DES535
Ubiquitous Computing

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Google Classroom Code : pcwnf5t

Core Characteristics of Ubiquitous Computing (UC) Systems

1. Computers need to be networked, distributed and transparently accessible.

2. Human computer interaction needs to be hidden more.

    - Implicit HCI over Explicit HCI

3. Computers need to be **context aware** in order to optimise their operation in their environment.

4. Computers can operate autonomously, without human intervention, be self governed, in contrast to pure human computer interaction.

5. Computers can handle a multiplicity of dynamic actions and interactions, governed by intelligent decision making.

Terms Related to UC

- **Context-awareness** : The “five W’s” of context:

1. **Who (identity)**

Current systems focus their interaction on the identity of one particular user, rarely incorporating identity information about other people in the environment. As human beings, we tailor our activities and recall events from the past based on the presence of other people.

Abowd, Gregory D., and Elizabeth D. Mynatt. "Charting past, present, and future research in ubiquitous computing." ACM Transactions on Computer-Human Interaction (TOCHI) 7.1 (2000): 29-58. https://dl.acm.org/doi/pdf/10.1145/344949.344988

The “five W’s” of context

2. What (action)

The interaction in current systems either assumes what the user is doing or leaves the question open. Perceiving and interpreting human activity is a difficult problem. Nevertheless, interaction with continuously worn, context-driven devices will likely need to incorporate interpretations of human activity to be able to provide useful information.

Abowd, Gregory D., and Elizabeth D. Mynatt. "Charting past, present, and future research in ubiquitous computing." ACM Transactions on Computer-Human Interaction (TOCHI) 7.1 (2000): 29-58. https://dl.acm.org/doi/pdf/10.1145/344949.344988

The “five W’s” of context

3. Where (location)

- In many ways, the “where” component of context has been explored more than the others. Of particular interest is coupling notions of “where” with other contextual information, such as “when.”
- Some tour guide systems have theorized about learning from a history of movements in the physical world, perhaps to tailor information display based on the perceived path of interest by the user. Again these ideas need fuller exploration.

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The “five W’s” of context

4. When (time)

- With the exception of using time as an index into a captured record or summarizing how long a person has been at a particular location, most context-driven applications are unaware of the passage of time.
- Of particular interest is understanding relative changes in time as an aid for interpreting human activity.
- For example, brief visits at an exhibit could be indicative of a general lack of interest.
- Additionally, when a baseline of behavior can be established, action that violates a perceived pattern would be of particular interest. For example, a context aware home might notice when an elderly person deviated from a typically active morning routine

Abowd, Gregory D., and Elizabeth D. Mynatt. "Charting past, present, and future research in ubiquitous computing." ACM Transactions on Computer-Human Interaction (TOCHI) 7.1 (2000): 29-58.

The “five W’s” of context

Hardest

5. Why (reason)

- Even more challenging than perceiving “what” a person is doing is understanding “why” that person is doing it.

- Sensing other forms of contextual information that could give an indication of a person’s affective state such as body temperature, heart rate, and galvanic skin response, may be a useful place to start.

Abowd, Gregory D., and Elizabeth D. Mynatt. "Charting past, present, and future research in ubiquitous computing." ACM Transactions on Computer-Human Interaction (TOCHI) 7.1 (2000): 29-58.

Context-Awareness : Early Example

Georgia Tech's Aware House

Technology-specific research agenda

- Context Awareness and Ubiquitous Sensing
- Individual Interaction with the Home
- Smart Floor
- Finding Lost Objects

Human-specific research agenda

- Elderly Care

https://sites.cc.gatech.edu/fce/house/cobuild99_final.html

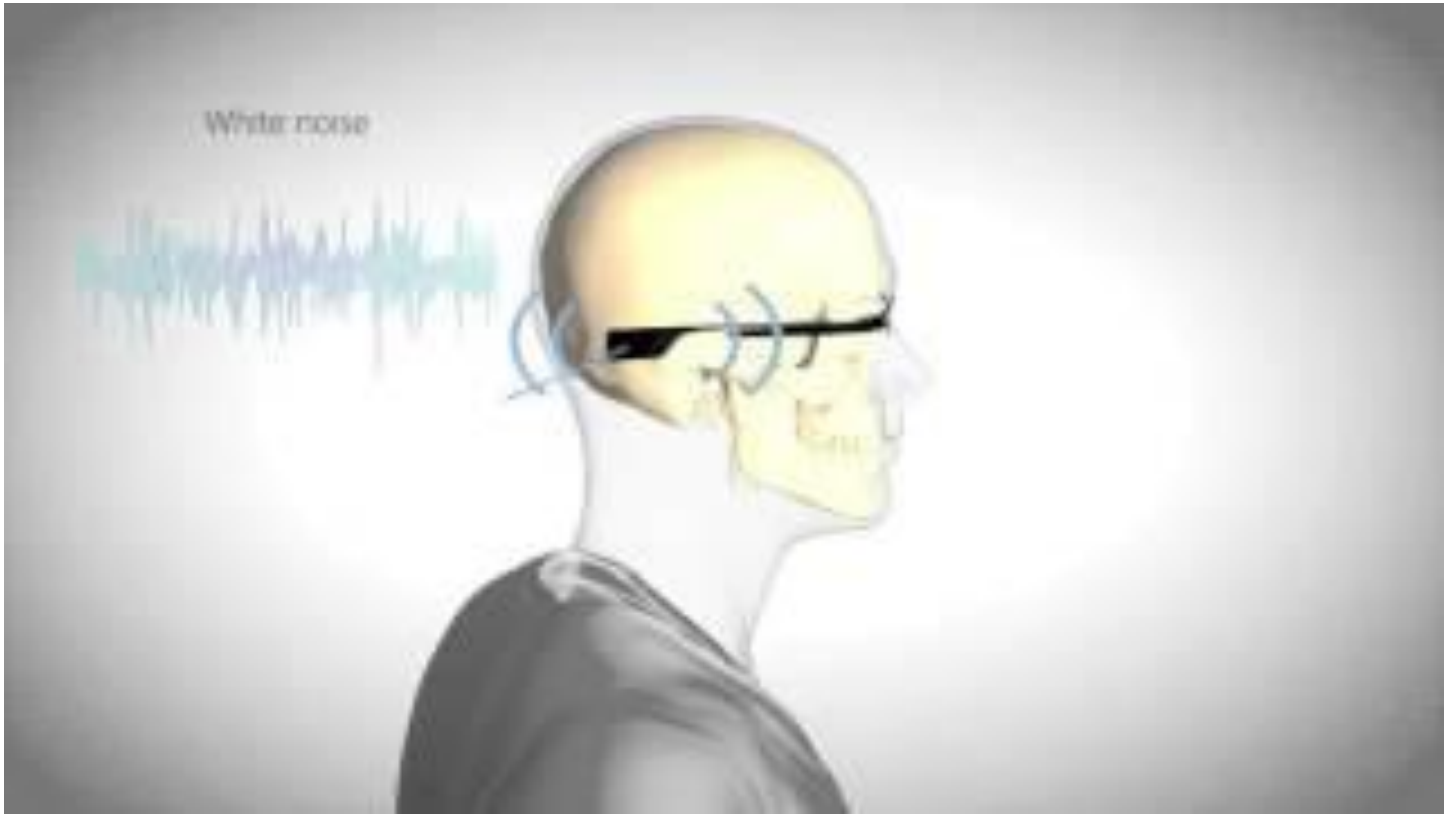
Context-Awareness : Modern Examples

Zhang, Yang, et al. "Wall++ room-scale interactive and context-aware sensing." *Proceedings of the 2018 chi conference on human factors in computing systems*. 2018.

Context-Awareness : Modern Examples

Das, Debasree, Sandip Chakraborty, and Bivas Mitra. "DriveR: Towards Generating a Dynamic Road Safety Map with Causal Contexts." *Proceedings of the ACM on Human-Computer Interaction* 8.MHCI (2024): 1-35.

Context-Awareness : Modern Examples



Youtube: ACM SIGCHI

Context-Awareness : Modern Examples

Youtube: ACM SIGCHI

Terms Related to UC

Calm Technology

Calm technologies are said to calm us as they can empower our periphery in three ways:

- to engage both the centre of our locus of attention and the periphery of our attention
  - Example : Nudges and Notifications
- to enhance our peripheral reach by bringing more details into the periphery.
  - Example : Video conferences and it's add on features
- to offer locatedness (location awareness)
  - Example : Smarthomes with location-aware devices

Wiley. (2009). *Ubiquitous Computing: Smart Devices, Environments, and Interactions*. Wiley.

Terms Related to UC

Invisibility : Analogical to printing technology “gets out of the way” of the user, allowing the higher-level goal of reading a story, or acquiring knowledge

Food for Thought

Imagine the capabilities of a mere motion-aware computer:

- Posture and gesture recognition
- Movement analysis
- Rotation Analysis

Activity

Reading the instantaneous values of different sensors of your smartphone through button clicks.