Managing a Life of Lifelogged SenseCam Images

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The CLARITY SenseCam team

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Thanks to …

Microsoft Research (Cambridge)

(for SenseCams)

Science Foundation Ireland

Science Foundation Ireland

&

Science Foundation Ireland

Overview

- OUR SENSECAM DATA COLLECTION
  - **CLARITY**
  - **Visual Lifelogging Analysis**
- BROWSING & SEARCHING SENSECAM DATA
- SENSECAM SUMMARISATION: THE NEXT GENERATION
- THE FUTURE

CLARITY [1/3]

CLARITY: Centre for Sensor Web Technologies

- CSET (Centre for Science Engineering & Technology) funded by Science Foundation Ireland (SFI) with industry contributions
- 5 year duration, following on from previous 4-year "Adaptive Information Cluster"
- Administrative centre in UCD, researchers in DCU, UCD and Tyndall Institute, up to 100 researchers
- Within DCU involves CDVP (Computing & EE), NCSR (sensor people), Health & Human Performance (sports people)

CLARITY [2/3]

CLARITY What ? “The Sensor Web”

- Increasing availability of cheap, robust, and deployable sensor technologies ushering in a wave of new information sources;
- Ubiquitous, dynamic, noisy, reactive and yielding unstructured data-streams == sensor web
- Realizing the sensor web demands a large-scale, multi-disciplinary research effort == CLARITY
- Moving beyond our research silos to novel research interactions;
- Demonstrator projects in:

TennisSense (and other sports); Environmental monitoring;

Karbon footprinting; Ambient Assisted Living;

CLARITY [3/3]

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Principal Investigators

Prof. Barry Smyth	- *Personalization, recommender systems, mobile computing*
Prof. Alan Smeaton	- *Content-based information retrieval*
Prof. Dermot Diamond	- *Materials research, wearable sensors*
Prof. Noel O'Connor	- *Audio-visual analysis, multi-modal information processing*
Mr. Gregory O'Hare	- *Ubiquitous computing, multi-agent systems*

Associate PIs

Prof. Paddy Nixon	- *Pervasive computing, middleware, security, trust, privacy*
Prof. Niall Moyna	- *Sports Science, wearable sensing*
Dr. Simon Dobson	- *Middleware, pervasive computing*
Dr. Cian O'Mathuna	- *Sensor devices, energy-aware hardware*
Dr. Brian Caulfield	- *Physiotherapy, therapeutic gaming, wearable sensors*

Funded Collaborators

Chris Bleakley (UCD), **Conor Brennan (DCU)**, Rem Collier (UCD), **Brian Corcoran (DCU)**, **Cathal Gurrin (DCU)**, Neil Hurley (UCD), Lorraine McGinty (UCD), **Kieran Moran (DCU), Kieran Nolan (DCU)**, Brendan O'Flynn (TNI), **Donal O'Gorman (DCU), Brett Paull (DCU),** Emanuel Popovici (TNI), Aaron Quigley (UCD), **Mark Roantree (DCU)**

Lifelogging

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Lifelogging is about digitally recording your daily life

Sometimes its for a reason

Work e.g. security personnel, medical staff, etc.
Personal e.g. diaries, etc.

Sometimes its for posterity

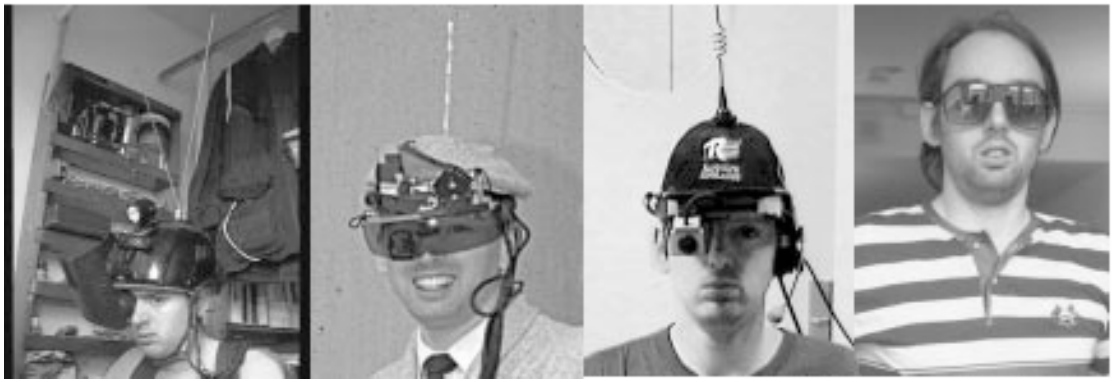
Recording vacations, family gatherings, social occasions

Sometimes its because we can

And we're not yet sure what we'll do with it e.g. MyLifeBits

Visual Lifelogging Devices

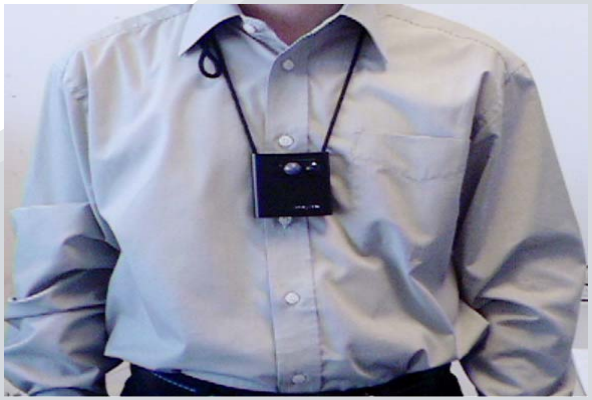
Much past research focus on miniaturising hardware and increasing battery-life + storage e.g. visual lifelogging domain



Steve Mann. Wearable computing: a first step toward personal imaging. Computer, 30:25–32, Feb 1997.

TIMELINE

Tano *et. al.* University of Electro-Communications, Tokyo, Japan



Microsoft Research SenseCam

SenseCam

SenseCam is a Microsoft Research Prototype

Multi-sensor device
Colour camera
3 accelerometers
Light meter
Passive infrared sensor

1GB flash memory storage

Smart image capture ~3 images/min

Since April 2006 we've had two SenseCams … in 2007 we received 5 more

SenseCam images

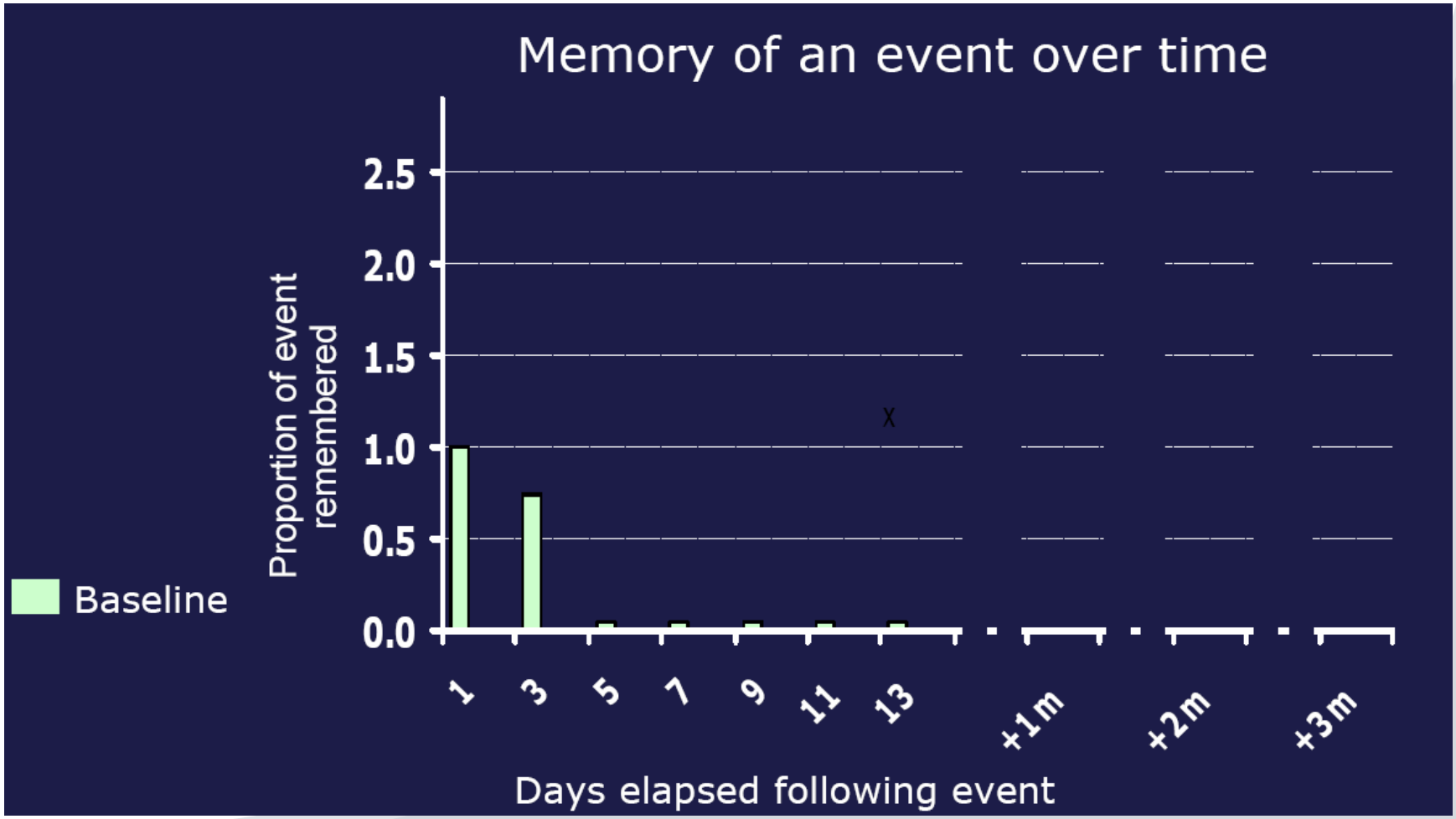
Addenbrooke's: SenseCam Work

Preliminary Study carried out by Cambridge Memory Clinic, Addenbrooke's Hospital

63 year old, well-educated married woman, with limbic encephalitis (usually has no memory a few days after an event)

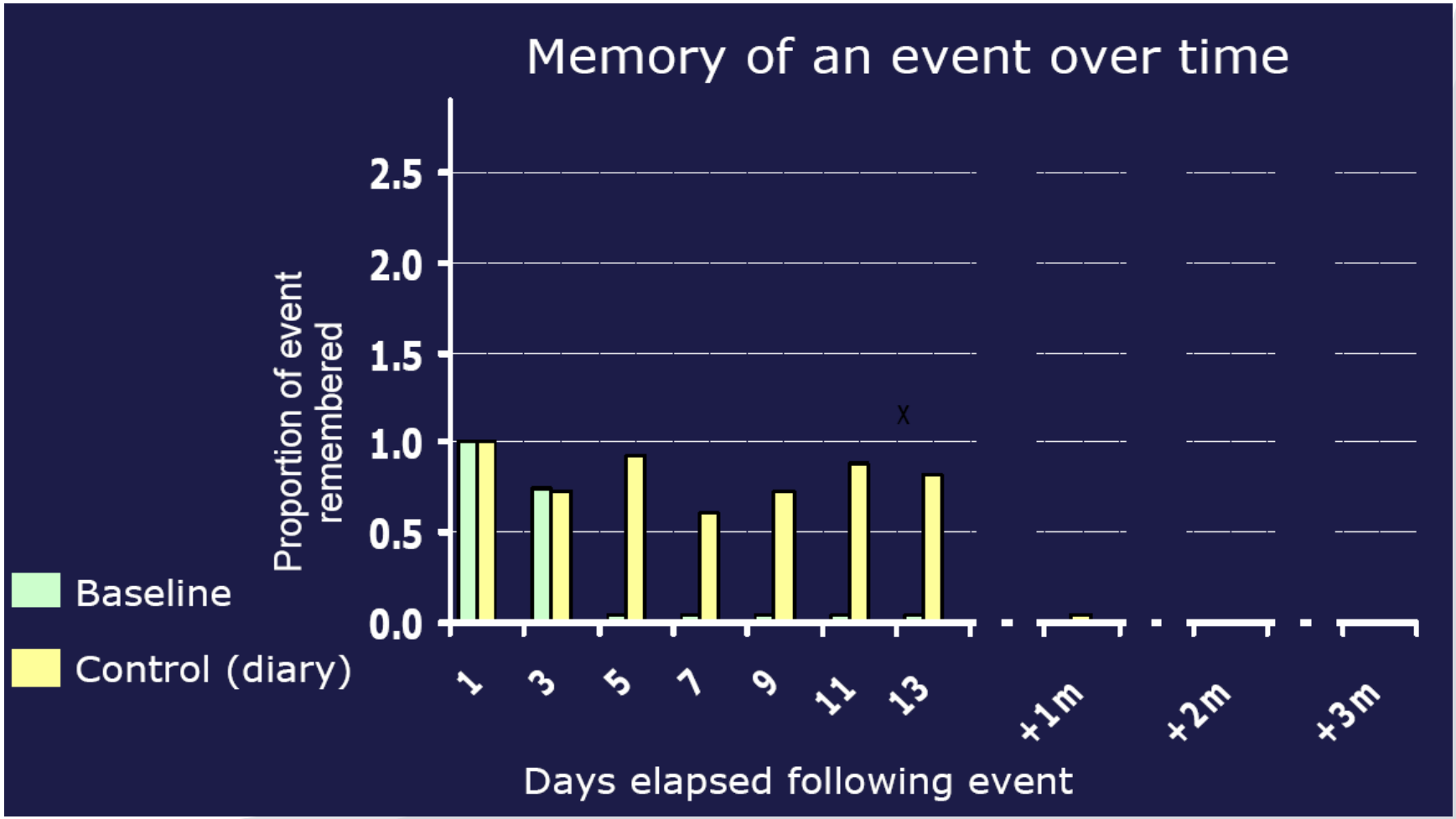
Attends events along with her partner

Addenbrooke's: SenseCam Work



Microsoft Research Cambridge presentation: http://research.microsoft.com/~shodges/presentations/UBICOMP_senseCam.pdf

Addenbrooke's: SenseCam Work



Microsoft Research Cambridge presentation: http://research.microsoft.com/~shodges/presentations/UBICOMP_senseCam.pdf

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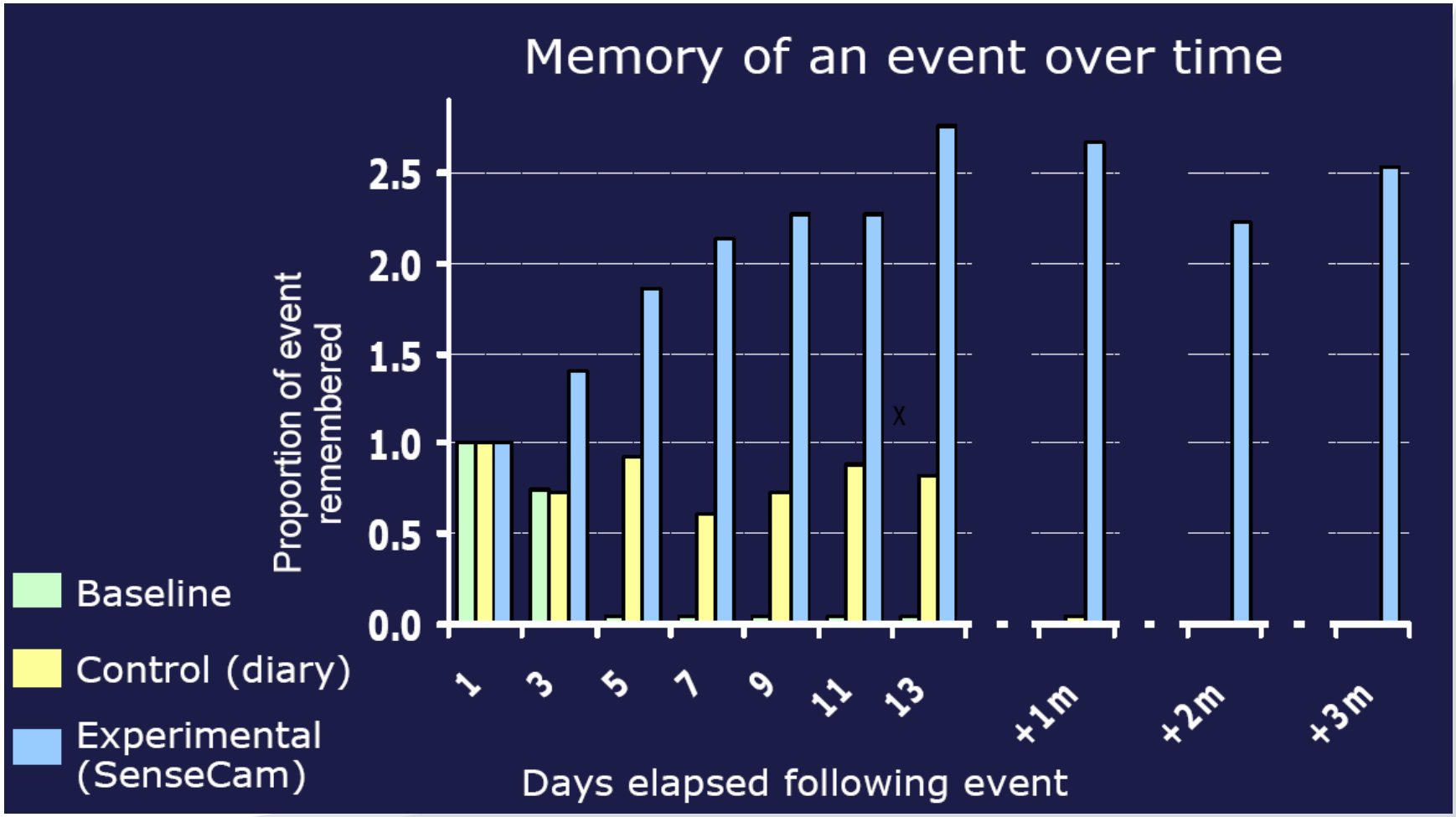


Microsoft Research Cambridge presentation: http://research.microsoft.com/~shodges/presentations/UBICOMP_senseCam.pdf

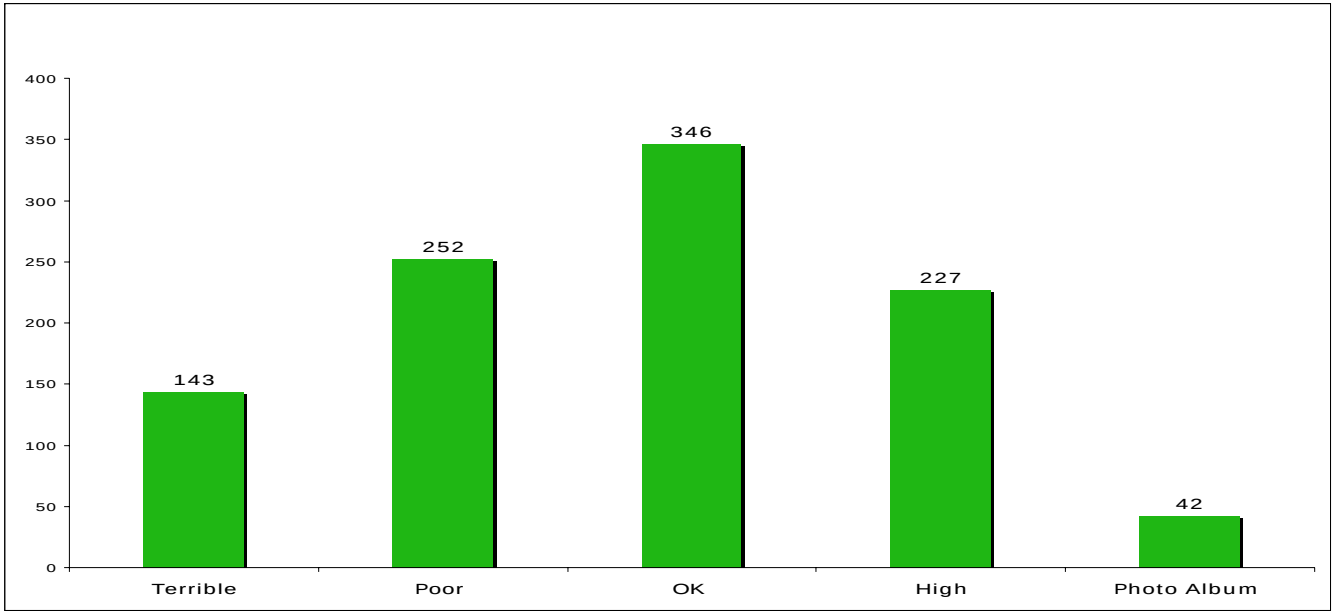
~4,000,000 SenseCam Images

- **One user wearing SC for over 3 years**
  - Each with GPS position!
  - Many other users too

Millionth Image

- **Experiences:**
  - Most people don't notice camera
  - Those that do always remember!
  - Most people don't mind the camera
  - Have been spotted/greeted by people who have heard about the 'guy with the camera'

Image Quality Analysis



- 40% of images are of low quality
- Many "boring" images of mundane tasks

Over last 3 years we've developed techniques for SenseCam data management, without having user input or direction …

… so our work is technologically-driven rather than based on user pull … let's look at it !!

Overview

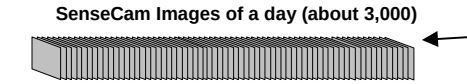
- OUR SENSECAM DATA COLLECTION
- BROWSING & SEARCHING SENSECAM DATA
  - **Event Segmentation/Searching/Interest/Augmentation**
  - **Browsing Application**
- SENSECAM SUMMARISATION: THE NEXT GENERATION
- THE FUTURE

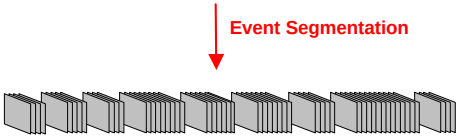
Our Take…

To effectively provide memory retrieval cues using SENSECAM we need to automatically:

- *Group similar images into distinct "events"*
- *Suggest more "interesting/distinctive" events*
- *"Associate" related events*
- *Provide potentially additional retrieval cues from other sources*

Daily Browser Overview





EVENT SEGMENTATION

Using MOTION sensors – very quick & accurate

Visual Search Facilities

SenseCam Images of a day (about 3,000)

Event Segmentation

Event-Event Comparison within the Multi-day Event database

Day -1

Day -2

Day -3

Day -4

Day -5

Day -6

Event database containing last 7 days' Events

?

Best: Compare Event Averages

(from middle *n* images)

Selecting Event "Keyframe"

SenseCam Images of a day (about 3,000)

Event Segmentation

Event-Event Comparison within the Multi-day Event database

Day -1

Day -2

Day -3

Day -4

Day -5

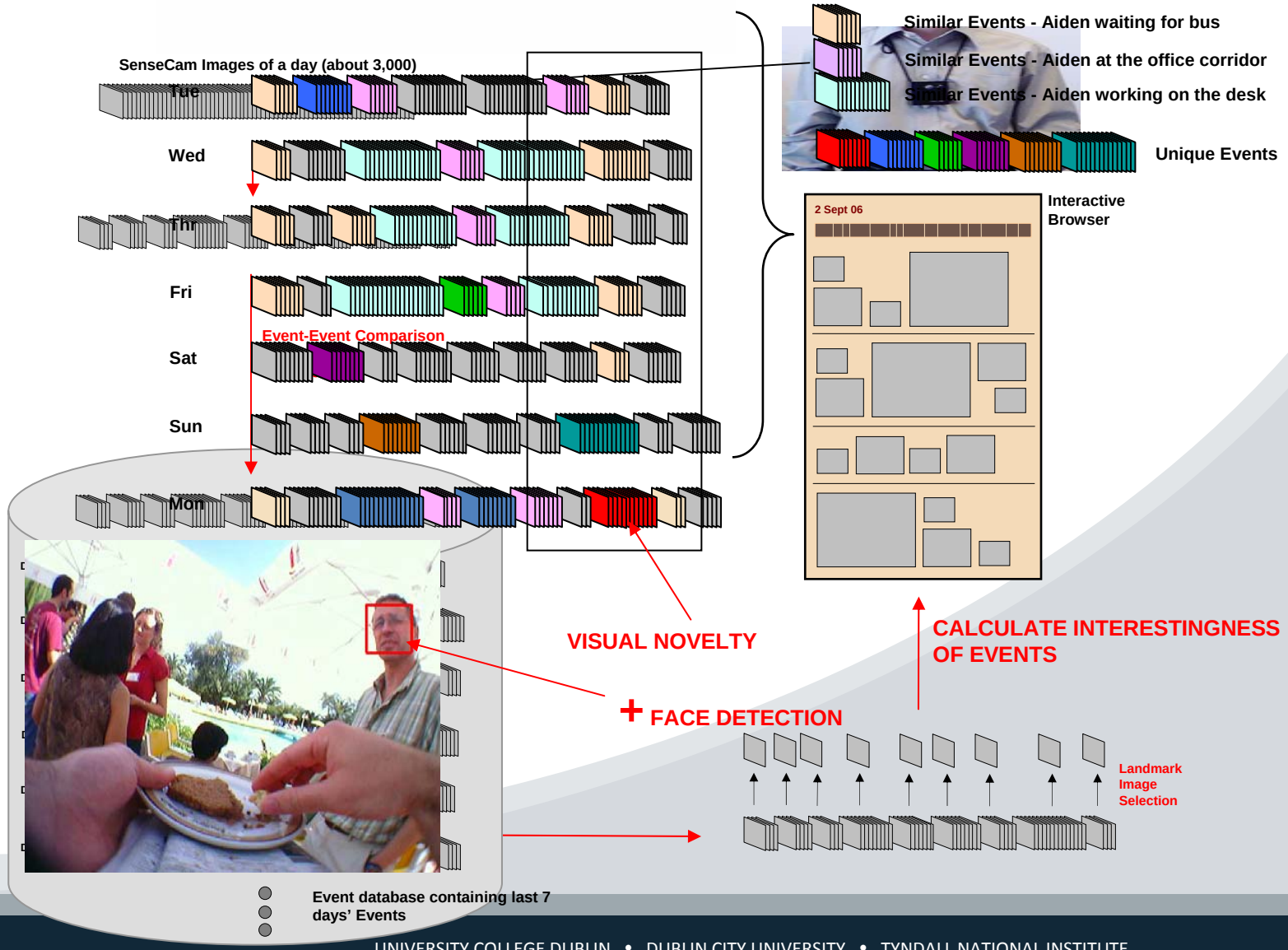
Day -6

Event database containing last 7 days' Events

Landmark Image Selection

Best QUALITY image around MIDDLE of event

Suggest Interesting Events



Event augmentation

Here's a SenseCam picture of Aiden at a pier in Santa Barbara, CA.

If he has GPS he can search for other pictures in the same location…

Event augmentation – more cues

- He receives the following “geotagged” images…
- Then after some processing on text associated with these images we get many more images, and even YouTube videos at times too!

Event Augmentation

Does it work?

Yes – we have it operational from 6 image sources, tested and evaluated with users.

Bringing the threads together … event segmentation, keyframe selection, event importance, event searching, and event augmentation …

… we have a system to manage a lifelog

My Visual Diary with SenseCam

hlee: 76,430 photos (25 days)

MY ACCOUNT | SIGN OUT | ABOUT

CALENDAR

◀ MAY ▶ 2006 ▲▼

S	M	T	W	T	F	S
30	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	1	2	3
4	5	6	7	8	9	10

DURATION ▶

CAPTION SEARCH

WEEKLY SUMMARY

Selected day is shown below in the context of whole week. Move mouse curosr over to see other similar Events in the week

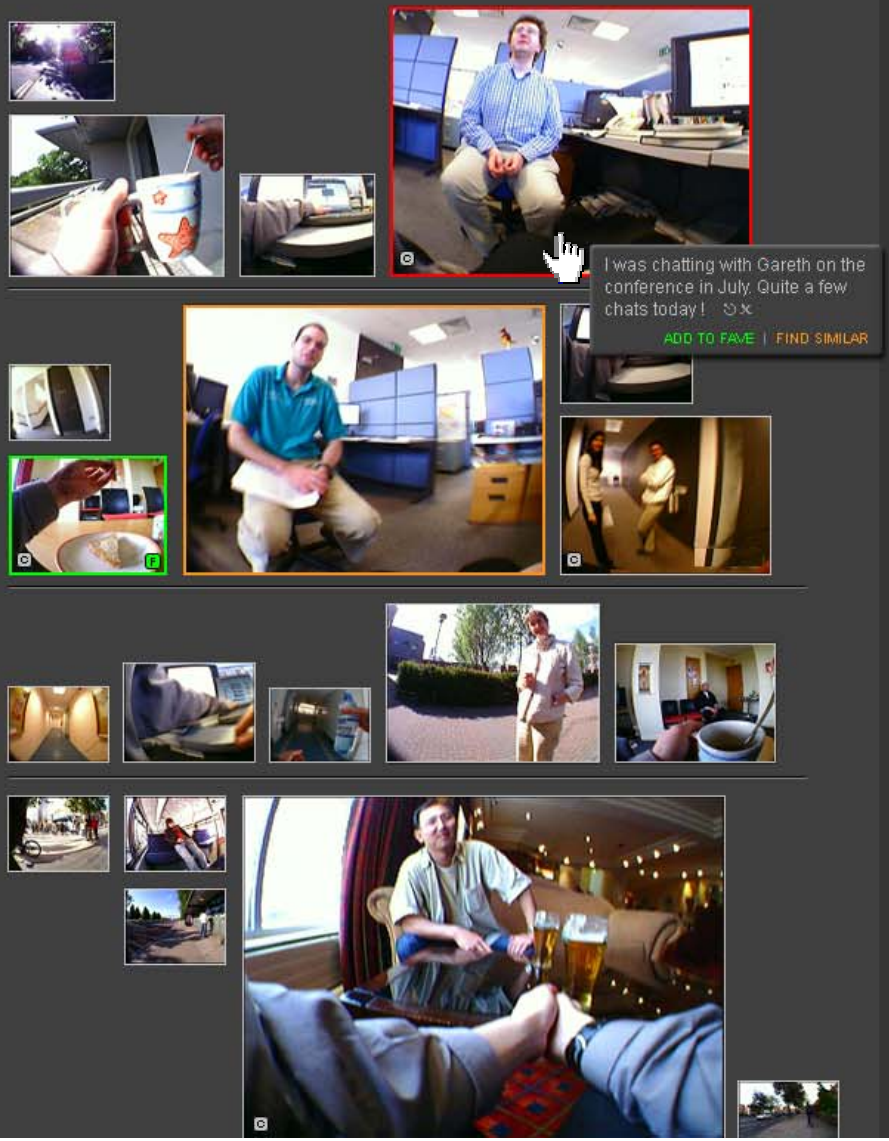
S
M
T
W
T
F
S

29 May 2006

19 EVENTS

Drag the slider bar to adjust the number of Important Events

0 am 6 am 12pm 6pm 0am



I was chatting with Gareth on the conference in July. Quite a few chats today !

ADD TO FAVE | FIND SIMILAR

MY FAVOURITE EVENTS

25 Favourite Events are shown below. Click on the photo to replay all photos within the Event.

| 1 | 2 | 3 |

Sort by: TIME | SIMILARITY | #PEOPLE

16:20 (Duration: 08m 43s)
14 APR 2006 ▶

13:45 (Duration: 14m 05s)
14 APR 2006 ▶

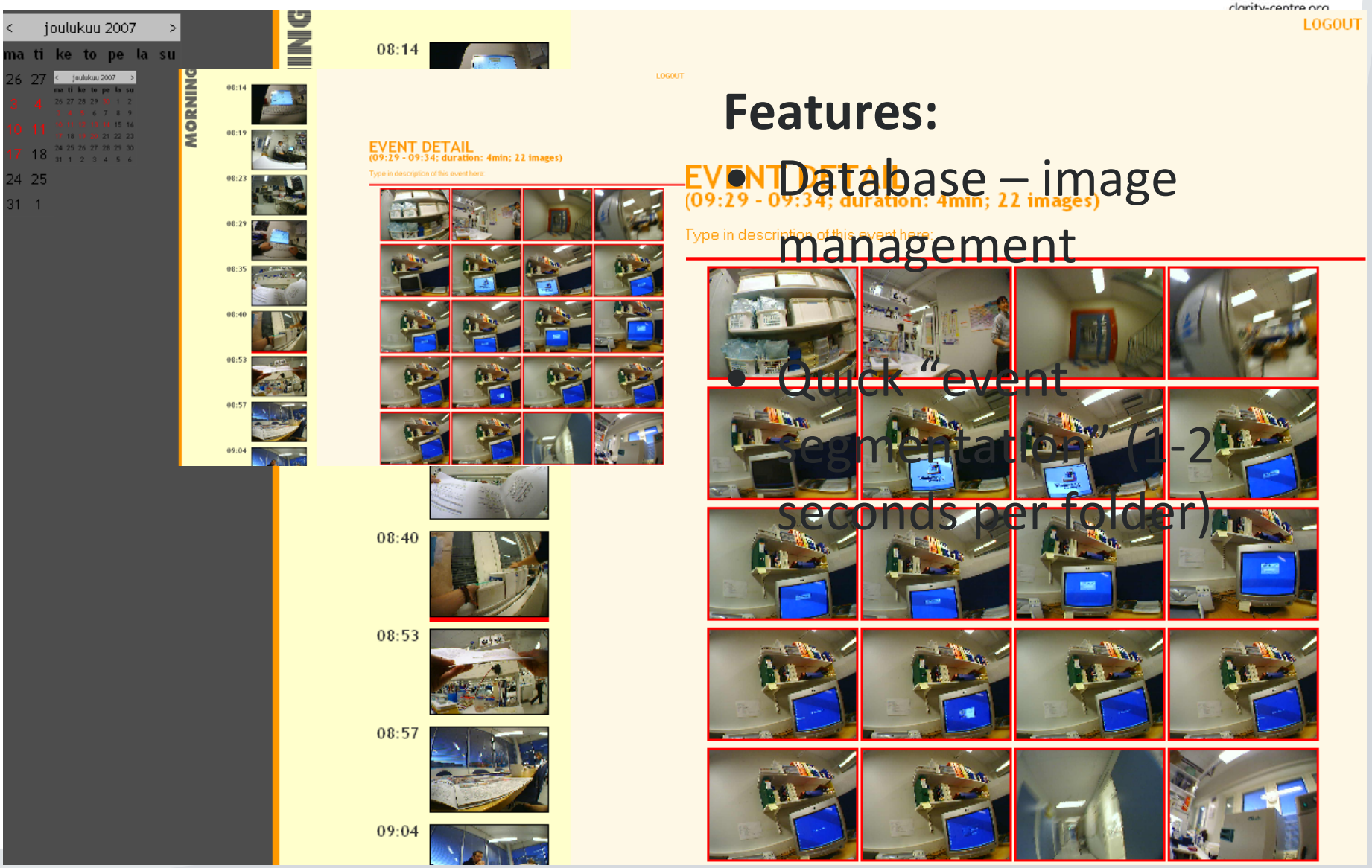
10:02 (Duration: 23m 56s)
13 APR 2006 ▶

14:39 (Duration: 15m 30s)
12 APR 2006 ▶

11:25 (Duration: 06m 21s)
12 APR 2006 ▶

09:52 (Duration: 01m 03s)
12 APR 2006 ▶

Released Software



Features:

- Database – image management
- Quick "event segmentation" (1-2 seconds per folder)

Event Segmentation S/W

- Carnegie Mellon University
- CWI, Amsterdam
- Lulua University of Technology
- Olivier Zangwell Centre
- “Mrs. W.”
- University of Leeds
- University of Limerick
- University of Toronto
- University of Utrecht
- University of Illinois
- University of Tampere

Overview

- OUR SENSECAM DATA COLLECTION
- BROWSING & SEARCHING SENSECAM DATA
- SENSECAM SUMMARISATION: THE NEXT GENERATION
  - **Activity Recognition**
  - **Diet Monitoring**
  - **Scene Detection**
  - **Trajectory Estimation**
  - **Incorporating Contextual Information**
  - **Keyword Searching**
- THE FUTURE

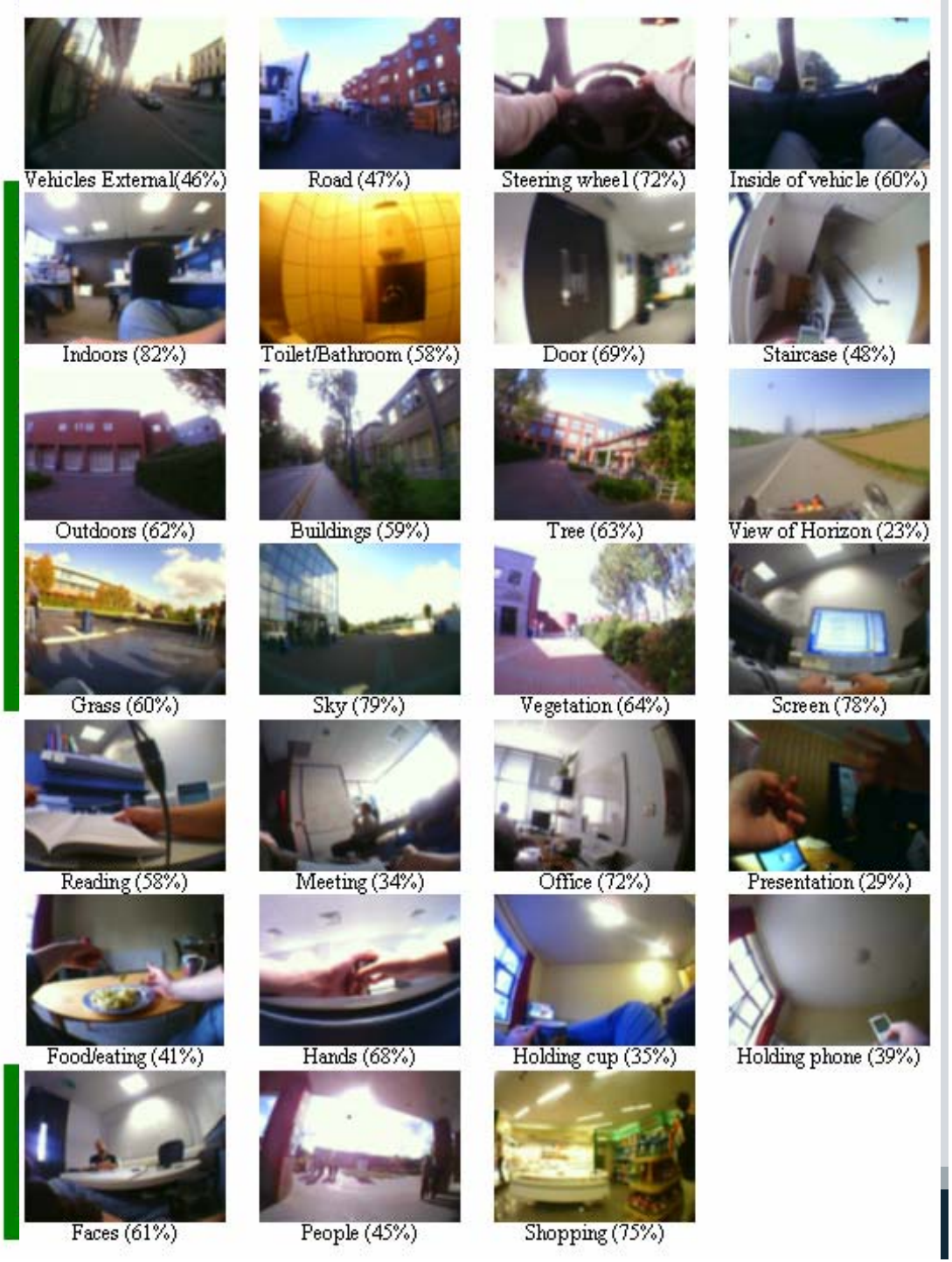
THIS IS WHERE THE REAL FUN STARTS !

Dublin SenseCam Work

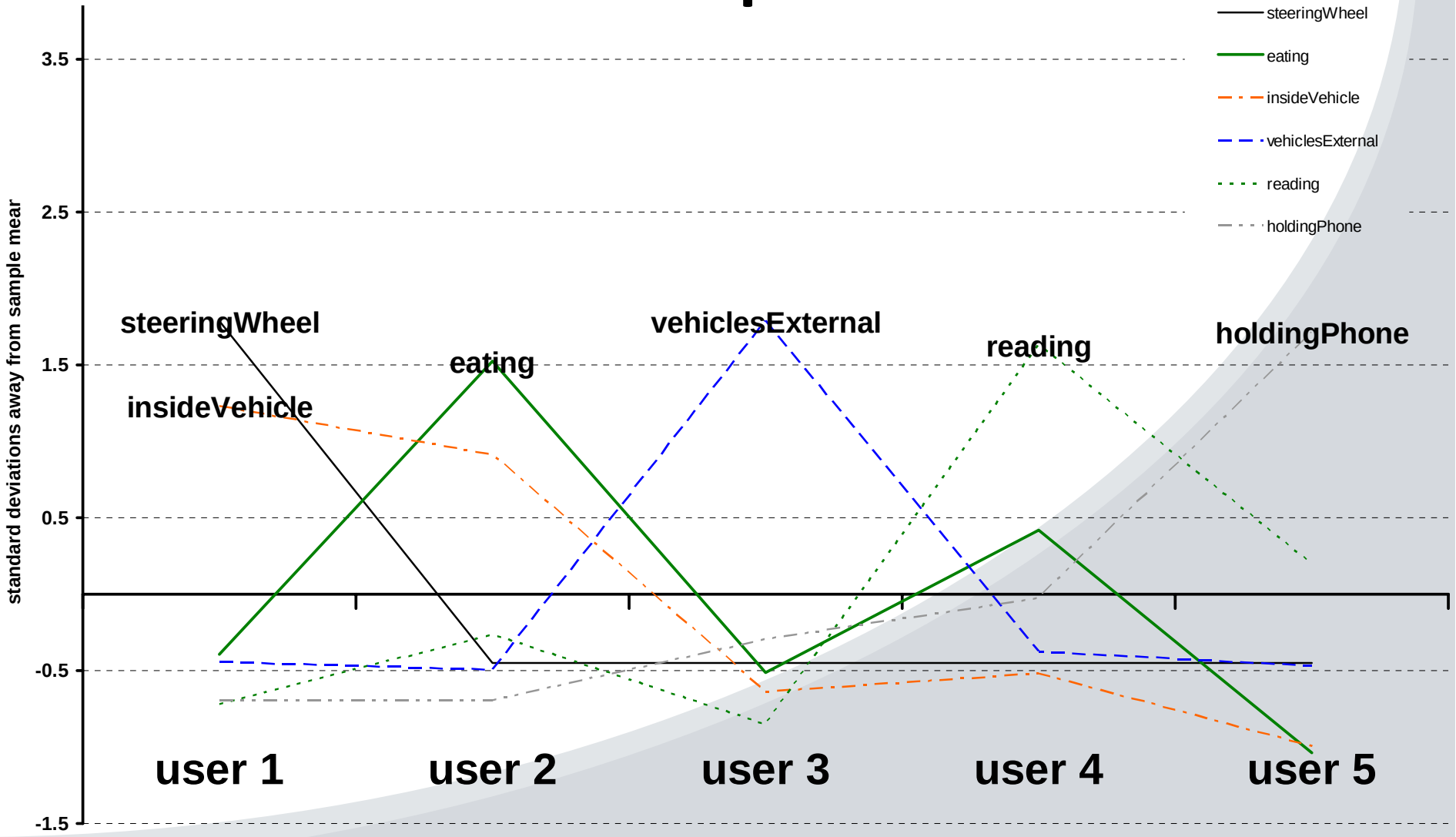
Activity Recognition

27 “concepts”

Outputs manually judged on ~95k images (5 users)



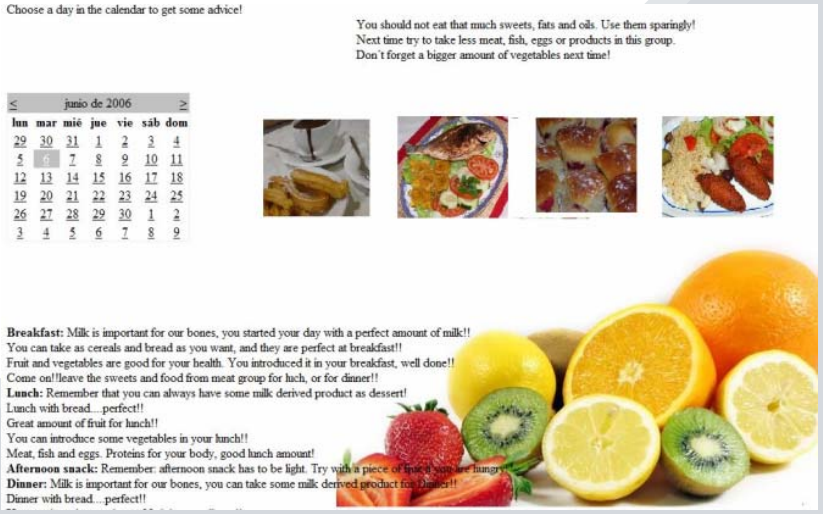
Comparison of Lifestyle Within Social Groups



Dietry habits

Consider using even only the “Eating” concept...

- Detect events where user is eating
- Allows us/family/dietations gain more complete record of our eating habits



MY DIET RECORD

Cathal | HELP | ABOUT

T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W

> CALENDAR

WEDNESDAY 17 OCT 2008

This day's food intake is as following:

4 Meals

2,118 Calories

Select a meal to annotate and/or see the type of food eaten for that meal

Meal 1
10:47am

Meal 2
1:20pm

Meal 3
3:15pm

Meal 4
9:08pm

Little

Milk
Meat
Vegetables
Fruits
Bread / Rice
Other Starch

My total calorie balance for each day over time…

Detected 'eating' events listed, for the

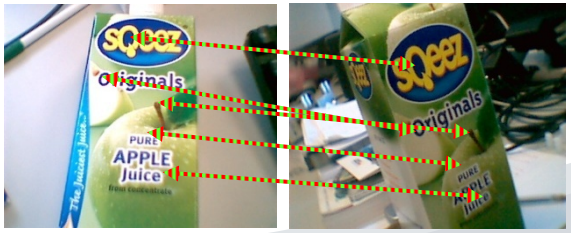
This re-calculates the overall calorie-exercise balance and displays on the screen

Advanced Image Matching

SURF feature are extracted

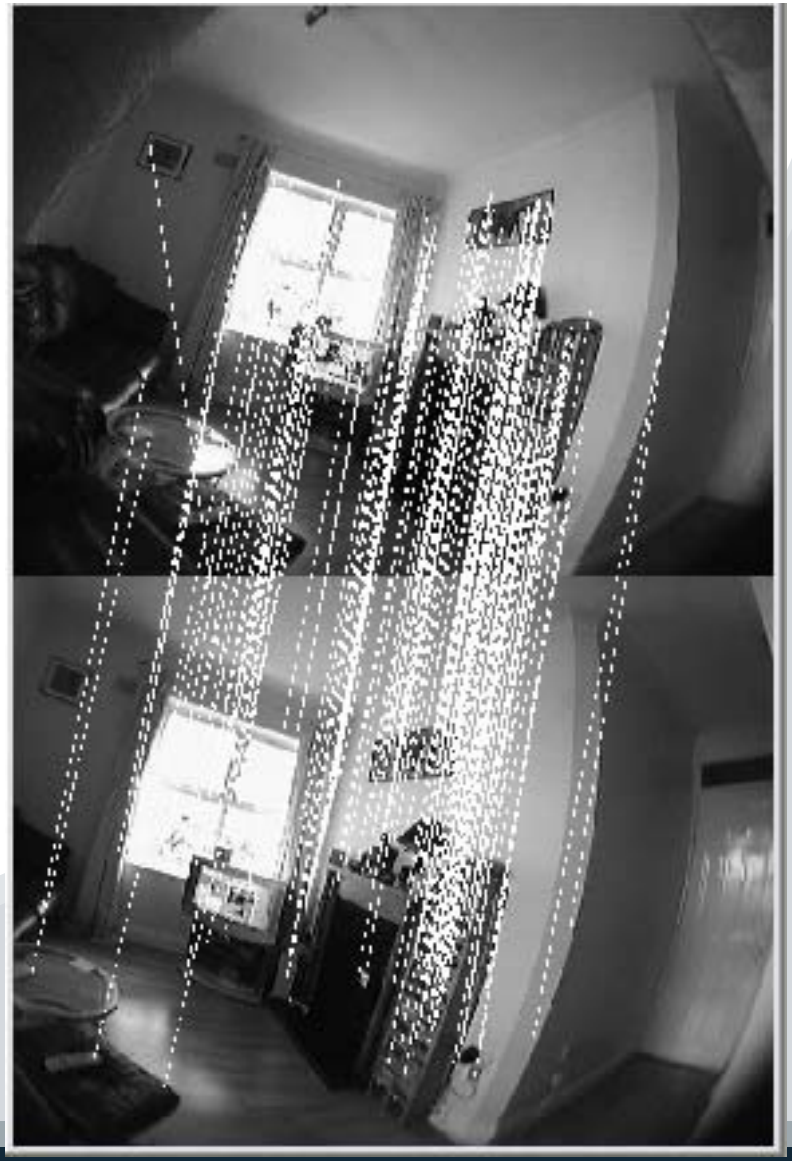
Each feature point casts a weighted vote for multiple database images

Votes are accumulated & the best match is found



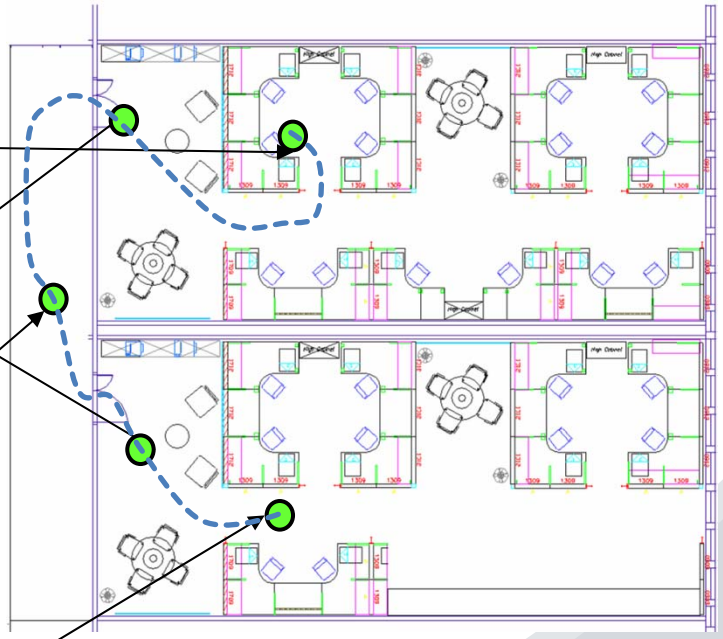
Bi-directional Match Verification & re-ranking of Top results

Setting Detection – Watching TV



Setting Detection – In the Park

Trajectory Estimation

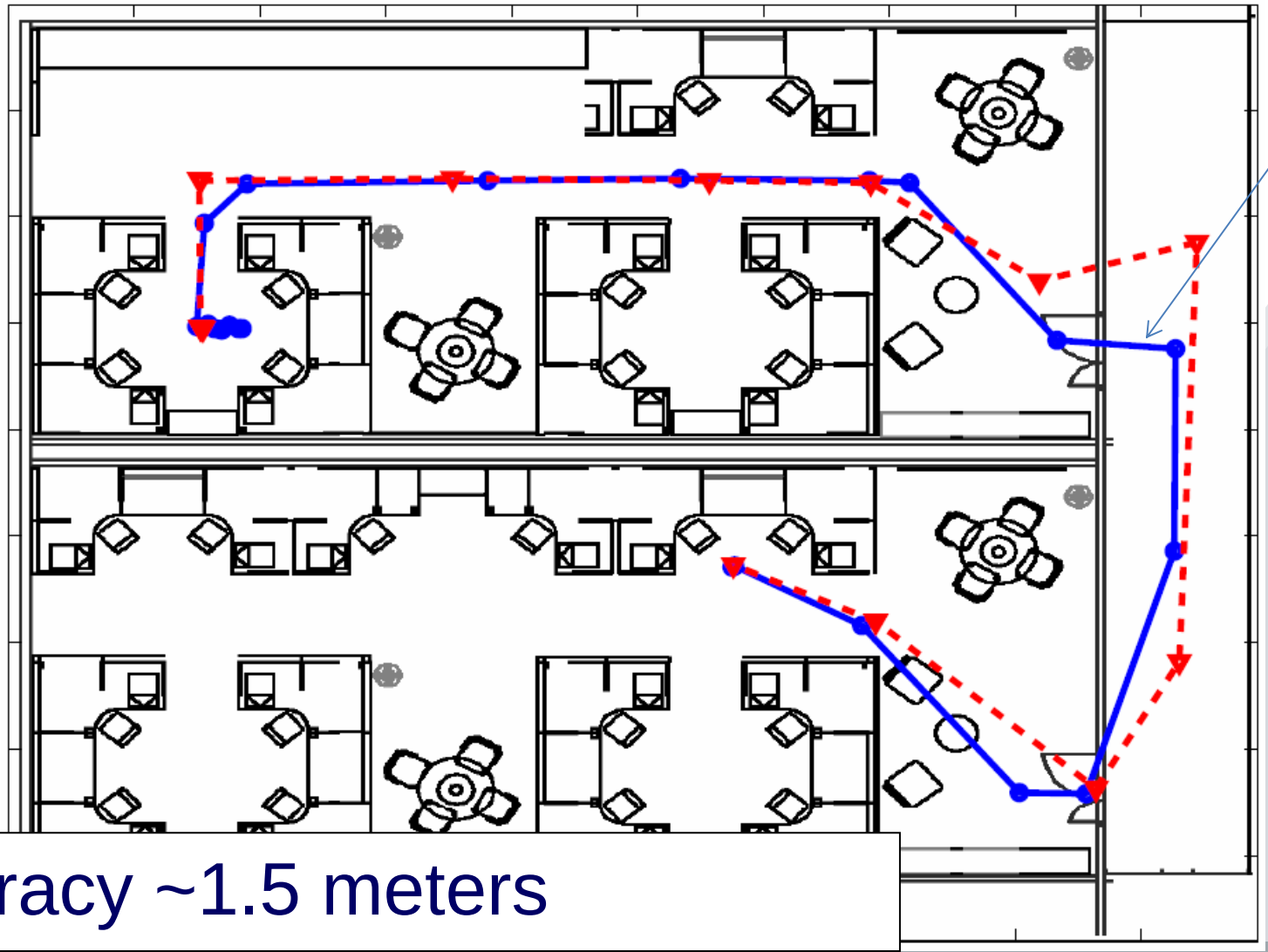


Area Map

A User's Images

Location Database Matching

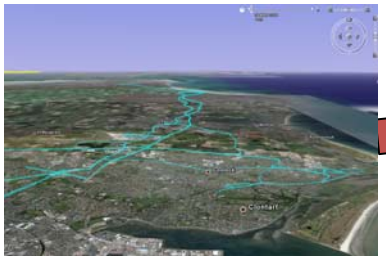
Trajectory Estimation Results



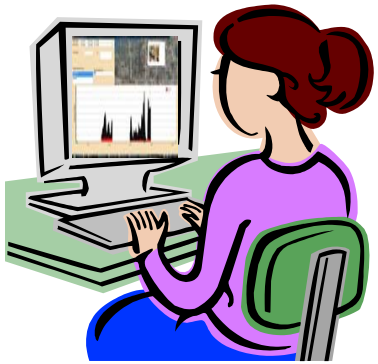
Accuracy ~1.5 meters

Other Data Sources

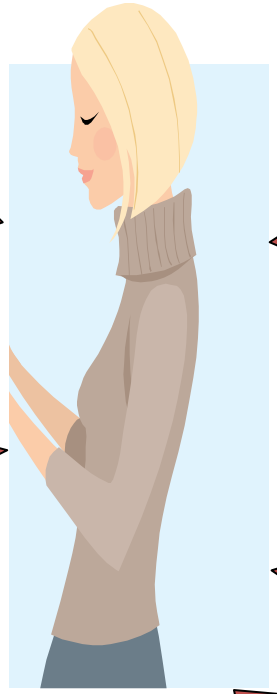
***SENSECAM**: Images*



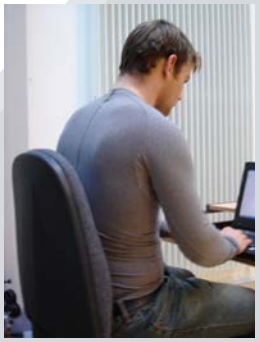
***GPS**: Location*



***PC**: E-mail, web pages visited, documents worked on*



***PHYSIOLOGICAL**: Heart Rate, body temperature, breathing rate, sweat ph analysis*



***PHYSIOLOGICAL**: Posture monitoring*

***BLUETOOTH**: People around me + FAMILIARITY*

Using Context in Personal Information Management

- **Represent events as text documents, then "Google" them**

- **Search using keywords to find the desired target (e.g. pics of SenseCam event):**
  - You may recall:
    - This document was for the ***Conference X.***
    - I worked on it before meeting with ***Professor A***.
    - It was a hot day
    - I was really tired
    - It was some restaurant in the city centre where we met

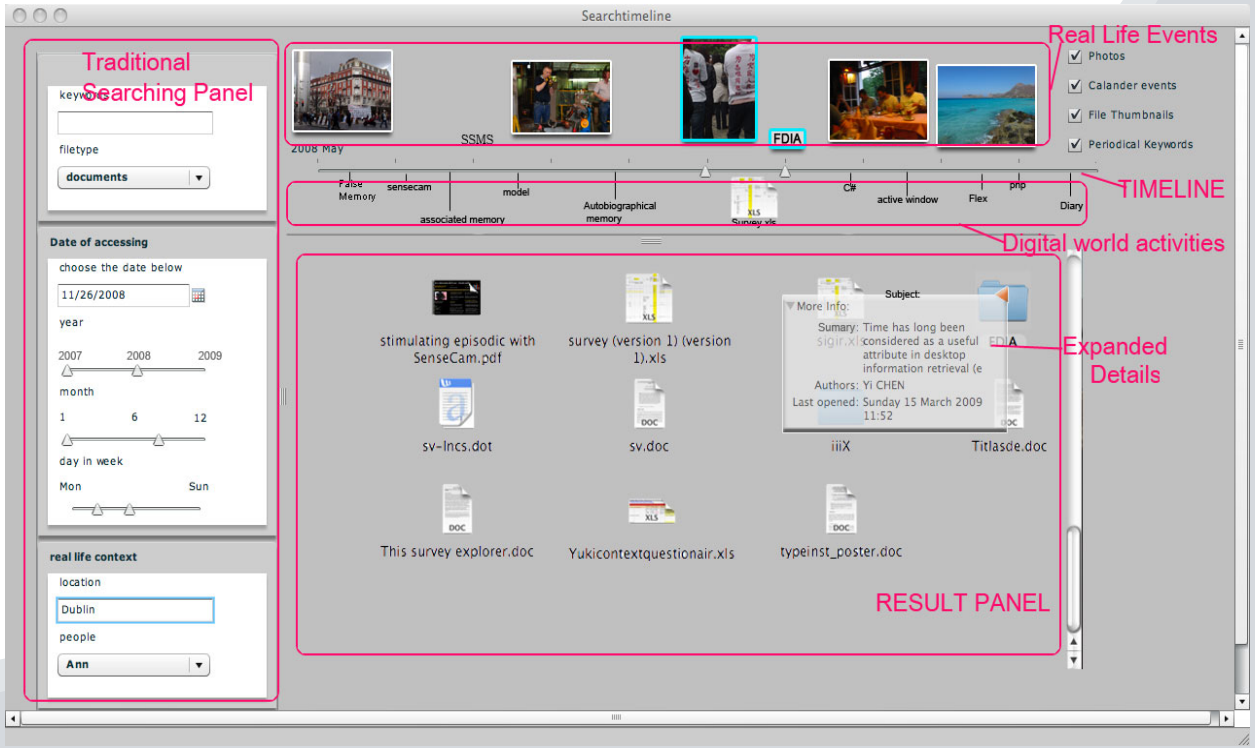
iCLIPS Browsing Interface

Present landmarks: real life events (Photos) and computer activities (Keywords and Thumbnails)

Refine searching by RECOGNIZING **landmarks and** Estimating **the relevant** Temporal **distance from the** Targets **to the landmarks**

Traditional Searching Panel also provide rich searching options:

- Keywords
- Target type
- Flexible time/date
- Geo-location
- People
- And more…



Overview

- OUR SENSECAM DATA COLLECTION
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- SENSECAM SUMMARISATION: THE NEXT GENERATION
- THE FUTURE
  - Storytelling
  - Energy Consumption
  - Designing for the Elderly
  - Summary

Lifelogs & Storytelling

Lifelogs offer huge opportunity for telling life stories.

The Need for Narrative:

1. Humans like stories - we tell them everyday
2. Lifelogs are complex & voluminous - we can't just present the material - we need to tame it somehow
3. Storyform communicates experience effectively & enables reflection and introspection

Lifelogs & Storytelling

Clear Challenges:

1. What components of a lifelog should be used in the composition of digital life stories and how should they be structured to enable retelling?

2. What information should be captured about the relationships between the various story elements in order to facilitate the reasoning required to build the end narrative?

3. How should an author be supported in the process of composing a life story and how should these stories be presented to their intended audience?

Classifying SC Motion Data

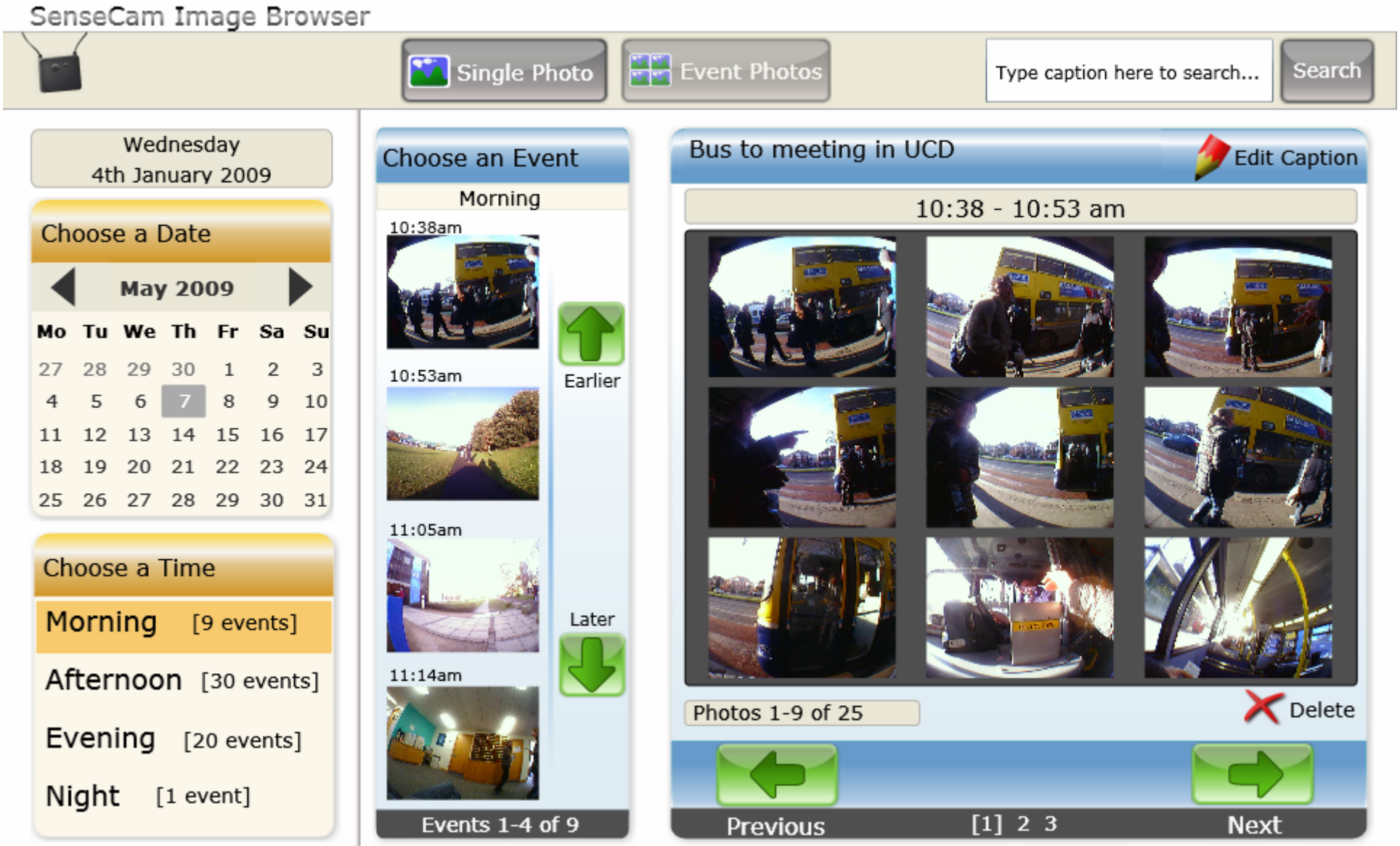
- Use accelerometer data to identify various states: sitting, walking, running, driving, on bus, on airplane
- Can estimate energy output
- Can estimate our “carbon footprint”
- This work is currently “early-stage”

Designing for Older Adults

Areas Affected by Ageing	Implications for Design
Cognitive Skills - Working Memory	Providing feedback to show what has been selected. Use combination of text and icons to support recall.
Sensory Skills - Vision and Hearing	Use of large images and text, large target areas for buttons and high colour contrast. Use of low frequency auditory signals.
Psychomotor skills	Use direct input devices (touch screen). Reduce scrolling.

Designing for Older Adults

CLARITY



Designing for Older Adults

CLARITY

CLARITY + U. Leeds

Martin Conway & Chris Moulin, Institute of Psychological Sciences, University Leeds

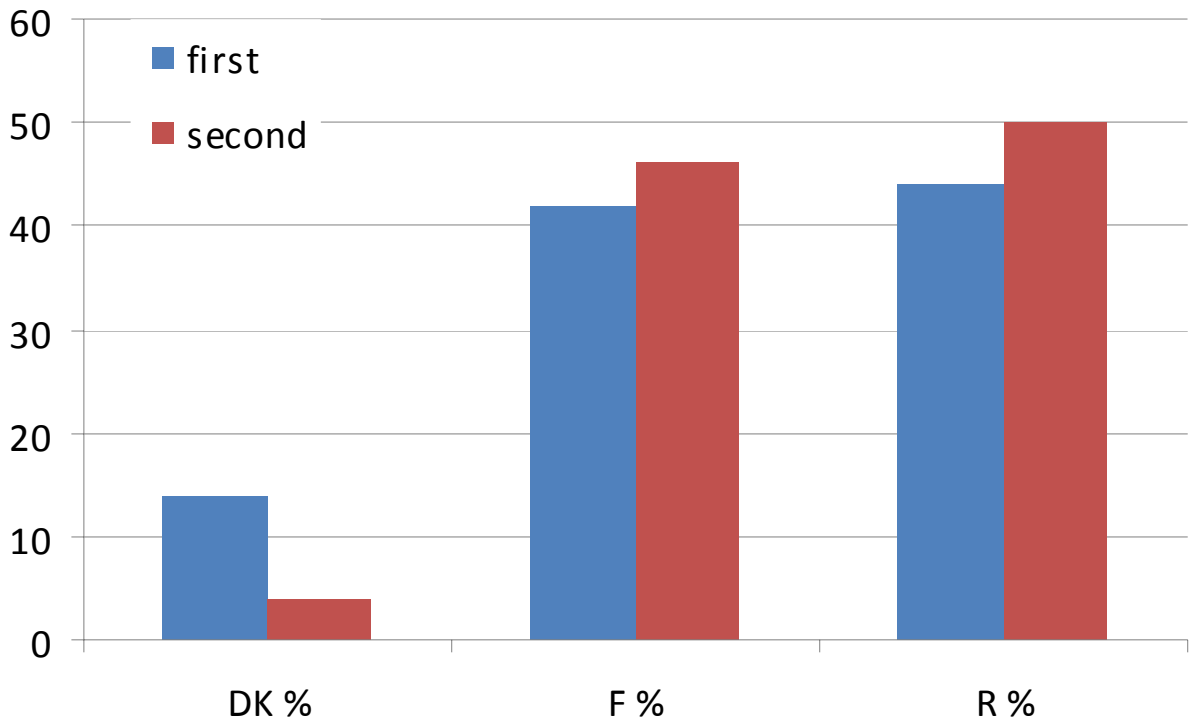
1 healthy subject -> 3 years of SenseCam images

How does SenseCam effect “normal” people?

Recollective experience as cued by SenseCam stills

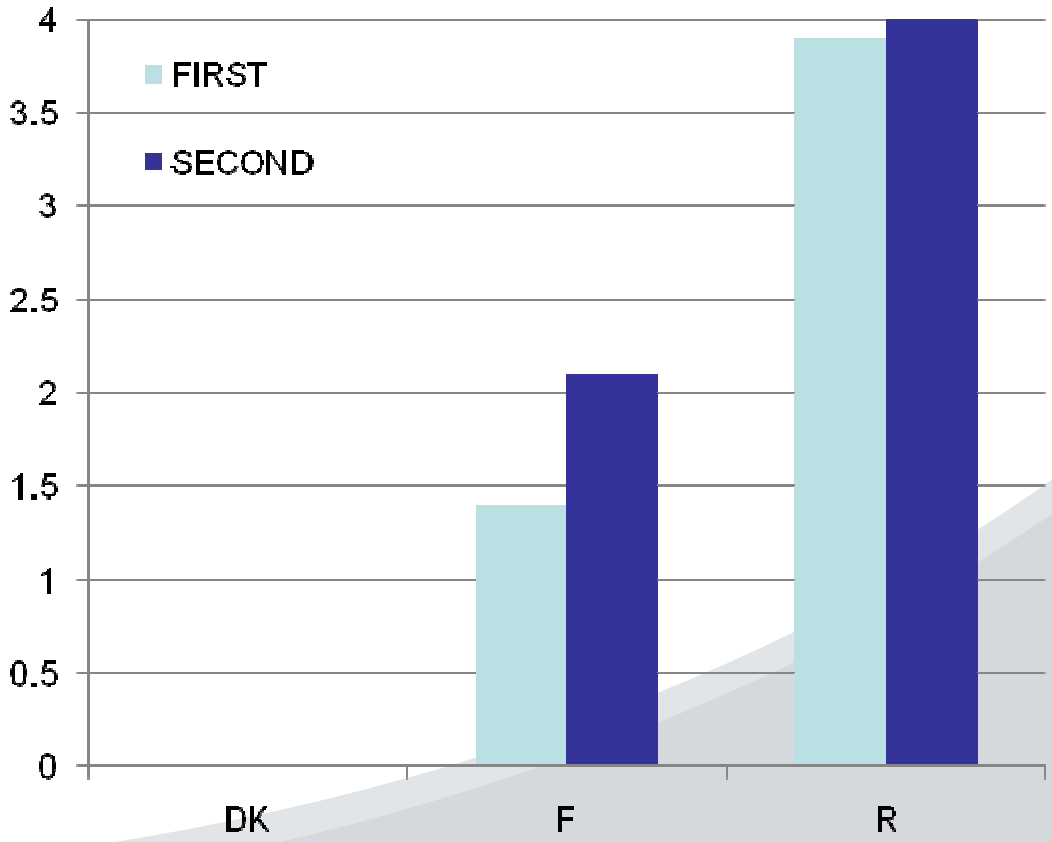
50 “keyframe” images reviewed – 2 months between viewings

Consistency of judgements (R / F / DK) … Same judgement on 78% of memories

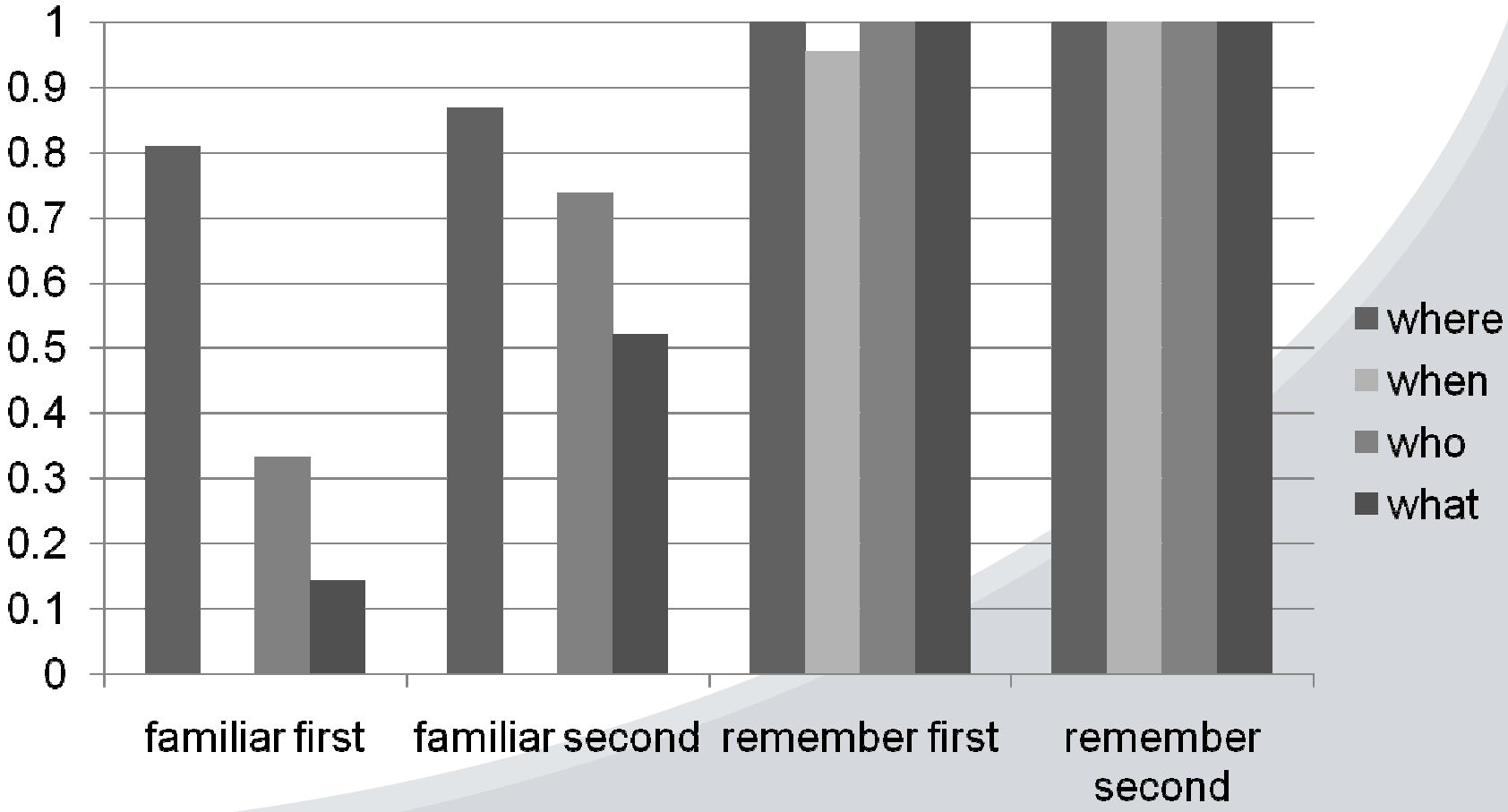


Episodic details 1

when / where / who / what



Episodic details 2



Next – Influence F-R shift

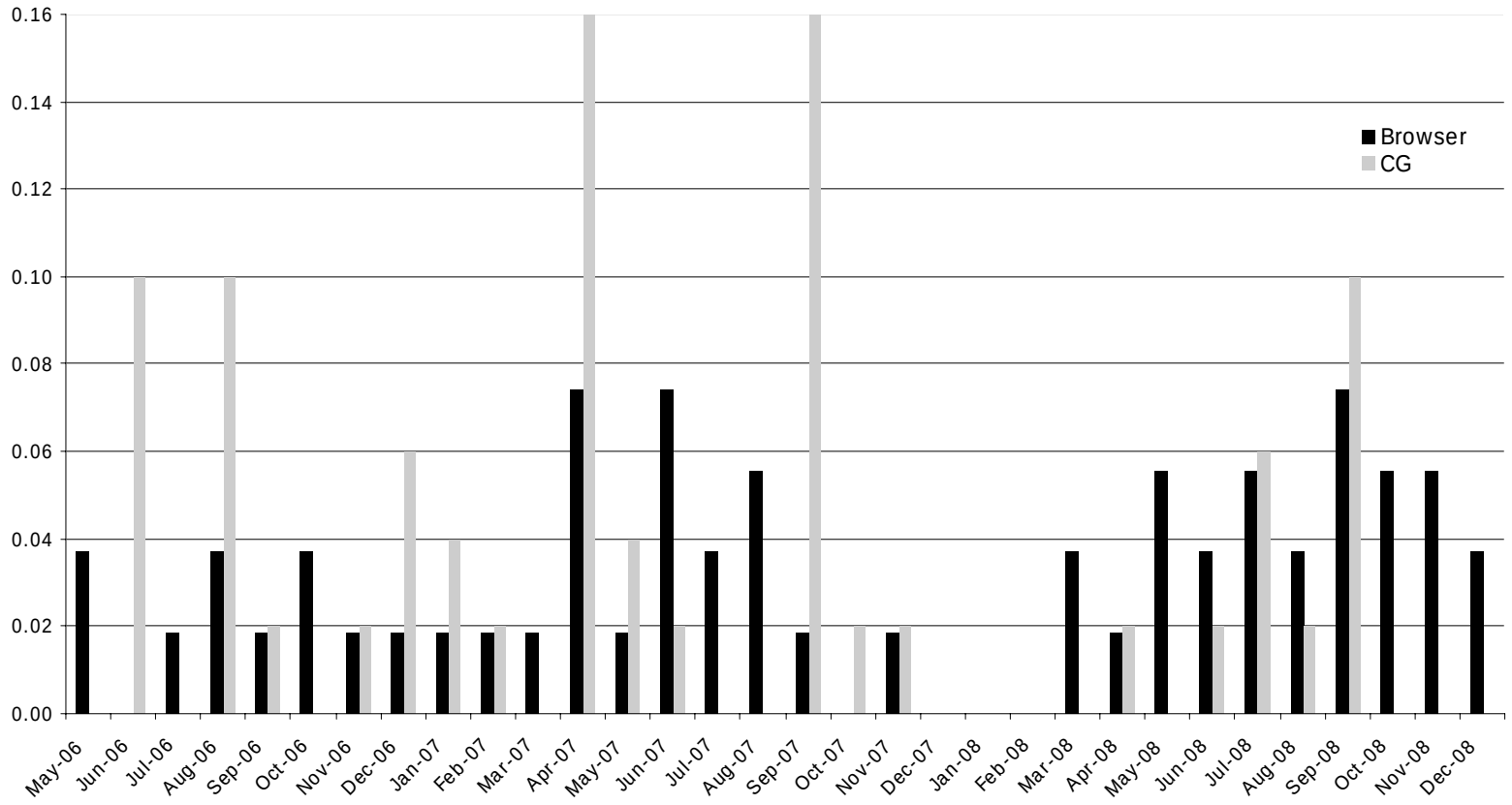
	R	F	DK
R	**19**	**3**	**0**
F	37	**18**	**0**
DK	**3**	0	**2**

- Working with SenseCam films instead of stills (using the same events)

- Working with surrounding events to provide further contextual information (to allow mind to storyboard)

- Change in recollective experience? F to R shift?

The SenseCam browser and human memory



Results so far

There is no considerable overlap between the most important browser events and those recalled by CG

r = .17

Spearman's rank correlation = .008

p = .967

novelty and personal relevance ratings given by CG on memories recalled by him and those generated by the browser

Novelty: 5.0 and 3.22 P.relevance: 4.0 and 3.0

t-test highly significant

Next?

Using user generated important events to help train system to improve…

How does user recollection of “free recall” memory change after being presented with SenseCam images of this memory…

Summary

- **More SenseCams**
  - we'd love 50+ of them!
- **Increased accuracy/flexibility in recognising a person's lifestyle**
  - More SenseCams = better recognition of lifestyle "norms"
- **Increased collaboration with memory experts e.g. as with Leeds**
  - we're good at summarising SenseCam data, but not at neuro psychology!

Managing a Life of Lifelogged SenseCam Images

Aiden R. Doherty

further information:

http://www.cdvp.dcu.ie/SenseCam

http://www.computing.dcu.ie/~adoherty

(case sensitive)