

Week 3: Context-Aware Computing

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Context-Aware Computing

- Using "context knowledge" such as location, time of day, activity(ies) user is involved in
- To change interaction of user with some information/application

Context-Aware Computing

- Required Readings:
 - **Context-aware computing applications by Schilit et al**
<http://www.ubiq.com/want/papers/parctab-wmc-dec94.pdf>
 - **A survey of Context-aware Mobile Computing Research by Chen & Kotz**

Context-Aware Systems

■ Some applications:

- City & museum tour guides
- Virtual graffiti & location-based messaging
- Memory augmentation
- Task assistance
- ...

City & museum tour guides - Christine & Nick

- Hippie: A Nomadic Information System, Oppermann et al, Proceedings of the 1st international symposium on Handheld and Ubiquitous Computing **Christine**
- Cyberguide by Abowd et al **Christine**
- GUIDE project by Cheverst, Davies, et al **Nick**
- ...

Virtual Graffiti systems/Location Based Messaging – Francis & Pattie

- Hanging Messages, Chang **Pattie**
- ComMotion, Marmasse **Pattie**
- Etherthreads, Lassey **Pattie**
- Mobile cinema, P. Pan **Pattie**
- Geonotes, Persson et al **Francis**
- UCSD ActiveCampus **Francis**
- ...

Hanging Messages – Emily Chang, 2001

 Hanging Messages: emily x

 Compose New Message x

To: Select Category

Subject:

Delivery Time Period:

12	:	00	AM	▼	01	/	01	
to	12	:	00	AM	▼	12	/	31

Location: ▼

▼
▼

Send Cancel

 Hanging Messages: michelle x

 emily: add/drop form x

To: emily Urgent-Personal

Subject: add/drop form

Delivery Time Period:

11	:	00	AM	▼	03	/	08	
to	7	:	00	PM	▼	03	/	09

Location: media lab ▼

▼
▼

Send Cancel

Motivation

- **Current messaging systems**
 - only recipient(s) are specified, no context
- **Many messages are context-driven**
 - appropriate during a certain time period
 - most useful delivered to certain location
- **More context helps prevent information overload**
 - sender's judgment is incorporated

How Is It Useful?

- Requests to friends/colleagues
 - “Can you pick up a book at the library...”
- Informative notices
 - construction information
 - crime bulletins
- Personal reminders
 - “Don’t forget to drop off registration forms...”
- Promotion distribution

Research Focus: Agent Filtering

- **Filtering mechanisms**
 - message categories
 - active and passive messages
 - user profiles
 - known sender list
 - multiple modes with separate profiles
- **Goal: no user should be bothered by unwanted or unsolicited messages**

Message Categories

- Every message belongs to a category
- Senders can select a category when sending a message
- The recipient's agent can override the sender's choice of category
- Filtering can be done by category



Etherthreads: An Infrastructure for Location-based Messaging, Brad Lassey 2004

- Location is an important contextual clue
- Scenarios
 - Walking tour of Boston
 - Restaurant reviews
 - Reminders
 - Organizational Memory

How to get Location

- **GPS**

- Approximately 10m – 30m resolution
- Works essentially anywhere in the world
- Does not work indoors

- **E911 and other cell sensing technologies**

- Resolution on the order a mile
- Dependant of service provider
- Not widely available at the present

- **Sensor networks: IR and RF**

- Require additional infrastructure

Sensor network based solutions

- **Technologies**
 - Infrared
 - Radio frequency
 - Sonic
- **Measurement techniques**
 - Time delay
 - Phase shift
 - Signal Strength

Etherthreads implementation

- Phone makes connection to at least three Bluetooth beacons
- Beacons serve requests for connection statistics
 - Signal Strength (RSSI)
 - Link Quality (a measure of interference)
 - Total Power Level
- Phone uses statistics to determine location
- Beacons then serve application specific requests

Messaging Application

- **Messages stored on a central server**
 - SQL Database
- **Beacon servers make queries to the SQL server**

Threads

- **Messages organized in threads**
- **Threads embody**
 - **Subject matter**
 - **Set of senders**
 - **Set of Receivers**

Screenshots

Functionality

- The user is tracked with GPS.
- A behaviour-learning agent determines the salient locations in the user's life.
- Messages or reminders can be sent to these prominent virtual locations. For example, "home", "work", "grocery store", "Grandma's".
- The user will only receive the specific message when in the relevant context (physical location, time and date).

Functionality (cont.)

- Once the behaviour-learning agent has established virtual locations and mobility patterns, it can start pushing information to the user, such as:
 - the latest traffic report when leaving "home" on the way to "work"
 - on a Friday evening after leaving "work", the agent might get the movies playing at the local cinema.
- Based on GPS
- speech-based I/O as well as graphical I/O option

M-views: Mobile Cinema, Pengkai Pan 2001

- PDA with 802.11 based location awareness
- Streams movie segments based on location & time of day
- 3 movies made & tested
- M-studio: authoring & story scripting tool for mobile movies

Example m-movie: Another Alice

- Mystery, user is investigator
- There are a number of characters that can be followed throughout the story.
- The viewer must literally go to the location where the next clip takes place in order to trigger playback.
- Each character is telling the story from his/her perspective, each narration is different.
- The viewer can go back and play the story again, following a different character until the entire plot is revealed.

Example m-movie: Another Alice

- Time is a limiting factor. The viewer must get from one location to another within a certain time frame in order to catch a particular ending of the story.
- If the viewer does not make it to the location in time, a different ending is shown. Therefore, while the creator initiates the story, it is the viewer who completes it through his/her actions.

Memory systems - Nick

- Forget-me-not Mick Lamming
Europarc
- (Remembrance agent, Rhodes)
- ...

Task Assistance - Pattie

- Activity recognition & just in time assistance
- Example: counter-active project – Wendy Ju et al

Counter Active, Wendy Ju, 2000

- The interface: a computer, an overhead projector, and electric field sensing array
- by touching the pictures and words on the countertop, users can step their way through recipes.
- an event detection system enables a non-command interface. An array of sensors distributed the kitchen can infer what events are occurring in the kitchen and respond before the user formulates an explicit command.

Discussion topics

- Pros & cons of context-based systems
- State of the art
- Other applications of context-based systems

Pros & cons of context-based systems

■ Pros:

- More immediate access to relevant info
- “*in situ intelligence augmentation*”

■ Cons:

- System makes assumptions about (1) what the context is and (2) what info may be relevant
- Limits to how much common sense systems can have

State of the art in Context-aware systems

- Have we only scratched the surface?
- What are hardest problems to be addressed?

Other applications of context-based systems

- List your favorite ideas here

Class 4

- **Interfaces with Common Sense – Push Singh, Hugo Liu, Pallavi Kaushik**
- **Required reading: Beating Some Common Sense into Interactive, Lieberman et al**
- **SCENARIOS PAPER DUE**

Class 5

- **Ubiquitous Computing**
- **Required reading:**
 - **Ubiquitous Computing, Weiser, 1993**
 - **Perspectives article for ACM Interactions, Weiser 1993**
 - **The coming age of calm technology, Weiser & Seely Brown, 1996**

Class 5 (cont)

■ Optional Readings:

Some computer science issues in ubiquitous computing, Weiser 1993 – Sajid Sadi

**Charting Past, Present, and Future Research in Ubiquitous Computing
GD Abowd, ED Mynatt, 2000 – Sajid Sadi**

Selection from UbiComp Proceedings/Videos last couple of years – Aaron Zinman

Class 5 (cont)

■ PROJECT PROPOSAL DUE!!!

- **2-3 pages:**
 - What is it & why is it interesting?
 - Usage Scenario
 - How will it be implemented?
 - What parts will you complete for this class
 - What do you hope to learn?