

Software for Context-Aware Multi-User Systems

Session 1 Introduction

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CS 895 / SWE 821

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outline

- what is...
 - ubiquitous computing
 - ambient intelligence
 - human-centric computing
 - context-aware multi-user
 - ... the course about?
- the rest of the course
 - course mechanics

the start ubiquitous(?) computing

[Weiser 91]: the most profound technologies
are those that disappear

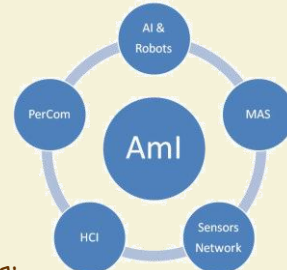
- virtual reality vs. real virtuality: mixed reality
- scale: tabs, pads, and boards
 - tabs: keep track of things (self-awareness)
 - pads: task support (grabbed/used anywhere)
 - boards: collaboration

today: many fields or one field from many perspectives

- ubiquitous/pervasive computing
- smart environments/spaces
- ambient intelligence
- human centered computing

many fields or one field from many perspectives

- ubiquitous/pervasive computing
- smart environments/spaces
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each mixes some proportion of these ingredients:

- new devices, power
- networking, security, operating systems, middleware
- HCI, vision/speech/gesture recognition, human factors
- anthropology, sociology, cognitive/learning sciences

different communities of interest funding opportunities

- ubiquitous computing
funded by NSF's CSR Computer Systems Research division
- HCC sponsored by the NSF starting in 1997
under the IIS Information and Intelligent Systems division
 - HCC PhD program at Georgia Tech
 - HCC consortium at UC, Berkeley
 - Institute of Human and Machine Cognition, Florida
 - ...
- smart health
funded by NSF cross-cutting program under
CISE Computer & Information Science & Engineering directorate

HCC [Sebe 2010]

computing connotes both concrete technologies
and a major social and economic force

- problem:
 - systems made by techies with little concern for general public
 - current path of development of computer technologies increases the gap between the educated and uneducated, and between the rich and the poor
- HCC is the development, evaluation, and dissemination of technology intended to amplify and extend the human capabilities to:
 - perceive, understand, reason, decide, and collaborate
 - conduct cognitive work
 - achieve, maintain, and exercise expertise

see also end-user programming of smart spaces

aside

HCC ≠ human-based computing

- in HBC, aka HC
computers ask humans to do hard tasks
 - fine-tune language translation
 - semantic labeling of images e.g. von Ahn's ESP game
- a form of *crowdsourcing*

HCC

multimedia production & access

- content is knowledge and vice versa
 - applications
 - life experiences photos, video, activity...
 - sports & entertainment
 - surveillance e.g. buildings, structure of bridges
 - distance education aka e-learning [Abowd 2000]
 - challenges
 - association of context and organization
 - fusion of sensor data e.g. cameras
 - synchronization of media e.g. slides, sound, video
 - semantic search
 - cultural differences -> hard to globalize content
- is this challenge to be expected?

HCC

multimedia interactions between users

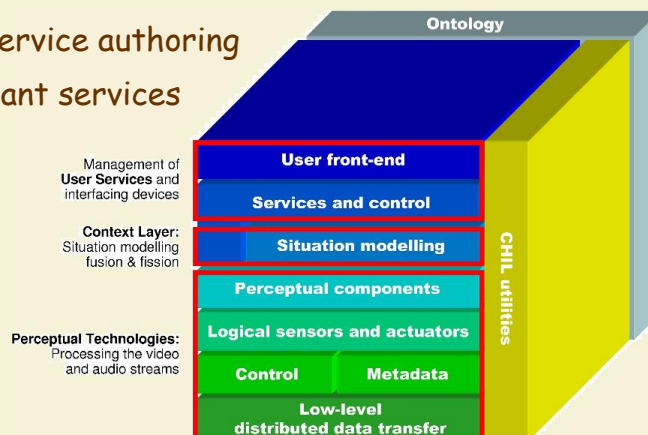
- computers become facilitators
- applications
 - social computing, telepresence
 - CSCW smart office, military, emergency response teams
 - multi-player games and virtual reality
- challenges
 - synchronous vs. asynchronous interaction
 - context awareness
 - distribution
 - connectivity delays, losses
 - timing, before and after relations
 - multi-user identification of authorship on input and output

computers in the human interaction loop chil [Waibel et al. 2010]

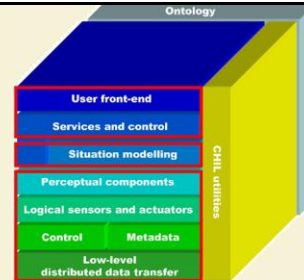
- what: unobtrusive technology...
focus: ...to facilitate interactions among humans
- tradeoff between
 - availability & flexibility of features and
 - ease of use & ability to use
- consortium for chil 15 labs in 9 countries
 - common software infrastructure
 - services
 - awareness technologies
 - multimedia data collection for evaluation benchmarks

software infrastructure chil

- reference architecture aka ice cube
- tools for service authoring
- chil-compliant services



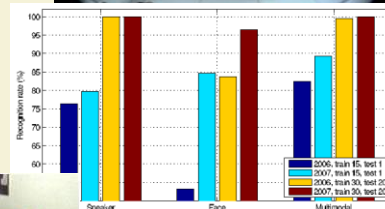
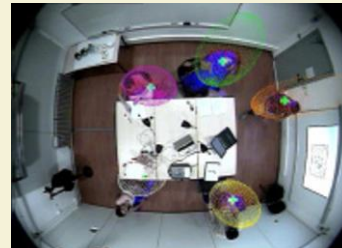
software infrastructure chil



- **user services** communicate with the user
 - appropriate information at appropriate time-space
build on context layer
 - profiles for personalization and access control
 - complex *services* by composition
- **context layer**
 - SitCom: set of situation (finite-state) machines
sieve through sensor data and announce higher-level events
- **perceptual techs**
 - body trackers, face recognizers, speech recognition...

awareness aka perceptual technologies

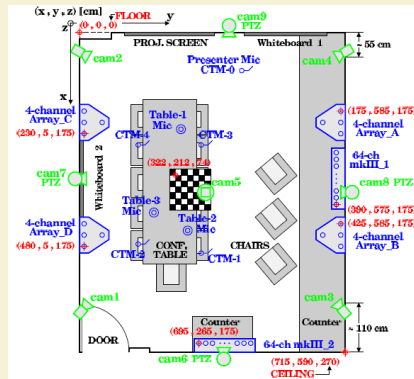
- speech recognition
- person tracking
- person identification
- interaction cues *gesture, gaze*
- activity recognition
- AV output
- conversation
rhythm, intonation



evaluation benchmarks

chil

- data collection
 - annotated by humans
- scenarios
 - presentation, meetings
- evaluation workshops
 - against data corpus



IBM collection room:
9 cameras 152 mics

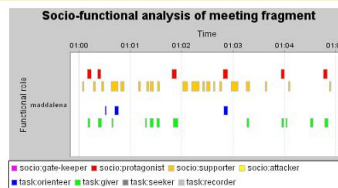
chil services i.e. apps collaborative workspace

- one of many systems to support meetings
 - CSCW covers both in-person and remote meetings
- virtual meeting docs projected on tabletop
- helps with agenda and minutes
- empirical study: tabletop shares use with traditional whiteboard and paper



chil services i.e. apps virtual professional coach

- relational cockpit: show attitude during meeting
- relational report: analyze participation after meeting privately delivered
- track speech and eye gaze
- helps
 - over-participants scale back
 - under-part become more active



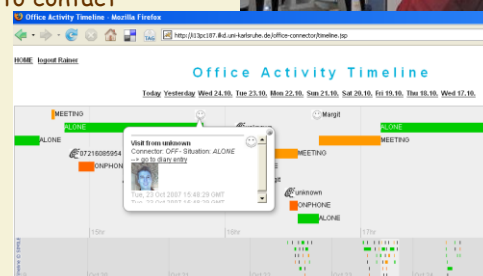
You have contributed scarcely to the discussion, with few verbal contributions. You have talked for the 16% of the meeting duration.

You have expressed scarcely your Ideas and opinions. (11% of the meeting duration, as shown by the bar in green).

You have mainly supported the ideas of the other participants.

chil services i.e. apps virtual secretary

- goal: help colleagues know when to contact
- image recognition, instrumented phone presence, meetings, phone calls
- understand a person's activity/availability
 - let visitors know
 - let the person know who tried to contact
- report of perception & actions
 - person rates secretary's actions for evaluation purposes



discussion

- HCC
- CHIL
- compare the takes of CHIL and HCC

take 5

this course combines

- seminar presentation of state-of-the-art topics
 - goal: raise your knowledge to improve your project design
- coding lab
 - goal: ramp you up for the project
- project
 - cell phone-based context gathering and sharing
 - ...

this course context-aware multi-user software

- applications
 - pervasive health care
 - sharing content and experiences
 - monitoring of physical infrastructures
 - assisted living
 - smart office
 - smart classroom/distance learning
- collaboration
 - support techs
 - collaborative context recognition
 - human factors for collaborative machine assistants

this course

context-aware multi-user software

- applications, collaboration
- end-user programming/control
 - customization of smart spaces
- method
 - developing human-centered interfaces
 - Android
- security & privacy
 - general issues
 - privacy in assisted living
- middleware
 - concrete examples and challenges

this course

context-aware multi-user software

- applications, collaboration
- end-user programming, method, security, middleware
- state of the practice
 - international projects and initiatives
- advanced HCI
 - UIs for smart spaces, multimodalities, eye tracking
 - ambient to human communication
- user awareness
 - video-based user tracking and surveillance
 - multi-sensor presence and activity recognition
 - spatio-temporal context awareness

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