Ubiquitous Computing

Related Research Areas & Examples

Related Research Areas

Public Interactions

Software Agents

Invisible/Silent/Calm Interfaces

Mobile-Nomadic Computing

Tangible Interfaces

Mechatronics

Ubiquitous Computing

Embedded computers

Context sensitivity

Wearable Computing

Adaptive services

Augmented Reality

Ad hoc Networks

What Augmented Reality (AR) is?* (1/4)

- All aspects of the physical world can be correlated with computing capabilities that **augments** the traditional physical aspects

- With the help of advanced AR technology (e.g. adding "*computer vision*" and "*object recognition*") the information about the surrounding real world of the user becomes **interactive** and **digitally manipulable**

(*Excerpt from: https://en.wikipedia.org/wiki/Augmented_reality)

What Augmented Reality (AR) is? (2/4)

- Information/content about the environment and its objects is overlaid on the real world. This information or knowledge can be virtual or real!

- AR brings out the components of the digital world into a person's perceived real world

- We can pose AR, Mediated Reality/Mixed Reality and Virtual Reality (VR) in a line, AR & VR are on the opposite side

What Augmented Reality (AR) is? (3/4)

- Which are the involved technology (HW, SW & algorithms, applications)?
- You will answer to these questions with presentations
- Many application domains:
  - Literature,**Archaeology**, Architecture, Visual art, Commerce, **Education**, Emergency management/search and rescue, Video games, Industrial design, Medical, (continue…)

What Augmented Reality (AR) is? (4/4)

- …(continued)
  - Spatial immersion and interaction, Flight training, Military, Navigation, Workplace, Broadcast and live events, Tourism and sightseeing, Translation, Music
- You can choose to deepen one application domain for your presentation!
- In the following slides I will present some examples of AR

AR: Digital Desk

- One of the first examples is DigitalDesk (Xerox, 1992)
- The PC is based on the desk metaphor; everybody work on two desks: the PC & the physical desk
- Why do not augment the physical desk with virtual information?
- http://www.youtube.com/watch?v=laApNiNpnvI

Useful information are shown on the windscreen

Augmented Reality: Some Example

Ray-Ban Virtual Mirror

Cosmetic Mirror

Live AR National Geographic

Augmented Reality: Tourism

"The World Park", New York
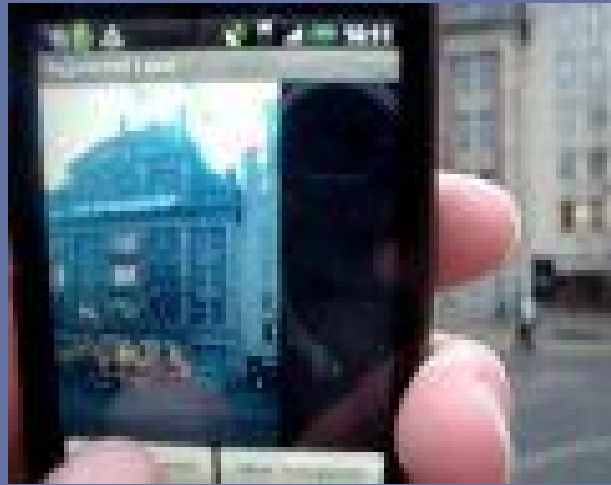QR Code

Tuscany+
iPhone app

tagMyLagoon, Venezia
QR Code

Torino, Microsoft Tag

Augmented Reality: Tourism & Past

Amsterdam

Actual pictures are overlaid with old pictures/paintings of the same scene

Milano d'autore

Un percorso temporale sulle tracce di Ermanno Olmi

AR: Some Technology

- **Quick Response Code (QRCode)**
  - Two-dimensional barcode with a matrix, it contains information which are read with a smartphone

- **Microsoft Tag**
  - Barcoding multicolor proprietary

- **Radio Frequency Identification (RFID)**
  - A unique and universal identifier coupled to each single object, it is acquired by systems of radio frequency

Tangible interfaces – Tangible Bits

Tangible Media group (MIT)

- *Where atoms meet bits*
  - **Tangible** = capable of being perceived especially by the sense of touch

- Facing the challenge of reconciling our dual citizenship in the physical and digital worlds

- Seeking a seamless coupling of bits and atoms by giving physical form to digital information and computation

Tangible Bits: a couple of examples

- **Trackmate** is an inexpensive, do-it-yourself tangible tracking system that allows your computer to recognize tagged objects and their corresponding position, rotation, and color information when placed on a surface
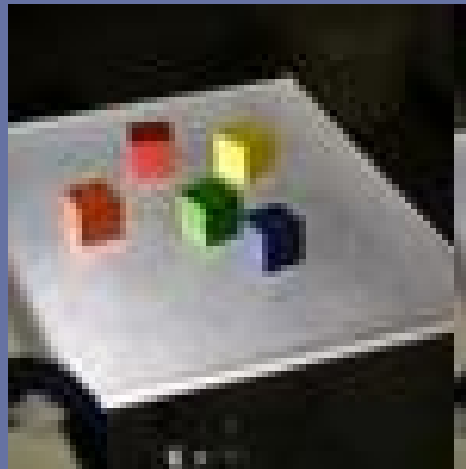
Tangible Bits: a couple of examples

- **I/O Brush** is a new drawing tool to explore colors and textures found in everyday materials by "picking up" and drawing with them. It has a small video camera with lights and touch sensors embedded inside

Public Interactions: MultiTouch Cells (Finland)

When computing devices become ubiquitous, the amount of *public* devices will increase; MultiTouch cells now named MultiTaction (e.g. Huge Interactive Wall, Interactive bar, Siemens, Music with marker)

(Semi-)public Interaction

Social affordances of tables/wall

InteracTable and Dynawall, (Roomware)
From http://www.smart-future.net/themes-and-issues/roomware/

Again Display & multi-touch interaction

- BendDesk:
  http://www.youtube.com/watch?v=5V
  NTPwVvLzE

- A day made of Glass 2 by Corning Ltd
  (www.corning.com):
  - http://www.youtube.com/watch?v=jZkHp
    NnXLB0
  - http://www.youtube.com/watch?v=X-
    GXO_urMow

Context Sensitivity – The focus of this course

- Sensors that measures non traditional modalities
  - Focus of attention
  - Location
  - History
  - Local computing environment

- Measure Emotion via facial expression recognition:
  - Affective Computing & Empathic tech [Rosalyn Picard, MIT laboratory]: https://www.affectiva.com (sdk available)
  - Emotion aware computing (comprata da Apple):https://imotions.com/emotient/ https://imotions.com/request-demo-thank-you/

- User/Task modeling -> Context modeling

Adaptive Services – The focus of this course

- Sensors /Observation
  - User
  - Task
  - Physical context
  - Organization context
- Inference
- **Modified behavior** of the services

Embedded Computers

- Computers are becoming smaller and cheaper ->

- Everyday things will to a higher extent be "computerized".

  - Analogy: **Electric motors** used to be large, powering several appliances. They are nowadays embedded in the devices and invisible, so that the user sees a task-specific tool and not the technology of motors. "Computers as well as motors are *enablers* and *infrastructure*." (Donald Norman)

Invisible/Silent/Calm Interfaces

- Computers -> Appliances
  - Each device are specialized for the task it performs
  - The user is largely unaware of interacting with a computing or communication device
- Unobtrusiveness
  - The focus of attention is not forced towards a single box
  - Dwelling instead of interacting with computers
  - Ambient media: Peripheral sound and light
  - *No one should ever have to see a computer*

Wearable Computing 1/2

- ## Access information anywhere

  - Heads-up Displays (HUD): GoogleGlass
    https://www.youtube.com/watch?v=G1XdSf33cjQ (italiano)
    https://www.youtube.com/watch?v=IaU6DWb0yzs (English)

- ## Wearable technology

Winter sport, mountain bike

Track racing

Wearable Computing 2/2

- Activity Trackers:
- https://www.youtube.com/watch?v=PwtvTN7zw90 (2018)
- https://www.youtube.com/watch?v=_U9qux0C7q4 (2017)

Mobile-Nomadic Computing –out of our scope

- ## Mobile computing

  - Extreme:
    User carry "work context" with him wherever he moves in the physical world

- ## Nomadic Computing

  - Extreme:
    "Work context" travel in parallel with the user in the electronic world. The user carries nothing

- ## Intermediate forms

Ad-hoc networks – out of our scope

- Mobile Ad-hoc networks (MANET)
  - Bluetooth
  - WLAN
- (Jini)
- Dynamic context adaptation

Software Agents – out of our scope

- Software agents = Software components with:

  - Autonomy

  - Persistence

  - Non trivial long term behavior

    - Proactive

    - Reactive

    - Reflective

- Adaptivity

- Senso-motoric skills

Selected Bibliography

- Donald Norman:
  - The design of the everyday things
  - La caffettiera del masochista (italiano)