TOWARDS THE ENGINEERING OF AGENT-BASED AUGMENTED WORLDS

Angelo Croatti, Alessandro Ricci

DISI - University of Bologna - Italy

EMAS 2017
“AUGMENTATION”
“AUGMENTING HUMAN INTELLECT”
FRAMEWORK (1962)

a research center
for augmenting human intellect

(DOUG ENGELBART, 1962/1968)

http://www.1968demo.org/
“AUGMENTING HUMAN INTELLECT” FRAMEWORK (1962)

“we mean increasing the capability of a man to approach a complex problem situation, to gain comprehension to suit his particular needs, and to derive solutions to problems”

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“we mean increasing the capability of a man to approach a complex problem situation, to gain comprehension to suit his particular needs, and to derive solutions to problems”

“more-rapid comprehension, better comprehension, the possibility of gaining a useful degree of comprehension in a situation that previously was too complex, speedier solutions, better solutions, and the possibility of finding solutions to problems that before seemed insoluble”
“AUGMENTED WORLDS” (AW)

- Augmentation of the *physical environment*
  - *augmented reality* & *pervasive computing*
- Augmentation of the *human users*
  - *wearable computing*
AUGMENTED & MIXED REALITY
"Merging of real and virtual worlds to produce new environments and visualizations where physical and digital objects co-exist and interact in real time"

"Understanding Augmented Reality" - by Alan B. Craig
AUGMENTED & MIXED REALITY

“anywhere between the extrema of the virtuality continuum” [Milgram, Kishino]
“MERGING” (REGISTRATION)
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- Indoor / outdoor AR/MR
  - computer vision & sensor-based techniques
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• Indoor / outdoor AR/MR
  - computer vision & sensor-based techniques
    • fiducial markers, GPS, depth-sensors,…

• **Hologram** perspective
  - Microsoft Hololens, Meta2, Magic Leap…
AR/MR DEVICES

- Smartphones
- Head Mounted Display
  - smartglasses
  - visors
  - future (?) : contact-lens
PHYSICAL ENVIRONMENT AUGMENTATION: PERVERSIVE/UBIQUITOUS COMPUTING

(~90ies)
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- Enhancing the functionalities of physical environments and objects by means of embedded computational and network capabilities
PHYSICAL ENVIRONMENT AUGMENTATION: PERVERSIVE/UBIQUITOUS COMPUTING

• Enhancing the functionalities of physical environments and objects by means of embedded computational and network capabilities

The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it.

~Mark Weiser
HUMAN AUGMENTATION
HUMAN AUGMENTATION

WEARABLE COMPUTING

EYEWER COMPUTING
HUMAN AUGMENTATION

WEARABLE COMPUTING

EYEWER COMPUTING
HUMAN AUGMENTATION

WEARABLE COMPUTING

EYEWER COMPUTING
“HANDS-FREE” SYSTEMS
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- Exploiting computer-based functionalities and services *on-the-go*, without interrupting your activities
  - wearable devices as “*extension of the self*”
    - T. Starner (IEEE Pervasive Computing - Volume 12 Issue 2, April 2013)
“HANDS-FREE” SYSTEMS

• Exploiting computer-based functionalities and services \textit{on-the-go}, without interrupting your activities
  ‣ wearable devices as “\textit{extension of the self}"
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• Strong impact on applications
  ‣ maintenance & repair, manufacturing, healthcare, logistics, …
WHAT AGENTS CAN DO FOR AW?
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• Principled way (models, methods, techniques, technologies) to model, design, develop AW featuring levels of
  - autonomous behaviour
  • pro-activity, besides reactivity
  - decentralisation of control and distribution
WHAT AW CAN DO FOR AGENTS?
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• Conceptual framework to integrate existing agent research lines
  - agents & augmented/mixed reality
  - agents & pervasive computing
  - interface agents, virtual agents
  - ...
• Providing new issues and perspectives to consider
AGENTS FOR AW: TWO MAIN PERSPECTIVES

- Agents augmenting the users
- Agents augmenting the physical environment
A NEW GENERATION OF PERSONAL ASSISTANT AGENTS

- “I see what you see”
  - perceiving and reasoning about what the users is perceiving (and is not perceiving) of the physical context

- Fruitful interaction with eyewear computing research community
A NEW GENERATION OF PERSONAL ASSISTANT AGENTS

• **Agents as an augmentation of the self**
  - from the “delegation perspective” to the “augmentation perspective”
  - from explicit to implicit interaction/communication

• Agents capability empowering humans’ ones
  - both at the individual and group level
A NEW GENERATION OF PERSONAL ASSISTANT AGENTS

- **Agents as mediators for augmented realities**
  - to deal with rich worlds
    - filtering/selecting/focusing/hiding…
- Enriching the spectrum of agent research in
  - context-aware computing
  - interface agents
A NEW GENERATION OF SMART ENVIRONMENTS

• Agents shaping augmented realities
  - agents used to model and design the structure and behaviour our augmented realities

• Existing agent research
  - AR/MR
  - Ambient Intelligence
A NEW GENERATION OF SMART ENVIRONMENTS

- Towards augmented societies
  - exploring cognitive, social, organisational perspective
- Fruitful interaction with research lines in cognitive and social science exploring AR impact
MODELING & ENGINEERING AW

- Agent-based models, methods, technologies, platforms for engineering AW
  - proper level of abstraction
- Integrating existing AW enabling technologies
  - AR/MR platforms
    - e.g. ARToolkit, Vuforia, Unity+Vuforia, Hololens, ..
A CONCEPTUAL MODEL FOR AW

- Generalisation of the *Mirror World* model
- Concepts
  - **Augmented Entity (AE)**
  - Holograms
  - Region
A CONCEPTUAL MODEL FOR AW

Characteristics
- Spatial coupling
- Discovery & observability
- User modelling & interaction
- Physical embedding & coupling
TOWARDS AN OPEN PLATFORM FOR AW

• Objective
  - exploiting existing agent programming platforms / frameworks / technologies for building and running AWs
  - exploiting the “environment” dimension
    • e.g. EIS, CArtAgO
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• The idea
  - designing & developing an open platform infrastructure that
    • allows for using different agent technologies for developing agents and agent-related abstractions
    • is based on possibly lower-level heterogeneous augmentation technologies
FROM IoT to WoT to the **WEB OF AUGMENTED THINGS** (WoAT)

• Reusing the IoT/WoT lesson for conceiving the platform
  - Web as a REST-based platform

• Integration with research work on Web/REST + Agents
  - see e.g. Ciortea, EMAS 2017
IN THE RESEARCH AGENDA…

• Refining and formalizing a (reference ?) model for AW
• Designing and developing an open platform for AW
• Relevant case studies
  - e.g. healthcare domain:
    • “augmented hospitals” or “Hospitals 4.0”
    • first steps: paper in A2HC workshop
THANK YOU.