




ADAPTIVE SOCIO-TECHNICAL PERVASIVE SYSTEMS: CHALLENGING CASE STUDIES

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MOTIVATIONS (OF THIS TALK AND OF THE SUMMER SCHOOL IN GENERAL)

- Trying to show you something interesting, i.e.,
 - About the existence of interesting technology/science for pervasive adaptation and adaptive socio-technical systems
 - How to apply such technologies and how science can be of help to better understand them
 - Seeing far in the future of pervasive adaptation and socio-technical systems
 - Trying to have you discuss with each other and exchange experience and knowledge
 - Social events
 - Group work
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THE GROUP PROJECTS: OVERVIEW

- Now (with this talk):
 - Identify a few interesting/visionary/challenging future application scenarios
 - In which “pervasive socio-technical adaptation” research/technology can be effectively applied
- After this talk
 - Group students in teams of 4-5 and assign a case study to each one
- Following (during the summer school)
 - Adopt the identified case studies as the themes of group projects (one for each group)
 - To be expanded/developed by exploiting the lessons learnt at the school, and by applying models/technologies presented by speakers
 - To be presented during the last day
 - And to be possibly worked out into survey/vision papers




THE METHODOLOGY FOR GROUP PROJECTS (1)


- I will only “sketch” the general vision behind the case study scenarios
 - Do not go into technical details or into the details of the envisioned functioning of applications within
- You will have to detail the scenario with your own visions of usage, functionalities, and technological solutions
 - Possibly revising (or even totally scrambling) the scenario if you think so
 - Going as far as possible in terms of “conceptual design”
 - Trying to identify open challenging issues too
- There are specific time slots devoted to group project
 - However, since we are all here, we can work on projects at any time and at any place
 - Inter-group interactions are encouraged



THE METHODOLOGY FOR GROUP PROJECTS (2)

- The tutorialists, during the week
 - Will be around to discuss with
 - Will try to refer to case studies in their talk
 - In some cases, they will actively participate with you in building your group projects (visionary mind exercises are fun for seniors too!)
 - On the last day
 - You will finalize the project and its presentation
 - You will present it to the others
 - Past the school
 - You can continue refining the workgroup project
 - Turning it into a research proposal or
 - Into a visionary position paper
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WHAT CHARACTERIZES THE CASE STUDIES?

- Medium/long-term social/technological scenarios in which:
 - Pervasive computing technologies (sensors, tags, PDAs, wireless communications, etc.) have become massively pervasive (houses, streets, offices, etc.)
 - And can be put to the service of people (whoever) and society
 - Can enrich human capabilities
 - Yet, for them to be very useful
 - They require capability of dynamically self-organize and self-adapt their computational/communication activities
 - i.e., they require “Pervasive Adaptation at the Socio-Technical Level”
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THE SELECTED CASE STUDIES

- A single scenario:
 - The *urban organism*
- Different specific case studies with different goals
 - Adaptive crowdsourcing of city maintenance
 - Zero-stress mobility
 - Let the children play
 - Smart energy management
- Yes many common points
 - Intensive exploitation of pervasive computing technologies
 - Strongly embedded in the physical and social fabrics
 - Dealing with social (and psychological) aspects
 - Need for adaptation at both the social and the ICT level
- Also (possibly, you will tell us)
 - Many technical solutions and issues that can be shared by more than a single scenario
 - Many “sub-parts” than can be useful to several scenarios

THE URBAN ORGANISM SCENARIO (I)

- An ICT-enriched urban environment with rich sensing, actuating, and computing capabilities
 - Sensing: sensor networks, rfid tags, smart objects, traffic and crowd detectors
 - Actuation: traffic lights, traffic inhibitors, digital traffic signs, public digital displays, but also critical infrastructures (electric grid, heating, phone, and wifi networks)
 - Computing: highly distributed and decentralized, with interconnected computational engines available everywhere
- People with smart phones or alike (or whatever will appear in the future as wearable devices) contribute to such capabilities
 - Sensing: beside the 5 senses (which people can input to their personal devices), also cameras, accelerometers, microphones, to contribute to the sensing capabilities of the town
 - Actuating: the body
 - Computing: human intelligences, networked via social collaboration tools

THE URBAN ORGANISM SCENARIO (II)

- The ICT and Human/Social level in the depicted scenarios are not distinct, and are rather blurred to the point of invisibility:
 - ICT-driven actions inter-twined with Human actions
 - People-driven sensing intertwined with and indistinguishable from ICT-driven one
 - Computational decisions and human-made decisions
- Their capabilities well complement each other in a process of extremely high value co-creation
 - There are things ICT still cannot do (e.g. recognize some complex visual events) for which human sensing is necessary.
 - There are things that ICT can do (e.g., enable distributed collaboration among a group of distributed persons) that humans cannot easily do
- In the resulting overall “urban organism”, we can therefore achieve very high-level of collective “urban” intelligence
 - That can dramatically change the way we live, work, move, and play, in our towns

CASE STUDY 1: CITY MAINTENANCE CROWDSOURCING

- Our municipality spend a lot of their money in try to maintain at the best our urban environment
 - Garbage collection, maintenance of roads and public green, public lights, etc.
 - A lot of human work involved, some specialized, most not
- Issues (apart from the frequent case of inefficient municipalities administrations)
 - Very costly and typically based on static planning of activities and of workforce involved
 - Not adaptive → slow in reacting to contingencies
 - Not properly accounting for the real needs of inhabitants
- Thus, since we are often unsatisfied, we either
 - (i) accept the state of things and mumble OR
 - (ii) gets proactive to improve things (e.g. get in touch with neighbours to share the load of cleaning the streets/green around our houses)
- Can the proactive approach become a systematic one?

CITY MAINTENANCE CROWDSOURCING: HOW COULD IT WORK

- A totally different perspective form current way of acting
 - No (or very little) workforce within the municipality
 - No a priori planning of maintenance activities
- Dynamic sensing of needs (a broken lamp, a hole in the street)
 - Either by humans or by digital sensors
- Dynamic recruitment of workforce
 - Robots, if available, activated and coordinated via proper ICT distributed coordination infrastructures
 - Humans, dynamically recruited via social collaboration tools, and not necessarily specialized people → *crowdsourcing*
- Issues of recruitment
 - Psychological and Social: How bring people to cooperate?
 - Economical: should I pay them? How much?
 - Technical: How? Via which infrastructures? How to coordinate them?
 - Socio-Technical: Can I keep control over what happens? What dynamics?
- Extending this idea to other area can lead to a radical revolution in our very concept of “work”

CITY MAINTENANCE CROWDSOURCING: ACTORS AND REQUIREMENTS

- Actors:
 - Municipality planners, specialized agencies, common citizens, robots, human and digital sensors, network infrastructure
 - Some “easy to be controlled” some not
- Requirements
 - Effectiveness → in terms of costs and time
 - Adaptivity in the long term → capable of working for every situation
 - Adaptivity in the long term → evolve methods and algorithms to have the overall system improve
 - Openness → anyone should be able to contribute (with sensing, computation, actuation/work)
 - Fairness → not all the money to the same persons

CITY MAINTENANCE CROWDSOURCING: YOUR TASKS

- Within the project work (*the same considerations apply to all other scenarios*) you are expected to:
- Refine the scenario, or scramble as you wish it
 - Define functionalities, expected way of using it, involved actors/devices
- Refine requirements
 - Beside the ones I have roughly indicated
- Identify a sort of “conceptual design” for a working system, which include
 - The overall system architecture
 - Technological/algorithmic solutions to be integrated within
 - Patterns of adaptation and solutions to deal with them
- Go further and try to
 - Identify open issues and grand challenges



CASE STUDY 2: ZERO-STRESS MOBILITY

- Whether you move by car, by public transport, or in some multimodal way, getting around can be very very stressful in most of the cases (and in most of the cities) – parking, queuing, delays, etc.
- Can the “urban organism” be of help?
 - Consider again the existence of sensor, actuators (e.g., digital traffic signs and adaptive traffic lights)
 - Consider “intelligent” vehicles capable of retrieving and digesting information, and communicating with other vehicles and with the urban organism
 - Consider the possibility of dynamically instantiating collaboration patterns with other citizens moving around
 - Consider the possibility of dynamically “borrow” means of transport
 - Consider the possibility of dynamically affecting the timetable of public transport
 - Consider the possibility of being entertained or being productive while commuting
- Can all of this lead to a “nearly-zero-stress” mobility model?



CASE STUDY 2: ZERO-STRESS MOBILITY EXAMPLARY SERVICE

- *Public transit recommendation.* The service allows querying information about public transport systems to reach an indented destination. Pervasive technology can improve the current state of the art (e.g., Google Transit) by:
 - Incorporating dynamic traffic conditions, available transportation means and events taking place on route
 - Incorporating user profile and preferences to recommend route and transportation means,
 - Offering proactive advices on interesting events and possibilities the user might be interested in visiting in the route to her destination
 - Detecting anomalies, unexpected and sudden change of route, and alert the user accordingly.




CASE STUDY 3: LET THE CHILDREN PLAY


- The oldest among us may remember that we were used to move around our cities in full autonomy since we were 7-8
 - The streets were our everyday playground
- No this is mostly unconceivable
 - The cities have changed, less familiar, more traffic, more dangers, etc.
 - And maybe our state of mind has changed too
- Can the urban organism be of help?
 - Continuous monitoring of children activities
 - Actuation actions to prevent dangerous situations
 - Dynamic involvement of adult citizen to support child security
 - Dynamic recruitment of citizen (robots?) to temporarily act as baby sitters
- The same technology can be used to create more compelling and interactive kind of games:
 - Pervasive computing enriched treasure hunt
 - On-line multiplayer in the city (alternate reality games)
 - Tourism and games together



CASE STUDY 4: SMART ENERGY MANAGEMENT

- Smart energy management and demand shaping is a pressing problem for future cities.
 - Extremely distributed
 - Need to have a small impact on people habits
 - Pervasive technology can be of help:
 - Smart energy grid
 - Wireless energy consumption sensors
 - Smart plugs and smart appliances
 - Challenges and opportunities
 - Predict user whereabouts and regulate heating accordingly
 - Prioritize devices and perform city-wide coordination to avoid energy peaks
 - Identify anomalies and leaks in the power network
 - Avoid cascading failure and black outs
 - Autonomic management (no need for people to pay attention)
 - But at the same time social involvement and social participation
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EXPLOITING WHAT YOU WILL LEARN WITHIN THE CASE STUDIES

- It is expected that the various lectures of the week will give you useful insights for pushing your project work ahead
 - Just to make some examples:
 - What methodology to build the scenario and its architecture?
 - Course on “Models for Pervasive Service Ecosystems”
 - How can one reach more global view of what’s happening?
 - Course on “Algorithms for Fully-distributed Socio-Technical Systems”
 - How can the overall social organization be put at work?
 - Courses on “Social Intelligence”
 - How can we interact with the system?
 - Course on “Implicit interactions”
 - How can the system recognize situations and event?
 - Courses on “Human activity recognition” and on “
 - Etc. etc.
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CONCLUSIONS

- There is a lot of fantasy and technique to be put at work in the selected case studies
- There is a lot the courses of this week can provide inspiration

- In any case:
 - Do you have alternate case studies to suggest?
 - Do you already have in mind extensions/modification to suggest to the case studies?

- Then, let start working on it!

