HCI & Computação Ubíqua

Definição de **Usability** (ISO standard 9241)

- Usability: the effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments
- Effectiveness: the accuracy and completeness with which specified users can achieve specified goals in particular environments
- Efficiency: The resources expended in relation to the accuracy and completeness of goals achieved
- Satisfaction: The comfort and acceptability of the work system to its users and other people affected by its use

Uma definição de HCI?

O estudo de pessoas e da tecnologia computacional e do modo como um influencia o outro

3 U's

- U
- U
- U

3 U's

- Utilidade
- Usabilidade
- Ubiqüidade

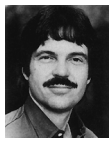
Uma definição de Computação Ubíqua

Computação embutida no ambiente de modo transparente

- Apoio ao usuário sem este "utilizar o computador"

Alan Kay

The best way to predict the future is to invent it



Mark Weiser

The most profound technologies are those that disappear

The computer of the 21st century
Scientific American, 1991

Dispositivos ubíquos

Outras terminologias

- Pervasive Computing
  - Dispositivos computacionais embutidos no ambiente e naturalmente acessíveis
- Invisible Computing
  - Aplicações centradas nos usuários e não na tecnologia envolvida, que é considerada invisível
- Wearable Computing
  - Propõe que computadores e seus usuários não sejam vistos como conceitos separados, mas como uma *simbiose*
- *Calm computing...*

Calm Technology

- Centro x periferia
  - Grande porção do cérebro humano é baseado no processamento sensorial
    - Inerentemente periférico
- Calm technology
  - Enriquecimento da periferia aumenta a percepção humana
    - Pode ser alcançado através do uso de dispositivos ubíquos

exemplos

- No exemplos que seguem, os textos em inglês correspondem aos títulos dos artigos onde os exemplos são apresentados...

Using Pervasive Computing to Deliver Elder Care

Vince Stanford
NIST Smart Space Laboratory,
IEEE Pervasive Computing 1:1

(10-13) *As an example of an early application that puts pervasive computing technologies directly in the service of improved quality of life for the elderly and that is "gracefully integrated with human users....*

Using Pervasive Computing to Deliver Elder Care

- Locator badges
- Embedded weight sensors
- In-apartment computers
- Personalized databases

Computação Ubíqua

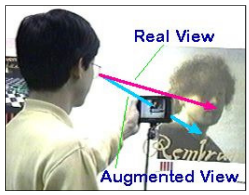
- Desenvolvimento de aplicações está associado a vários temas:
  - Computação ciente de contexto
  - Interfaces naturais
  - Computação no cotidiano
  - Wearable computing
  - Realidade aumentada
  - Captura e acesso de experiências ao vivo

Computação Ciente de Contexto

- Adaptação do comportamento computacional de acordo com informações obtidas do ambiente
  - Leva em consideração
    - Pessoas envolvidas
    - Locais
    - Datas/horas
    - Atividades
    - Reconhecimento de objetos

Computação Ciente de Contexto

- Reconhecimento de objetos
  - NaviCam System

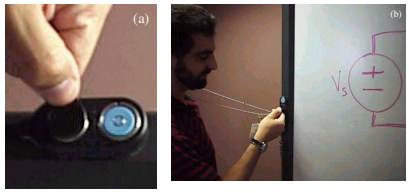


Context Toolkit

- Visa facilitar a utilização de informações de contexto por aplicações de computação ubíqua
  - Composto por "context widgets" + infraestrutura distribuída de suporte aos widgets
    - Widgets -> componentes de software que provêem informações de contexto em alto nível às aplicações

Context Toolkit

- Inferindo presença e identidade
  - Aplicação baseada em iButtons



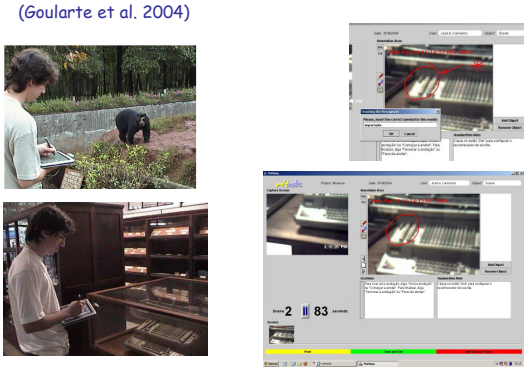
Anind Dey (2003): It is all about SENSORS!

Interfaces Naturais

- Fundamental em computação ubíqua
  - Adaptar as interfaces à forma segundo a qual os homens interagem com o mundo físico
    - Paradigma teclado/mouse/display
    - Paradigmas baseados em voz, video/ em escrita por caneta, objetos do mundo físico, sensores

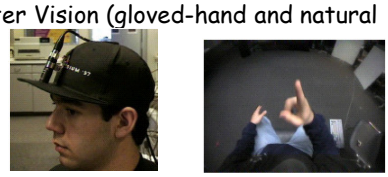
M4Note: multimodal capture

(Goularte et al. 2004)



Wearable Computing

- A Wearable Computer Based American Sign Language Recognizer
  - Computer Vision (gloved-hand and natural skin)

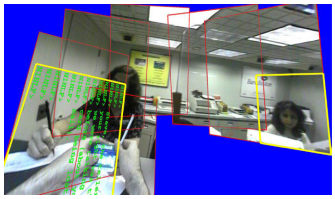


Continuous lifelong capture of personal experience with EyeTap

- Steve Mann

CARPE 2004

Continuous lifelong capture of personal experience with EyeTap

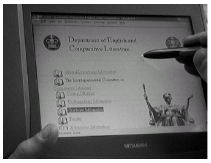


Wearable Computing

- The People Sensor: A Mobility Aid for the Visually Impaired

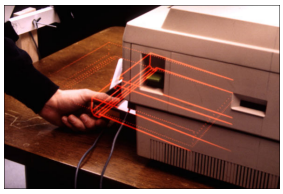
The people sensor: a mobility aid for the visually impaired
Ram, S.; Sharf, J.;
Wearable Computers, 1998. Digest of Papers. Second International Symposium on
19-20 Oct. 1998 Page(s):166 - 167

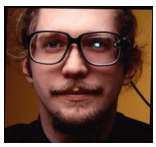
Augmented Reality, Mobile Computing, Wearable Computing



Realidade Aumentada

- Ciência de contexto + interfaces naturais -> realidade aumentada

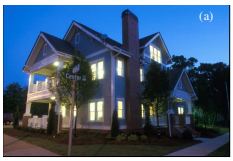




Computação no Cotidiano

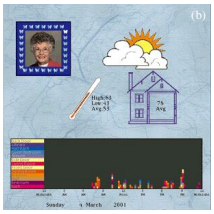
- Explora formas de auxiliar atividades humanas não centradas nos ambientes de trabalho e estudo
  - Exige disponibilidade computacional constante
  - Explora fortemente informações contextuais
  - Exemplos
    - Aware Home, Digital Family Portrait, Cooks Collage, Dude's Magic Box

Computação no Cotidiano + Calm Computing: Aware Home



Computação no Cotidiano + Calm Computing: Digital Family Portrait

Porta retrato com bordas digitais



Informações detalhadas

Computação no Cotidiano + Calm Computing

- Cook's Collage: visa capturar informações de atividades recentes e apresentá-las de forma resumida

Quadros representativos das principais atividades realizadas

Escolha dos quadros representativos

Computação no Cotidiano + Calm Computing

- Dude's Magic Box and Grandma's Lapdesk: visa conectar avós e netos que vivem remotamente usando abstrações comuns no cotidiano de crianças e idosos

Semantic Space: An Infrastructure for Smart Spaces

- Xiaohang Wang, Jin Song Dong, ChungYau Chin, SankaRavipriya Hettiarachchi, Daqing Zhang - IEEE Pervasive 3.3
- *...a pervasive computing infrastructure that exploits Semantic Web technologies to support explicit representation, expressive querying, and flexible reasoning of contexts in smart spaces.*

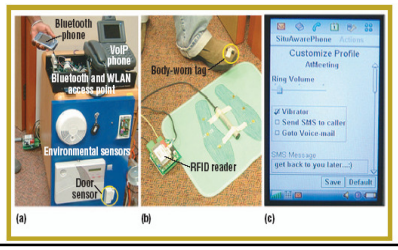
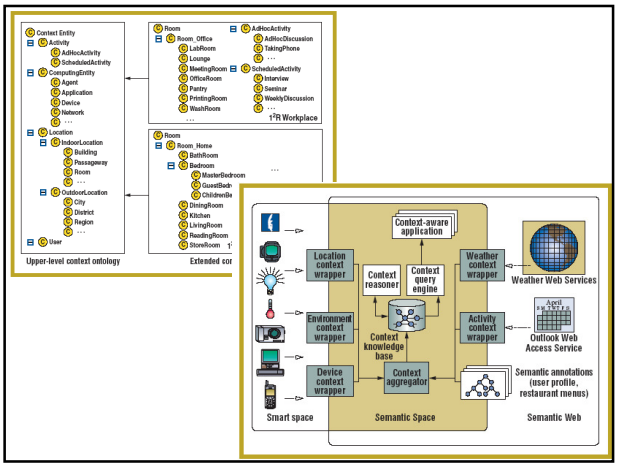


Figure 4. Building a prototype: (a) Networked sensors and devices; (b) the RFID indoor location system; and (c) a snapshot of SituAwarePhone, the GUI for configuring the response mode in each situation.

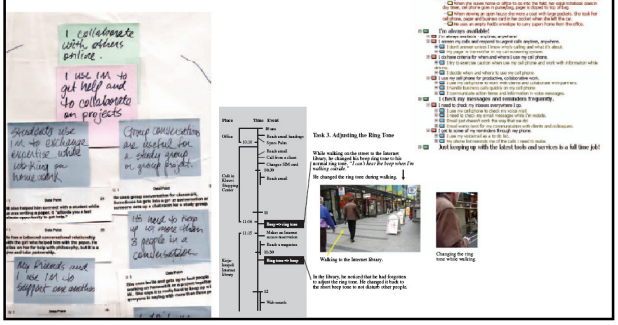


Captura e Acesso de Experiências ao Vivo

- Cérebro humano é inadequado para registrar experiências
  - Muita informação é perdida nas atividades do cotidiano
- Solução: caneta, lápis, gravador, câmera ...
  - O computador pode capturar melhor
    - Aplicações de captura e acesso permitem registro de diversos fluxos de informação
      - Integrados, tais fluxos podem fornecer acesso eficiente ao conteúdo capturado

Mobile research strategies for a global market

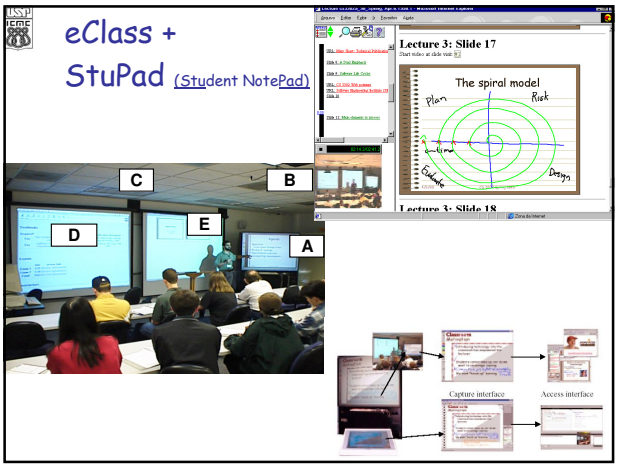
- Colleen Page, CACM July 2005



Captura e Acesso de Atividades Didáticas

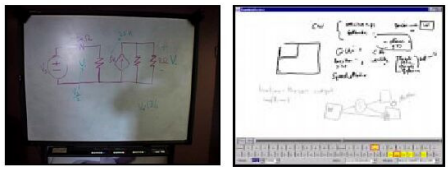
- Desde 1995 pesquisadores do GATech investigam o uso da computação ubíqua no ambiente de sala de aula
  - eClass – Classroom 2000
    - implementa um ambiente de computação ubíqua que permite a captura de material multimídia em sala de aula, e a disponibilização e acesso desse material através da Web

eClass + StuPad (Student NotePad)



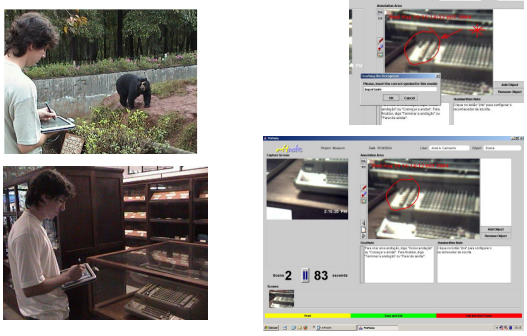
Captura e acesso + Contexto

- DUMMBO
  - Sistema para captura de reuniões informais
  - Ativação e desativação automática
  - Timeline para acesso

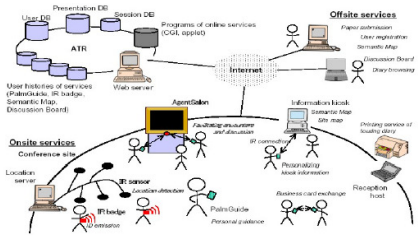


M4Note: multimodal capture

(Goularte et al. 2004)



Digital Assistant



Pebbles Slideshow Commander

(Myers 2002)

Efficient retrieval of life log based on context and content

Aizawa et al. CARPE 2004

Figure 1. Wearable devices for life log.

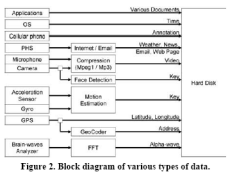


Figure 2. Block diagram of various types of data.

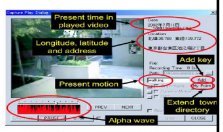


Figure 3. User interface of capture dialog.

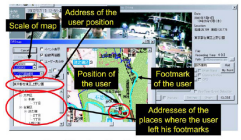


Figure 6. Frames extracted every 60 seconds.

Figure 8. Frames extracted every 50 meters.

Figure 7. Frames extracted every 30 seconds.

Figure 9. Frames extracted by speed.

Figure 10. Frames extracted by speed changes.

Figure 12. Frames extracted by speed or direction.

Figure 11. Frames extracted by direction changes.

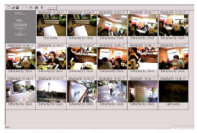
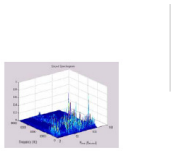
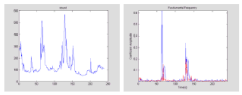


Figure 13. Frames for content extraction.

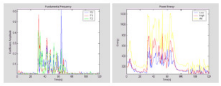


(a)



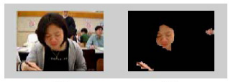
(a) (b)

Figure 15. Characteristics of walking scene:
(a) power spectrum of voice,
(b) fundamental frequency.



(b) (c)

Figure 14. Human voice detection:
(a) sound spectrogram,
(b) fundamental frequency and harmonics,
(c) energy of each frequency band.



(a) (b)

(c) (d)

Figure 16. Human face detection with skin color:
(a) examined frame, (b) color face region,
(c) examined frame, (d) color face region.

(a) (b)

Figure 17. Conversation scene detection at university:
(a) all detected conversation scenes,
(b) detected face-to-face conversation scenes.

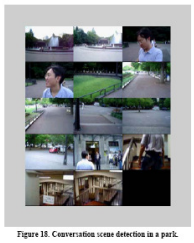
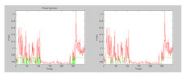


Figure 18. Conversation scene detection in a park.



(a) (b)

(c) (d)

Figure 19. Conversation scene detection at lunchtime:
(a) detection based on human voice analysis,
(b) detection with conversation characteristics,
(c) the first frames of each conversation scene,
(d) the last frames of each conversation scene.

A layered interpretation of human interactions captured by ubiquitous sensors

Takahashi et al. CARPE 2004

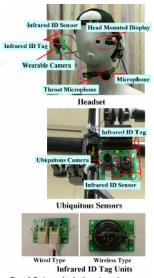


Figure 1. Devices used to develop an interaction corpus.

Figure 2. Setup of the Experience Capture Room at a poster exhibition site.

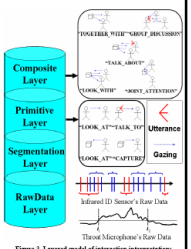


Figure 3. Layered model of interaction interpretations.

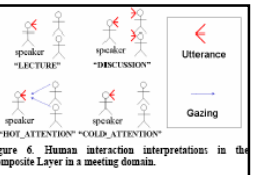


Figure 6. Human interaction interpretations in the Composite Layer in a meeting domain.

Figure 4. Various applications that refer to interaction indices.

Meeting Domain

Lecture Domain

Figure 5. Additional attempts of developing an interaction corpus in various domains.

Minimal-impact audio-based personal archives

Ellis & Lee, CARPE 2004

Figure 1: Data capture equipment. On the left is the Neuros hard-disk recorder, shown with the Soundman in-ear microphones and interface module. Middle is the mobiBLU flash-memory recorder. On the right is a logging personal GPS unit.

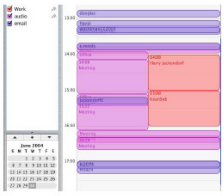


Figure 4: Example of diary display. Red items are user-entered diary events; purple regions show segments automatically extracted from audio along with their assigned labels. Blue items are outgoing email events scavenged from the user's sweebox. Audio was available only between 13:41 and 16:40.

Minimal-impact audio-based personal archives

Ellis & Lee, CARPE 2004

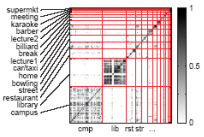


Figure 2: Affinity matrix for the 186 automatic segments. Segments are ordered according to the dominant ground-truth label in each segment.

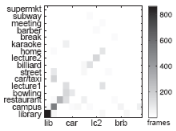


Figure 3: Confusion matrix for the sixteen segment class labels, calculated over the 3753 one-minute frames in the test data.

Table 1: Automatic clustering results, compared to manual ground truth. The first column gives the names assigned during manual annotation; the next two columns give the total number of segments, and the total number of frames (minutes) receiving this label in the ground truth. The next two columns describe the automatic segments assigned to each label based on maximum overlap. The final three columns give the raw count of correct frames for each label, and this as a proportion of the true frames (recall) and automatic frames (precision). Overall frame accuracy is 61.4% (rounded to 61% at the bottom right of the table).

Label	Manual		Auto		corr	rec	prec
	min	seg	min	seg	min		
Library	361	27	882	38	564	88%	98%
Campus	750	56	900	62	537	72%	59%
Rest'rant	500	5	303	6	302	54%	99%
Bowling	244	2	473	13	152	62%	32%
LectYr 1	234	4	104	5	0	0%	0%
CarTaxi	165	7	39	4	0	0%	0%
Street	102	10	146	9	35	22%	24%
Billiards	157	1	158	5	114	73%	72%
LectYr 2	157	2	176	9	152	97%	86%
House	138	9	292	15	103	75%	35%
Karaoke	65	1	21	2	0	0%	0%
Class bik	56	4	53	3	26	46%	51%
Barber	31	1	68	6	8	26%	12%
Meeting	25	1	38	4	0	0%	0%
Subway	15	1	0	0	0	0%	
Supmkt	13	2	97	5	10	77%	10%
total	3753	139	3753	186	2306	61%	61%

Paper Sessions

- **Passive capture and ensuing issues for a personal lifetime store**
- Jim Gemmell, Lyndsay Williams, Ken Wood, Roger Lueder, Gordon Bell Pages: 48 - 55

Passive capture and ensuing issues for a personal lifetime store

Gemmell et al. CARPE 2004

Figure 1 - SenseCam hardware

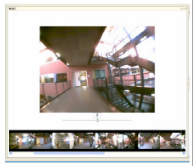


Figure 2 - RSVP viewer for SenseCam images. The slider below the large image controls speed/direction. The "filmstrip" at the bottom shows images adjacent in time.

Table 1- SenseCam hardware specification

PIC 16F876 8 bit microcontroller
I2C bus interfaces sensor/peripheral devices to the microcontroller
ADXL210 2 channel accelerometer/ tilt measurement +/- 10g – used for motion sensing. This also provides static tilt angle of the camera +/- 90 degrees in 2 axis
Passive infrared sensor (Seiko)– detects heat from a person at up to 2.5m
Digital Light Sensor (TCS230) – records light intensity (LUX) and also individual red, green & blue intensities.
Temperature sensor (LM75) - 0 to 70C
Real time clock – to record calendar data of time of image
RS232 serial interface (for loading data to PC)
MMC Card 64 MB (for sensor data)
Power management integrated circuit (Maxim)
Camera module 128 MB – various commercial modules used
Edmunds Optics lens – 2.2mm, f2, ultra wide angle (132 degrees)
2 x AA NiMh cells for recharging after 12 hours

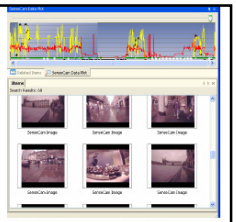


Figure 3 - SenseCam sensor readings plotted in upper pane. Thumbnails of photos in lower pane. Selecting a region of sensor readings updates the contents of the lower pane to only photo from the selected time region.

Table 2 – SenseCam sensor data

SAMPLE DATA	BYTES
Light intensity (LUX)	2
Red, green, blue intensity	6
X tilt (degrees)	2
Y tilt (degrees)	2
Temperature (degrees C)	1
Bit flag for each PIR, light, temperature, tilt change that is detected	1
Corresponding image number	2
Overhead	2
TOTAL	18

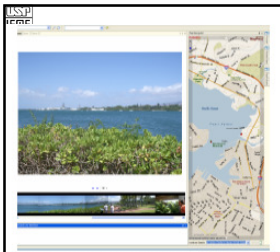


Figure 4 - Location user interface: map on right shows dots where photos are taken. Pane on left only shows photos taken in the are shown on the map.

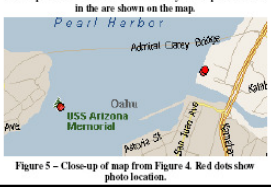


Figure 5 – Close-up of map from Figure 4. Red dots show photo location.

Table 3 – Some examples of MyLifeBits link types

Link type	Source	Target
Annotates	Document, audio, image	Any
Author of	Person	Any
Capture of	Person, Event	Image, video, audio, phone-call
Attendee	Contact	Event
Organizer	Person	Event

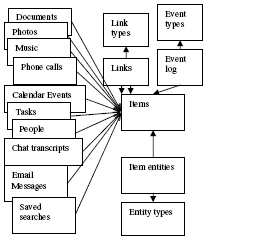


Figure 6 – Key elements of the MyLifeBits schema. Each box is a database table. Arrows indicate foreign keys.

Memory cues for meeting video retrieval

Jaimes et al. CARPE 2004

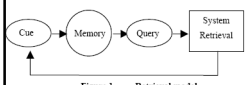


Figure 1. Retrieval model

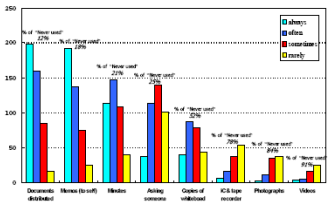


Figure 2. Results of meeting review survey. Numbers on top of each bar indicate value for "never" responses. Column on the left indicates number of participants.

Por que registrar vídeo?

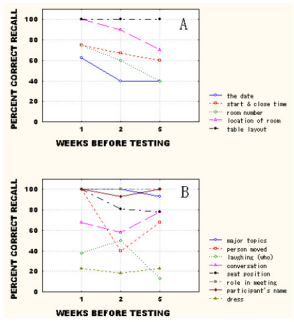
- Have accurate record of meetings (67%).
- Keep in mind what customers or key-persons said (in particular their wishes and questions) to achieve a successful outcome in a follow up negotiation (52%).
- Verify the truth when memory and descriptions in minutes are inconsistent (51%).
- Reexamine other person's speech and its context to correctly understand meaning or intention (49%).
- Listen to a portion of speech not understood (47%).
- Listen to a portion of speech not heard (47%).
- Know the results of discussion or ideas from earlier meetings with respect to current interest or problem (45%).
- Obtain proofs when someone denies having said something: "I cannot have said so" or "I can't remember saying that" (44%).
- Recall an idea that I had during the meeting (41%).
- Check the consistency between present and earlier presentations (40%).
- Show the details of events during the meeting.
- Keep undistorted (precise) record of original events

Por que é difícil?

- Troublesome to set up video camera, capture the scene, and start video player (6 persons)
- Difficult to take time to review a meeting (12 persons)
- Difficult to find a scene the user wants (6 persons)

Tarefas...

- *Verify* (e.g., what someone has said)
- *Understand* (e.g., part that was missed)
- *Reexamine* (e.g., view under a different context)
- *Keep record* (e.g., to be able to view in the future for unforeseen reasons)
- *Recall* (e.g., remember ideas not explicitly part of the meeting contents)



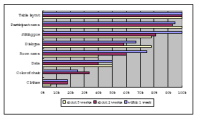


Figure 4. Recall Rate of 15 people over 3 meetings.

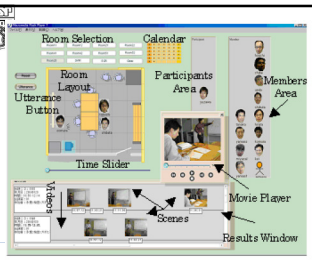


Figure 5. System Interface

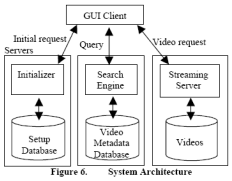


Figure 6. System Architecture

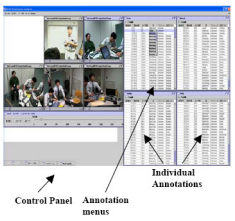


Figure 7. Meeting video annotation system.

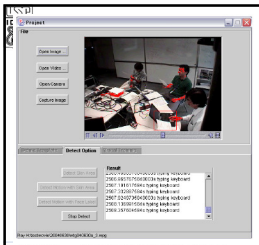


Figure 8. Visual Trigger Templates Interface. Detected skin areas appear in red and the template is defined by the red box.

Figure 9. Example template on PETS dataset [14].

Table 1. Results of detecting person standing in front of the board.

	Ground Truth	Hits	False Alarms	Prec.	Rec.
Meeting 1	4	4	0	100	100
Meeting 2	5	5	8	38.5	100
Meeting 3	0	0	10	N/A	N/A

Table 2. Results of detecting person leaving their seat.

	Ground Truth	Hits	False Alarms	Prec.	Rec.
Meeting 1A	2	2	0	100%	100%
Meeting 1B	1	1	0	100%	100%
Meeting 2A	4	4	1	80%	100%
Meeting 2B	3	3	2	60%	100%

Figure 10. Scenes from meeting 3. An attendee stands up accidentally triggering the template.

Personal chronicling tools for enhancing information archival and collaboration in enterprises

Kim et al. CARPE 2004

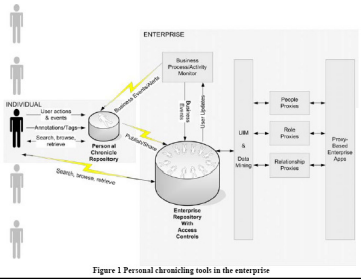


Figure 1 Personal chronicling tools in the enterprise

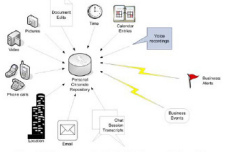


Figure 2 Data sources for individual personal chronicles

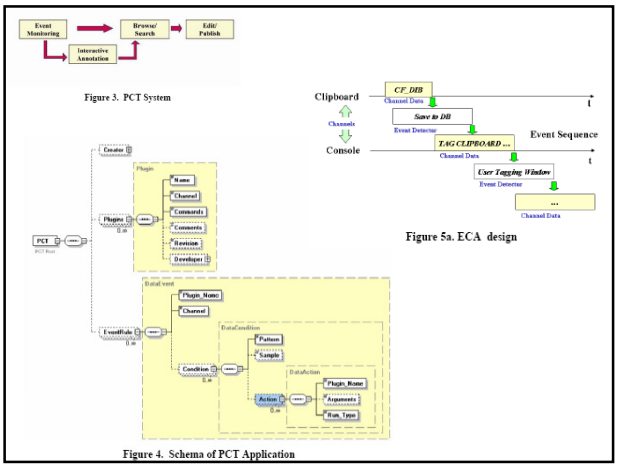


Figure 3. PCT System

Figure 5a. ECA design

Figure 4. Schema of PCT Application

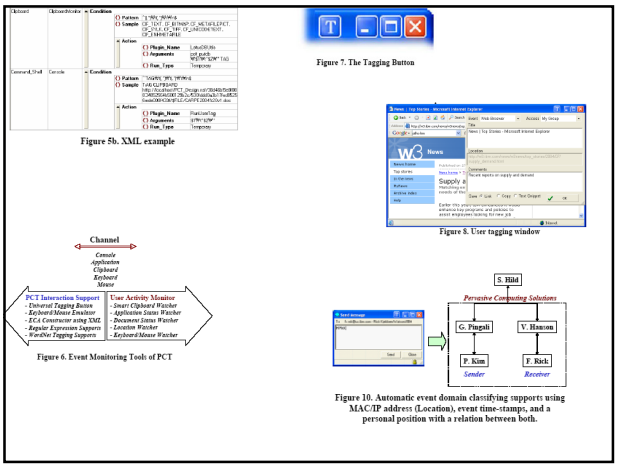


Figure 5b. XML example

Figure 7. The Tagging Button

Figure 8. User tagging window

Figure 6. Event Monitoring Tools of PCT

Figure 10. Automatic event domain classifying supports using MAC/IP address (Location), event time-stamps, and a personal position with a relation between both.

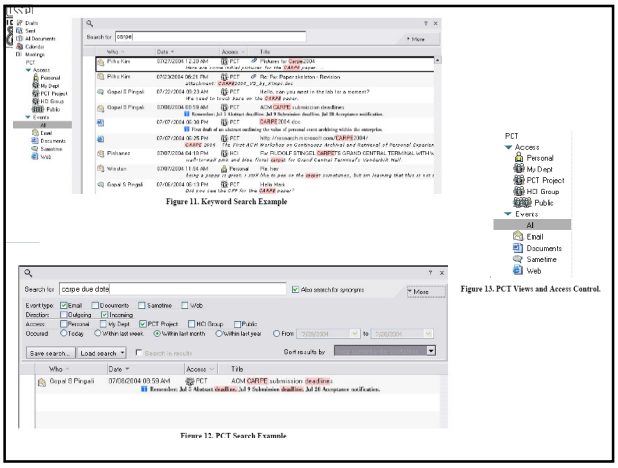
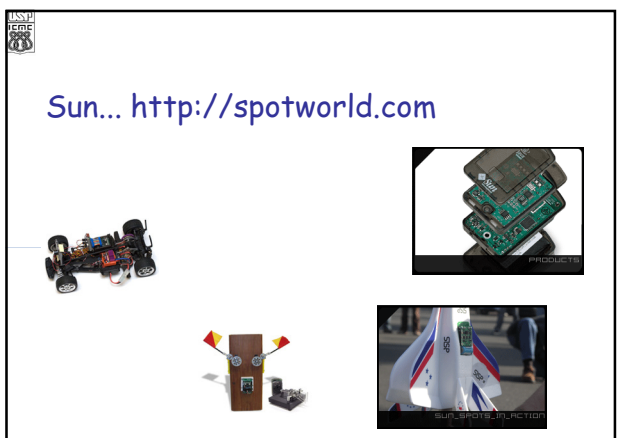


Figure 11. Keyword Search Example

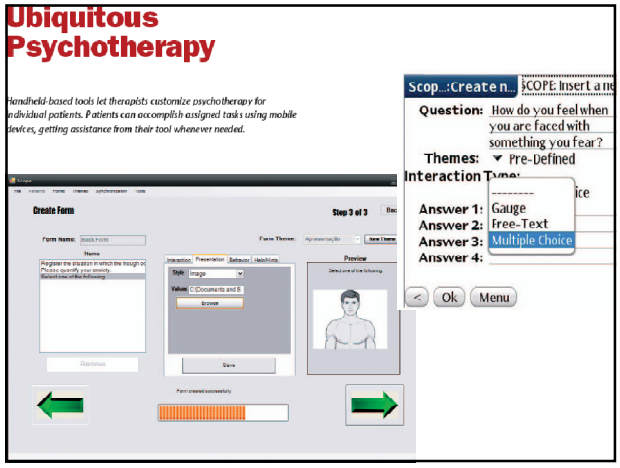
Figure 12. PCT Search Example

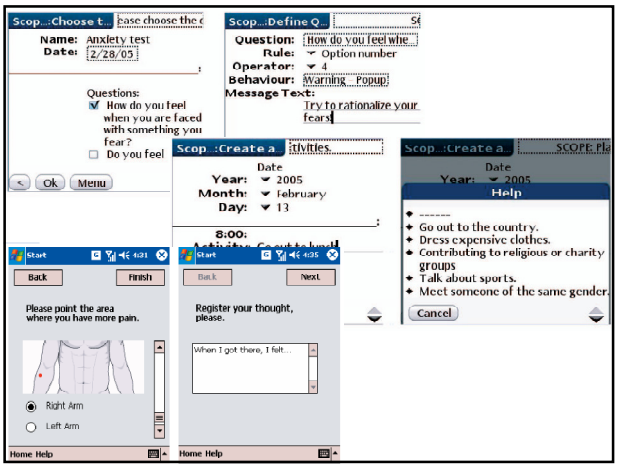
Figure 13. PCT Views and Access Control.



Problemas e Desafios

- Interação entre componentes
- Adaptação/sensitividade a contexto
- Mecanismos e políticas de gerenciamento
- Analise de tarefas
- Modelos economicos viáveis
- Aspectos sociais, legais e de privacidade
- Tamanho e peso
- Consumo/geração de energia
- **Usabilidade**

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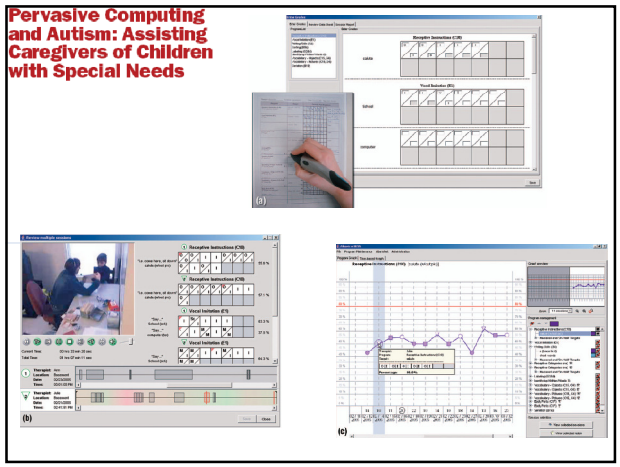
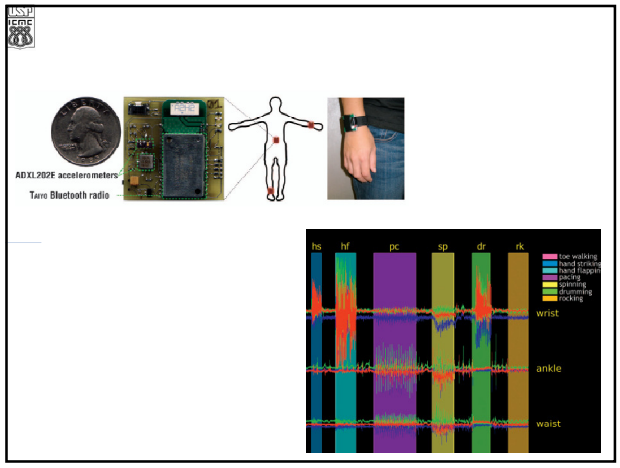
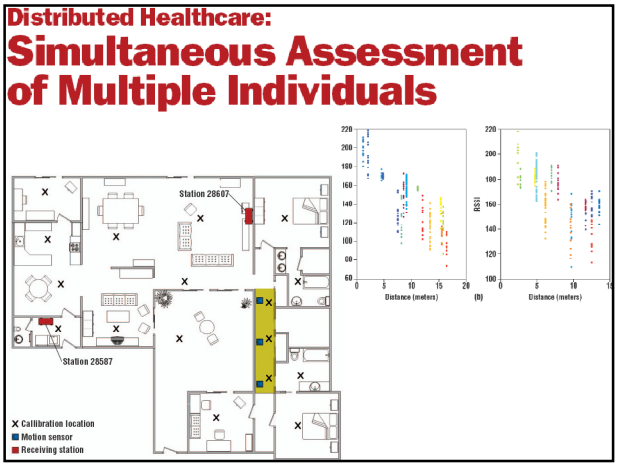
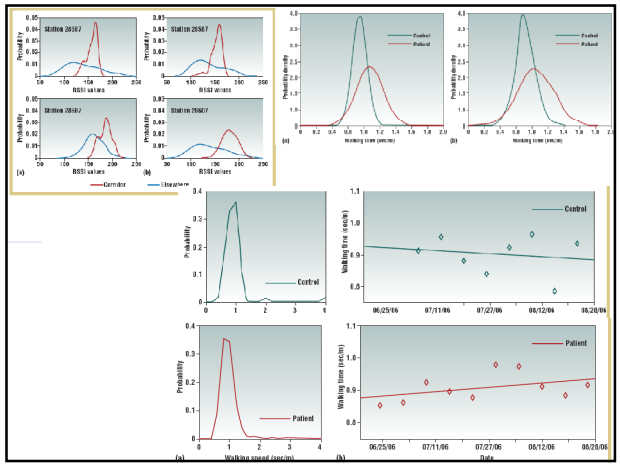
Date: 2/28/05
Questions:
How do you feel when you are faced with something you fear?
Do you feel
Ok
Menu
Question: How do you feel whe
Rule: Option number
Operator: 4
Behaviour: Warning Popup
Message Text:
Try to rationalize your fears
Date
Year: 2005
Month: February
Day: 13
8:00:
Back
Finish
Please point the area where you have more pain.
Right Arm
Left Arm
Back
Next
Register your thought, please.
When I got there, I felt...
Help
Go out to the country.
Dress expensive clothes.
Contributing to religious or charity groups
Talk about sports.
Meet someone of the same gender.
Cancel
Home Help


Pervasive Computing and Autism: Assisting Caregivers of Children with Special Needs


ADXL202E accelerometers
Tarro Bluetooth radio
hs
hf
pc
sp
dr
rk
toe walking
hand striking
hand flapping
pacing
spinning
drumming
rocking
wrist
ankle
waist


Distributed Healthcare:
Simultaneous Assessment of Multiple Individuals
Station 28607
Station 28587
Calibration location
Motion sensor
Receiving station
RSSI
Distance (meters)


Station 28607
Station 28587
RSSI values
Probability
Corridor
Elsewhere
Control
Patient
Walking speed (sec/m)
Walking time (sec/m)
Date