Association for Computing Machinery.



(Bad) Examples of User Interfaces

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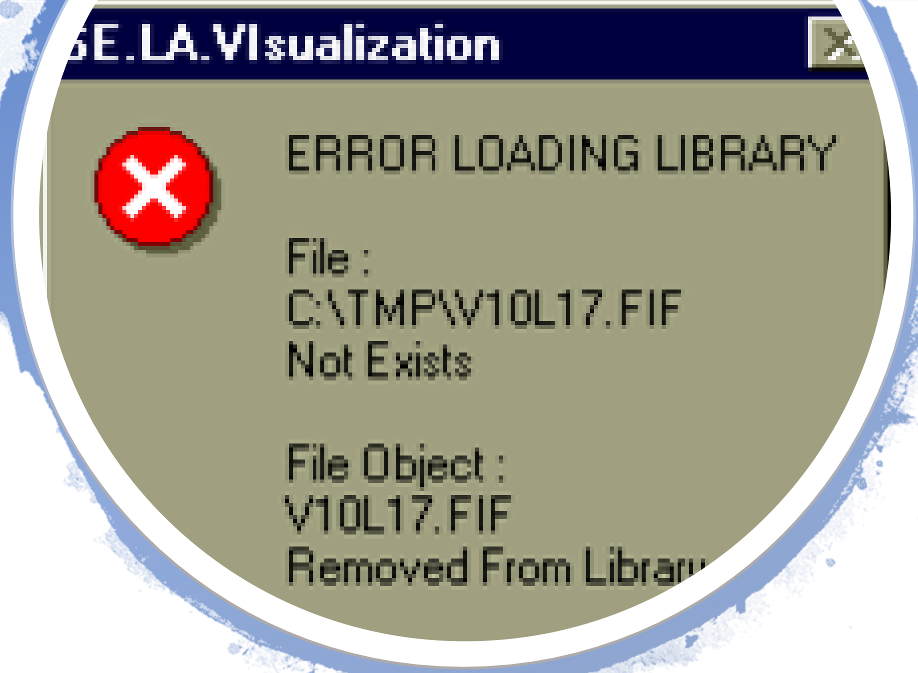
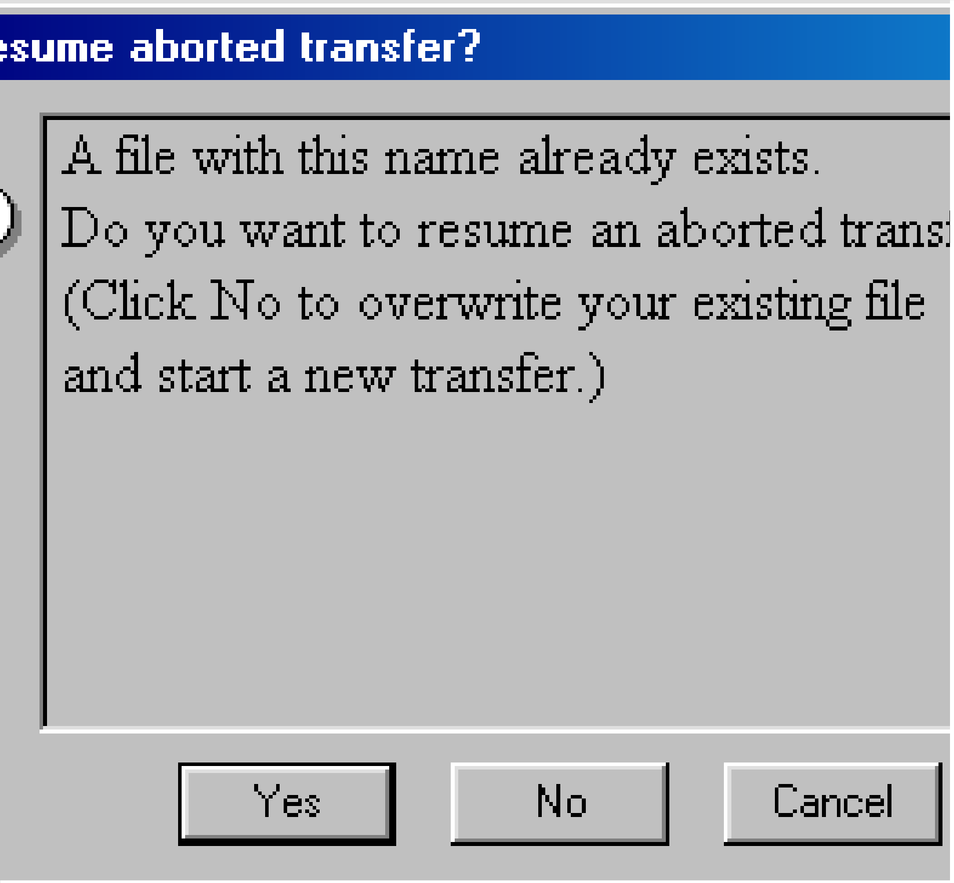


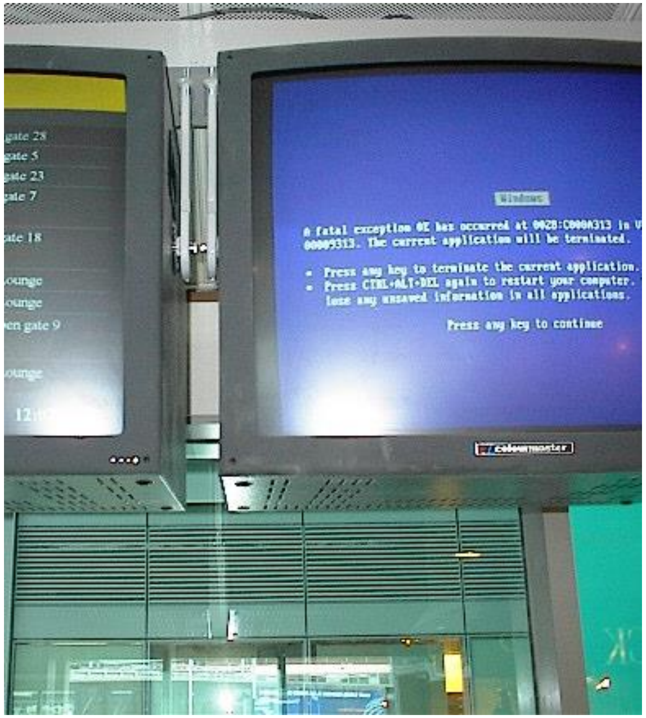
(Bad) Examples of User Interfaces



(Bad) Examples of User Interfaces

Why is HCI Important?

- It can affect
  - Effectiveness
  - Productivity
  - Morale
  - Safety
- Bad interfaces:
  - Confusing
  - Cumbersome
  - Time-consuming
  - Uninformative
  - Lead to errors
  - …

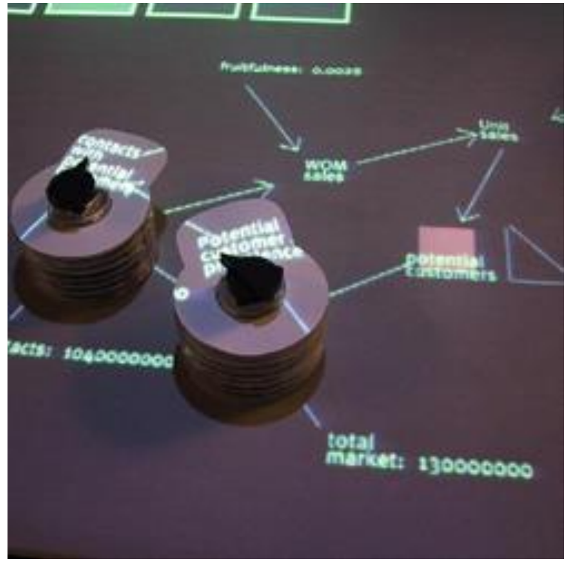


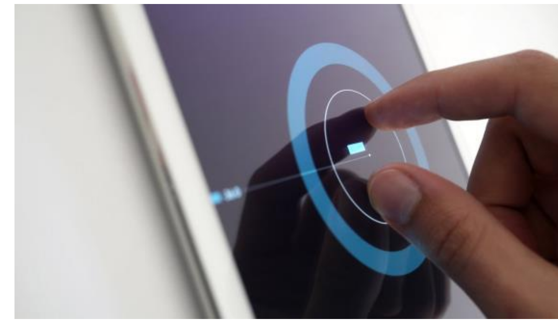
Interfaces

- **Keyboard/mouse/screen/speakers**
- Pen input
- Touch
- Speech/audio/sound
- Gesture, eye movement
- Tangible interfaces
- Virtual/augmented reality (VR, AR)
- Wearable computing
- **Multi-modal** interactive interfaces: more than just one input/output channel

Interface Discussion

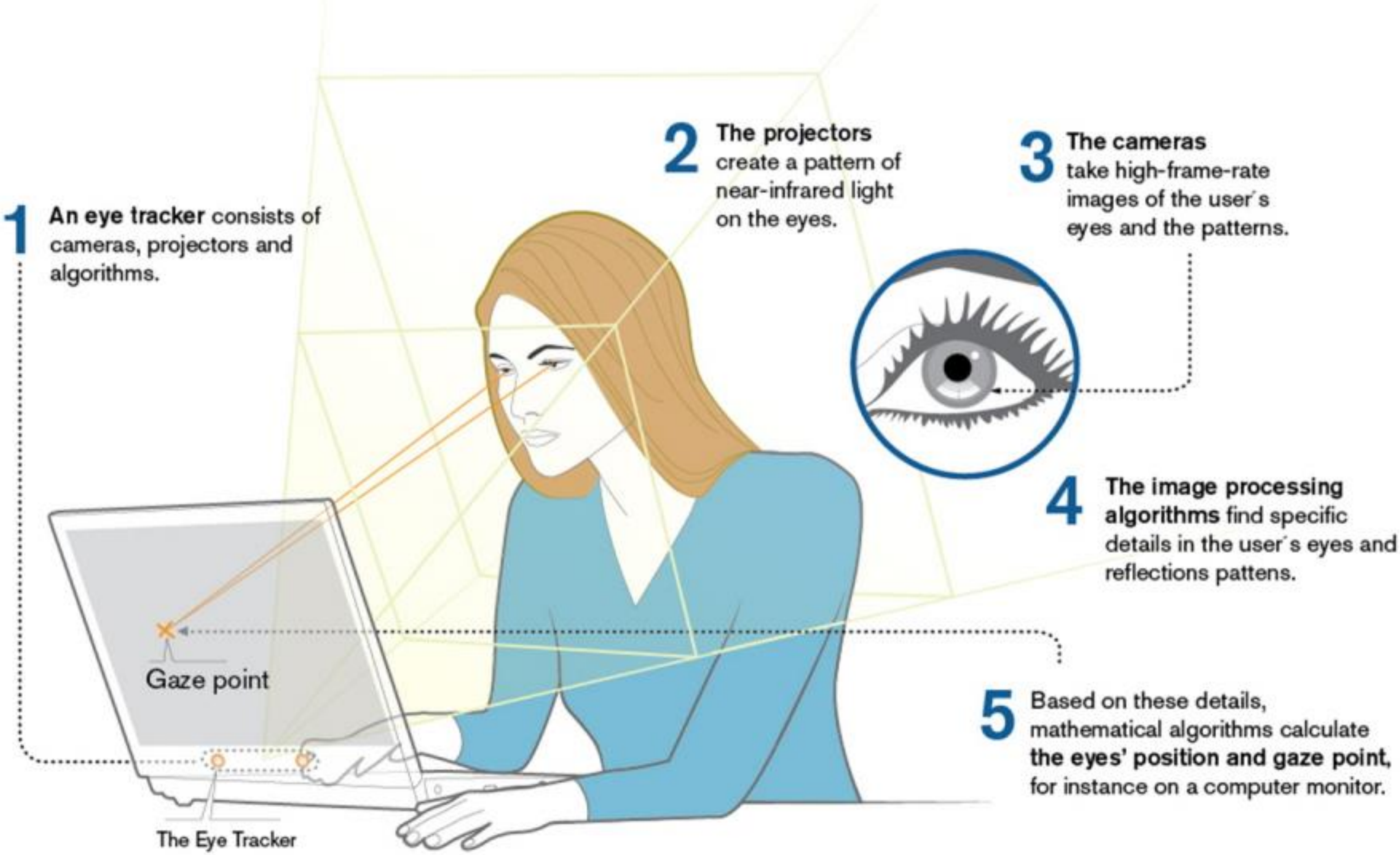
- **E**ase-of-Use?
- **F**lexibility?
- **A**ccuracy?
- **S**afety?
- **P**rivacy?





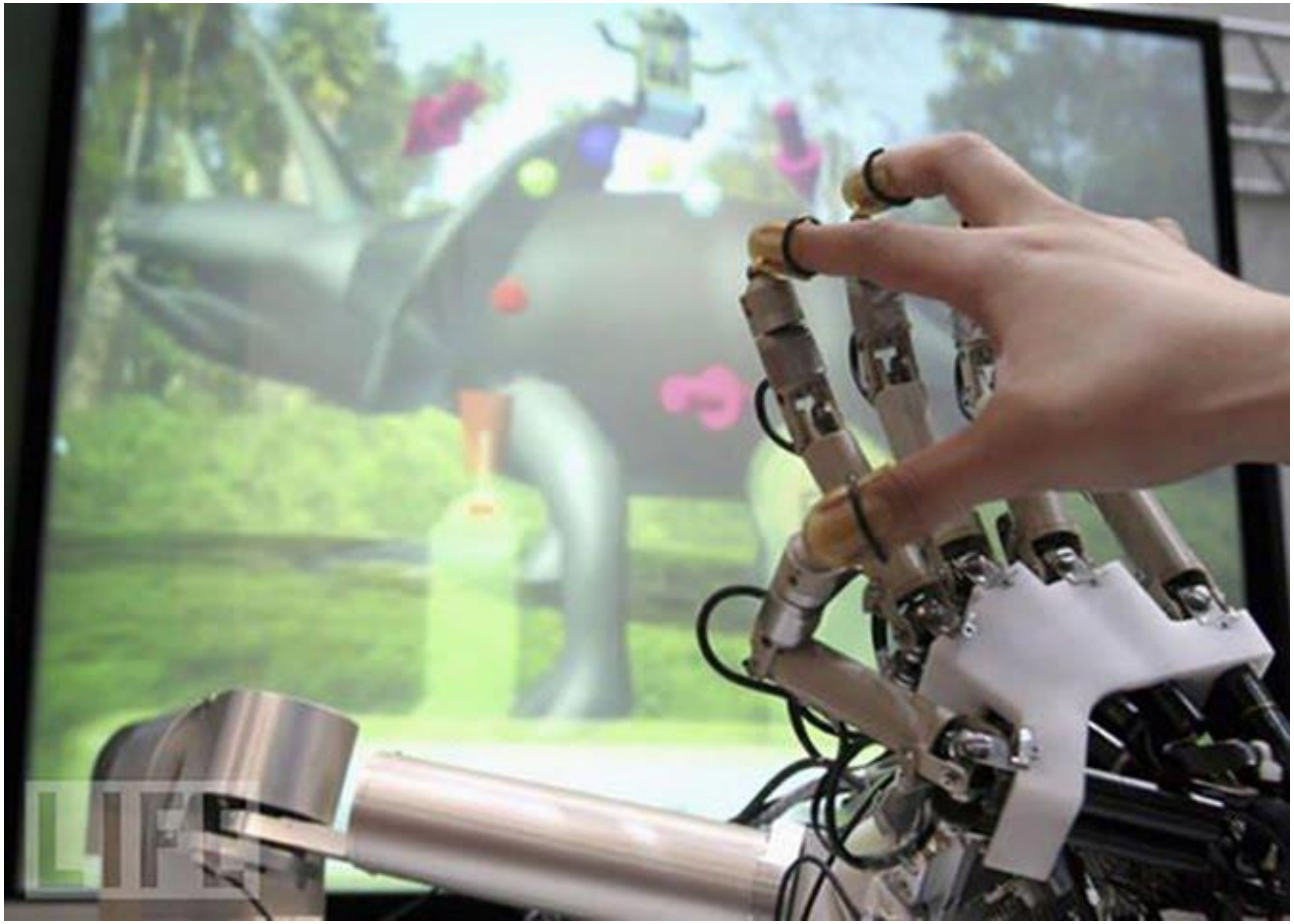
Touch as Input

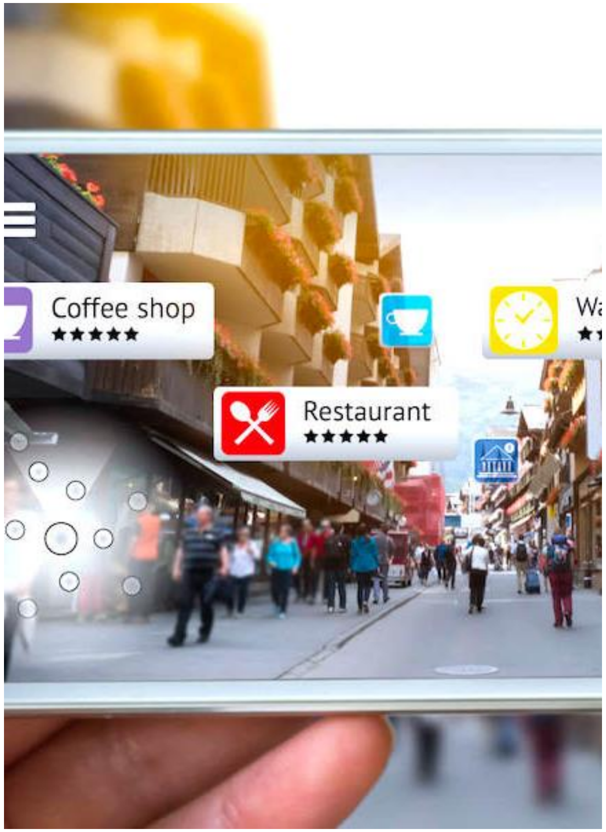
Gesture/Motion as Input

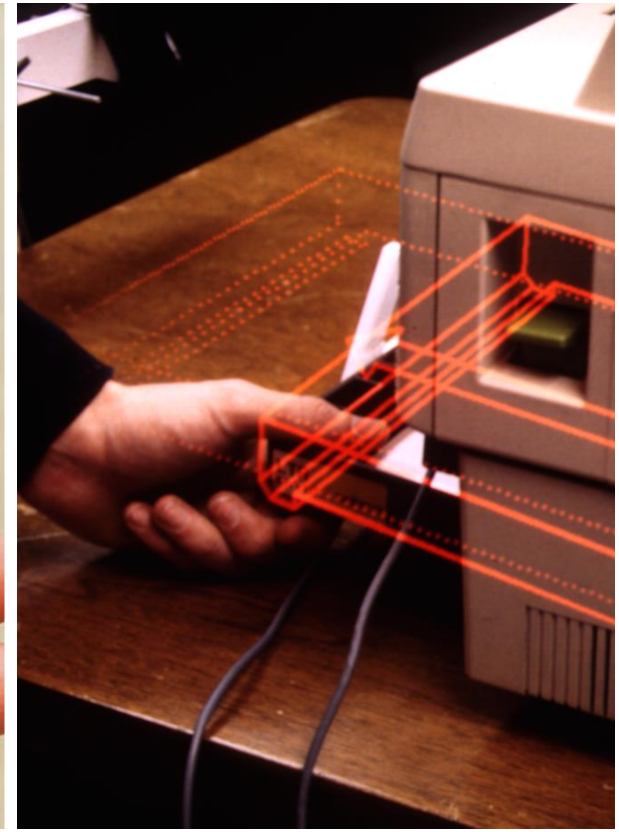


Eye Movement as Input

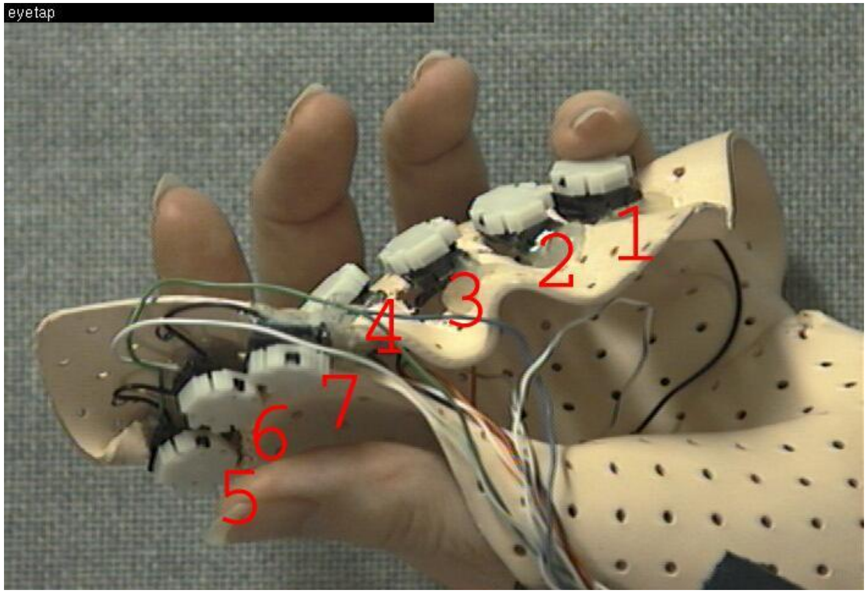
Haptic Interfaces







Augmented Reality



Wearable Computing

Computation devices accompany you, rather than you seeking them out

Speech Input

- Human beings have a great and natural mastery of speech
  - makes it difficult to appreciate the complexities
  - but it’s an easy medium for communication

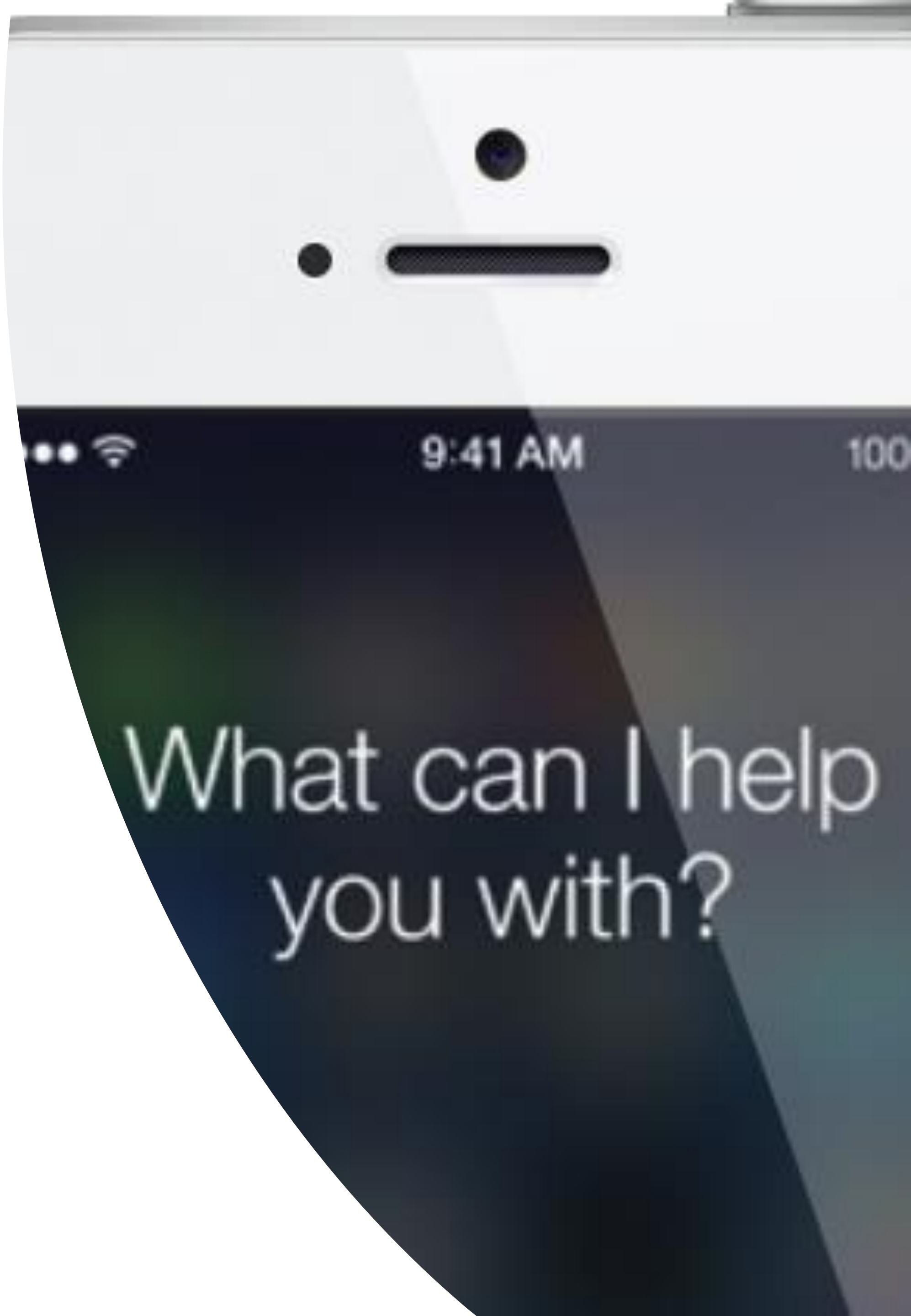
Windows Speech Recognition

- Supplied with every Windows machine
  - From ‘98 on
  - Almost no one used it
- What was the problem?
  - Need to “train” users to use early virtual assistants (VAs)
  - Microphone expense determines quality
  - No app buy-in.

And Then There Was Siri

A Technical Success

- Consistent microphone gives predictable quality
- Inclusion on every iPhone made it mainstream

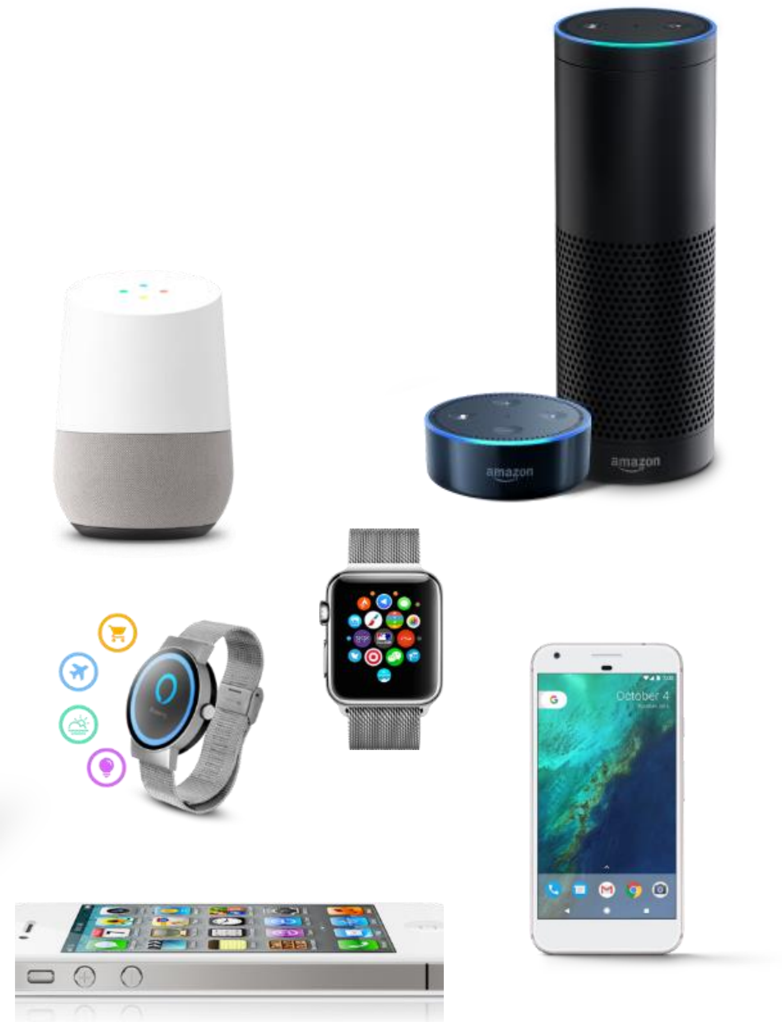


And Then There Was Siri

- Misunderstandings
- Limited skills
- What Apple wants isn't always what users want
- No 3rd parties; limited innovation and evolution

Current Incarnations

- What these look like now
  - Specialized hardware
  - Domestic setting
  - Initially aimed at home automation
  - Mostly used for home entertainment
  - All open to 3rd parties



Voice "Explodes" into Mainstream

amazon alexa

Google

IBM Watson™

Microsoft

Hi. I'm Cortana.

Ask me a question!

Seven Design Principles

1. **Equitable use**
   - same means for all users, do not segregate/stigmatize users, make design appealing

2. **Flexibility in use**
   - provide choice of methods & adapt to user's pace

3. **Simplicity and intuitiveness of use**
   - support user's expectations
   - accommodate different languages and literacy skills
   - provide prompting and feedback

Seven Design Principles

4. **Perceptible information**
    - redundancy of information: use different forms/modes
    - emphasize essential information

5. **Tolerance for error**
    - minimize impact caused by mistakes
    - remove potentially dangerous situations
    - hazards should be shielded by warnings

Seven Design Principles

6. Low physical effort

- comfort; minimize fatigue and effort
- repetitive or sustained actions should be avoided

7. Size and space for approach and use

- placement of system should be reachable by all users
- consider line of sight for standing and sitting user
- allow for variation in hand size
- provide room for assistive devices

Disabilities

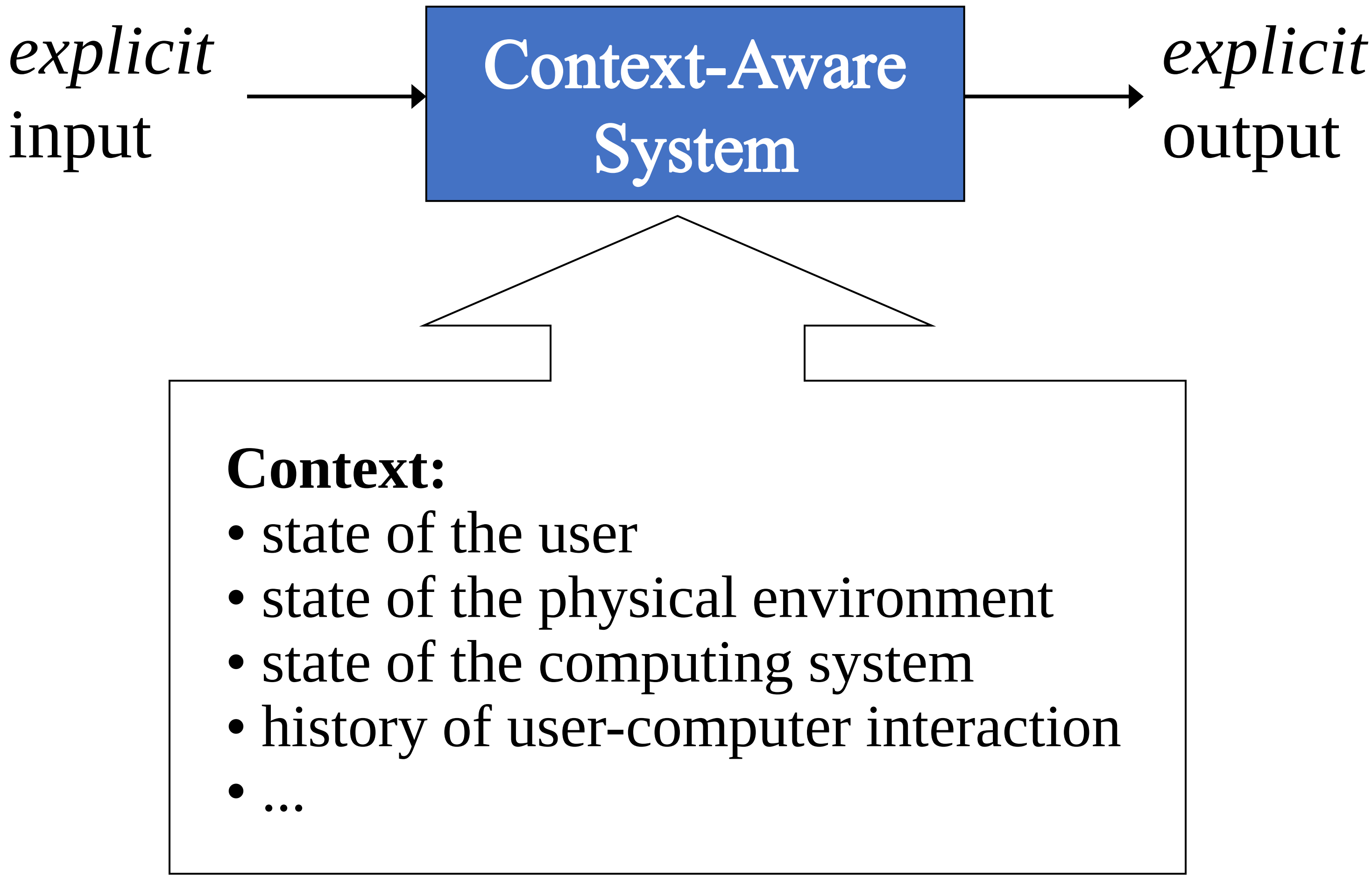
- Federal law to ensure access to IT, including computers and web sites.
  - Vision (low vision, blind, color blind)
  - Hearing (deaf, limited hearing)
  - Mobility
  - Learning (dyslexia, attention deficit)

Disabilities

- Keyboard and mouse alternatives
- Color coding
- Font size
- Contrast
- Text descriptors for web images
- Magnification
- Text-to-speech; speech recognition
- Head-mounted optical mice
- Eye gaze control

System Structure

Context as **Implicit** Input



What is Context?

Examples of Context

- Identity (user, others, objects)
- Location
- Date/Time
- Environment
- Emotional state
- Focus of attention
- Orientation
- User preferences
- Calendar (events)
- Browsing history
- Behavioral patterns
- Relationships (phonebook, call history)
- … the elements of the user’s environment that the computer knows about…

Relevance of Context Information

- Trying to arrange lunch meeting
- Going to a job interview
- Going home after work and making evening plans
- Shopping
- Tourist
- ...

Definitions of Context

- “Context is **any information that can be used to characterize the situation of an entity**. An entity is a person, place, or object that is considered **relevant** to the interaction between a user and an application, including the user and applications themselves” [Dey et al. 2001]

Classification

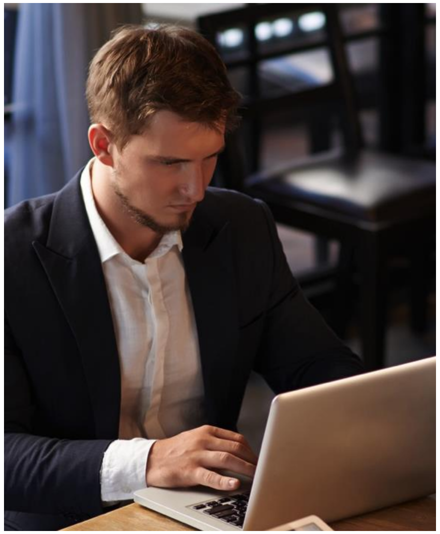
External (physical)

- Context that can be measured by hardware sensors
- Examples: location, light, sound, movement, touch, temperature, air pressure, etc.

Internal (logical)

- Mostly specified by the user or captured monitoring the user's interaction
- Examples: the user's goal, tasks, work context, business processes, the user's emotional state, etc.

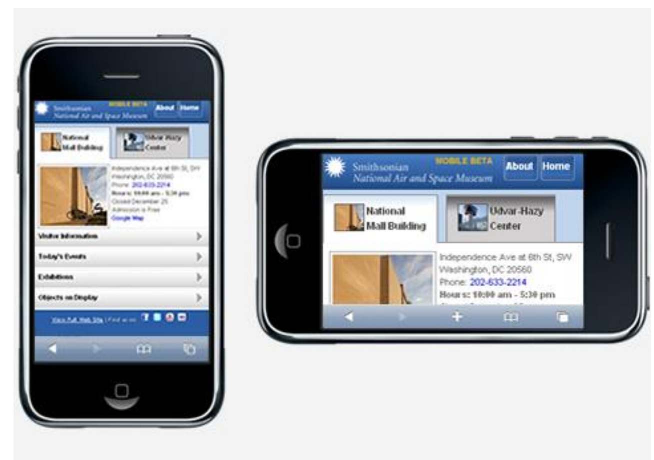
Context?



Context?

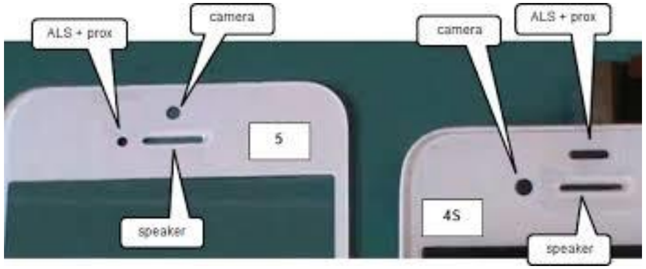
Simple Everyday Examples

- Smartphone adjusts the screen to the orientation of the device
- Apple Watch turns on display if arm lifted/rotated
- Orientation is determined by using both a gyroscope and an accelerometer



Simple Everyday Examples

- Phone display adjusts the brightness of the display based on the surrounding area
- Uses a light sensor



Simple Everyday Examples

- Device displays user's location, shows route to a desired destination, find nearby stores, geotag images on social media, etc.
- Uses location sensor

Simple Everyday Examples

- The time is displayed on the phone
  - Time zone change
  - Daylight savings time

Simple Everyday Examples

- Device disables touch screen when the user speaks on the phone
- Uses a proximity sensor (infrared signal travel time)

Challenges

- Lack of self-awareness
  - Knowing when to do or not to do something is hard
- Complexity
  - More rules do not necessarily yield more intelligence
  - But will become harder to maintain and understand
- Human-in-the-loop vs. automation
  - Loss of control vs. risk of human error
- Development
  - Sensing, aggregation, rules, etc., are complex issues
- Privacy
- User preferences
- Information overload

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