Human-Computer Interaction

Mobile & Tangible Computing

Professor Bilge Mutlu

Questions

To ask questions during class:

» Go to slido.com and use code **#2938904** or direct link or scan QR code

» Anonymous

» I will monitor during class

Today's Agenda

» Q&A: *Upcoming project milestones*

» Topic overview: *Mobile & Tangible Computing*

» Discussion

Project Timeline

- April 19 — Data collection
- April 29, May 1 — Final presentation
- May 3 — Data analysis
- May 8 — Final paper

Three Visions

Three visions that have shaped mobile and tangible computing research:

1. **Vision 1:** Communication will be mobile and ubiquitous, facilitated by networked small, handheld devices ↠ *Mobile Computing*

2. **Vision 2:** Computing will be pervasive and embedded within environments, facilitated by specialized, networked, and invisible computers ↠ *Internet of Things*

3. **Vision 3:** Computing will be physical, tangible, and manipulatable by people, facilitated by platforms and props that recognize human intent and expressions ↠ *Tangible Computing*

What is the history behind these visions?

Vision 1: **Mobile Computing**

Harold Osborne (chief engineer for AT&T) predicted in 1954:[1]

Let us say in the ultimate, whenever a baby is born anywhere in the world, he is given at birth a number which will be his telephone number for life. As soon as he can talk, he is given a watch-like device with ten little buttons on one side and a screen on the other. Thus equipped, at any time when he wishes to talk with anyone in the world, he will pull out the device and punch on the keys the number of his friend. Then turning the device over, he will hear the voice of his friend and see his face on the screen, in color and in three dimensions. If he does not see and hear him he will know that the friend is dead.

[1] Harold Osborne

An illustration of Osborne's *watch-like mobile communication device.*[2]

[2] Ling, 2004, The Mobile Connection

*Where is the research in **mobile computing**?*

» **Example 1:** Wish You Were Here (Venolia et al., 2018)

» **Example 2:** Geocaching with a Beam (Heshmat et al., 2018)

» **Example 3:** Supporting Elder Connectedness (Kleinberger et al., 2019)

Vision 2: **Internet of Things**

(a.k.a. Ubiquitous & Pervasive Computing)

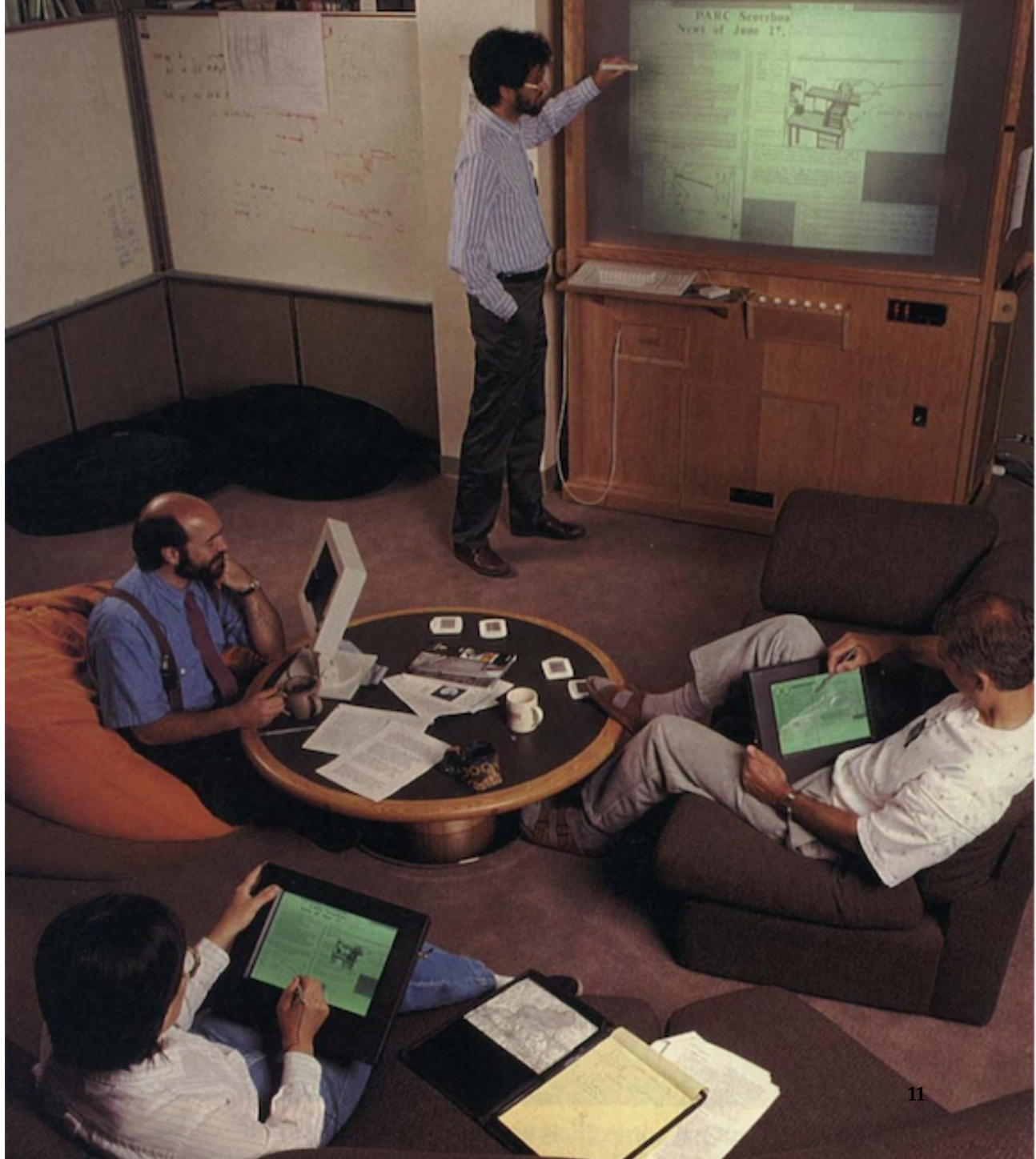
Mark Weiser (CTO of Xerox PARC) proposed in 1991:[3]

Ubiquitous computing names the third wave in computing, just now beginning. First were mainframes, each shared by lots of people. Now we are in the personal computing era, person and machine staring uneasily at each other across the desktop. Next comes ubiquitous computing, or the age of calm technology, when technology recedes into the background of our lives.

[3] Wikipedia: Mark Weiser

The Computer for the 21st Century:

Ubiquitous computing begins to emerge in the form of live boards that replace chalkboards as well as in other devices at the Xerox Palo Alto Research Center. Computer scientists gather around a live board for discussion. Building board and integrating them with other tools has helped researchers understand better the eventual shape of ubiquitous computing. In conjunction with active badges, live boards can customize the information they display.[4]



[4] Weiser, 1991, The Computer for the 21st Century

Principles of Calm Technology[5]

1. Technology should require the smallest possible amount of attention
2. Technology should inform and create calm
3. Technology should make use of the periphery
4. Technology should amplify the best of technology and … humanity
5. Technology can communicate, but doesn’t need to speak
6. Technology should work even when it fails
7. Right amount of technology = minimum needed to solve the problem
8. Technology should respect social norms

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[5] Calm Technology

*Where is the research in **pervasive/ubiquitous computing**?*

» **Example 1:** Wall ++ (Zhang et al., 2018)

» **Example 2:** Zensors (Laput et al., 2015)

» **Example 3:** Ubicoustics (Laput et al., 2018)

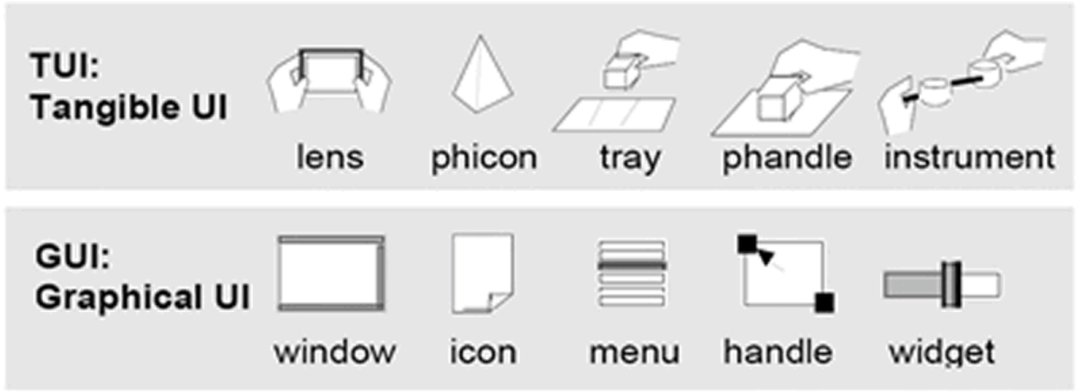
Vision 3: **Tangible Computing**

Hiroshi Ishii and Brygg Ullmer proposed in 1997:[6]

Humans have evolved a heightened ability to sense and manipulate the physical world, yet the GUI based on intangible pixels takes little advantage of this capacity. The TUI builds upon our dexterity by embodying digital information in physical space. TUIs expand the affordances of physical objects, surfaces, and spaces so they can support direct engagement with the digital world.

[6] Ishii & Ullmer, 1997, Tangible Bits

Physical instantiation of GUI elements in TUI[6]



metaDESK by Ishii and Ullmer[7]

[6] Ishii & Ullmer, 1997, Tangible Bits

[7] YouTube

*Where is the research in **tangible computing**?*

» **Example 1:** Affordance++, (Lopes et al., 2015)

» **Example 2:** Shape-shifting displays (Shape Lab)

» **Example 3:** Project Zanzibar (Microsoft Research)

Discussion Format

- Group discussion ~15 minutes
  - Separate to 9 groups randomly
  - Discuss with your group members
  - Take notes in the shared doc – pick your group number
- Summary from each group & discussion ~10 minutes

Discussion Questions

- Are these visions in *conflict*?
- What are *opportunities/challenges* associated with each vision?
- Are there developments that these visions have missed?
- What mobile/pervasive/tangible technologies do you use?
- What external resources have you identified in this space?
- …