Managing a Life of Lifelogged SenseCam Images

Alan F. Smeaton

CLARITY: Centre for Sensor Web Technologies,

Dublin City University, Ireland

The DCU SenseCam team

Alan Smeaton

Gareth Jones

Hyowon Lee

Aiden Doherty

Liadh Kelly

Zhengwei Qiu

Niamh Caprani

Noel O'Connor

Cathal Gurrin

Ciarán Ó Conaire

Daragh Byrne

Yi (Yuki) Chen

Peng Wang

Carolina Camacho

Thanks to …

**Microsoft Research (Cambridge)
(for SenseCams)**

Science Foundation Ireland

**Science Foundation Ireland
&
Science Foundation Ireland**

Overview: Research @ DCU

- OUR SENSECAM DATA COLLECTION
  - **CLARITY**
  - **Visual Lifelogging Analysis**

- BROWSING & SEARCHING SENSECAM DATA

- SENSECAM SUMMARISATION: THE NEXT GENERATION

- THE FUTURE

CLARITY

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 Computing & EE, NCSR (sensor people), Health & Human Performance (sports people)

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
- Need a large-scale, multi-disciplinary research effort == CLARITY
- Moves us 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]

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

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
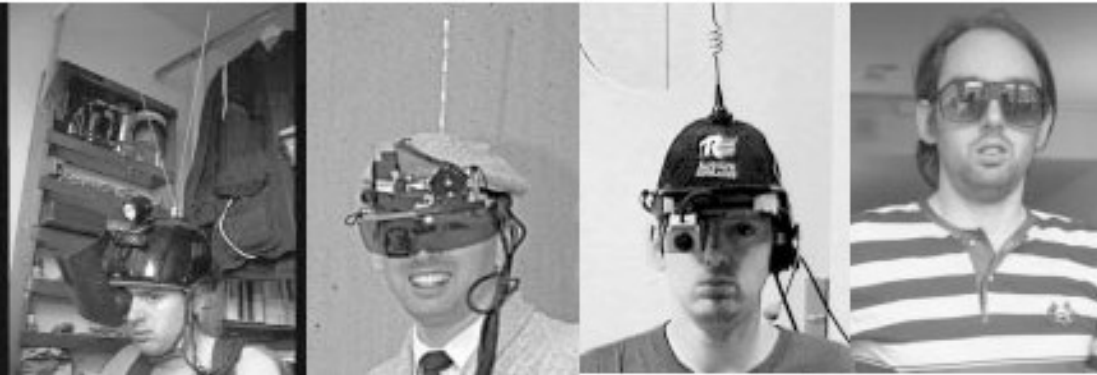
Recording vacations, family gatherings, social occasions
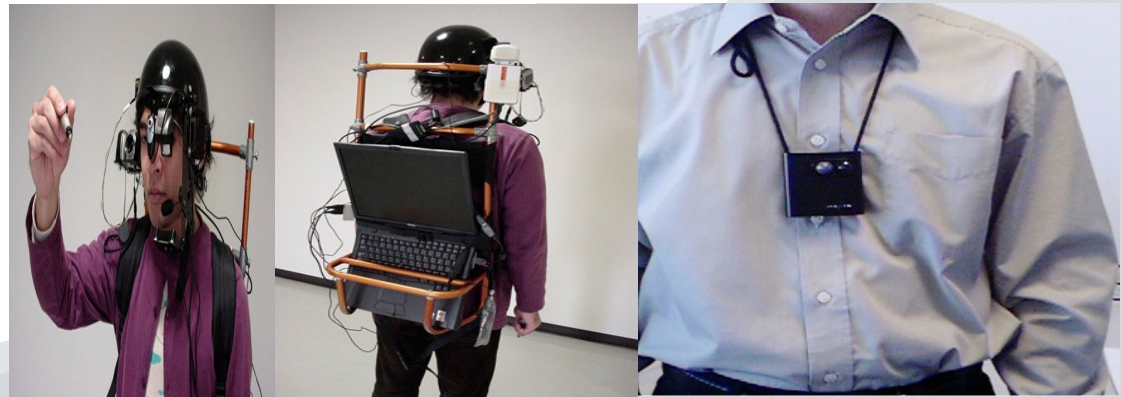
Sometimes its because we can

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

SC data: c.3.5M SenseCam Images

- **One user wears SC for almost 3 years, all day**
  - Each with GPS position
  - Ongoing collaboration with Univ. Of Leeds Dept. of Psychology

- **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'

Summary Experiences

- Event browsing is key
  - Too many photos to browse, need event summary and then 'drill down' to view event in detail if required
- Stop events, (like work desk and driving) should be identified and hidden.
- 'Total Recall', little sign of 'Event Decay'
  - Remembers nearly every (non stop-) event when presented again
  - Experiment underway exploring this
- Observations from three years suggest that many users want to get access to Lifelogging technology.

SC Image Quality Analysis
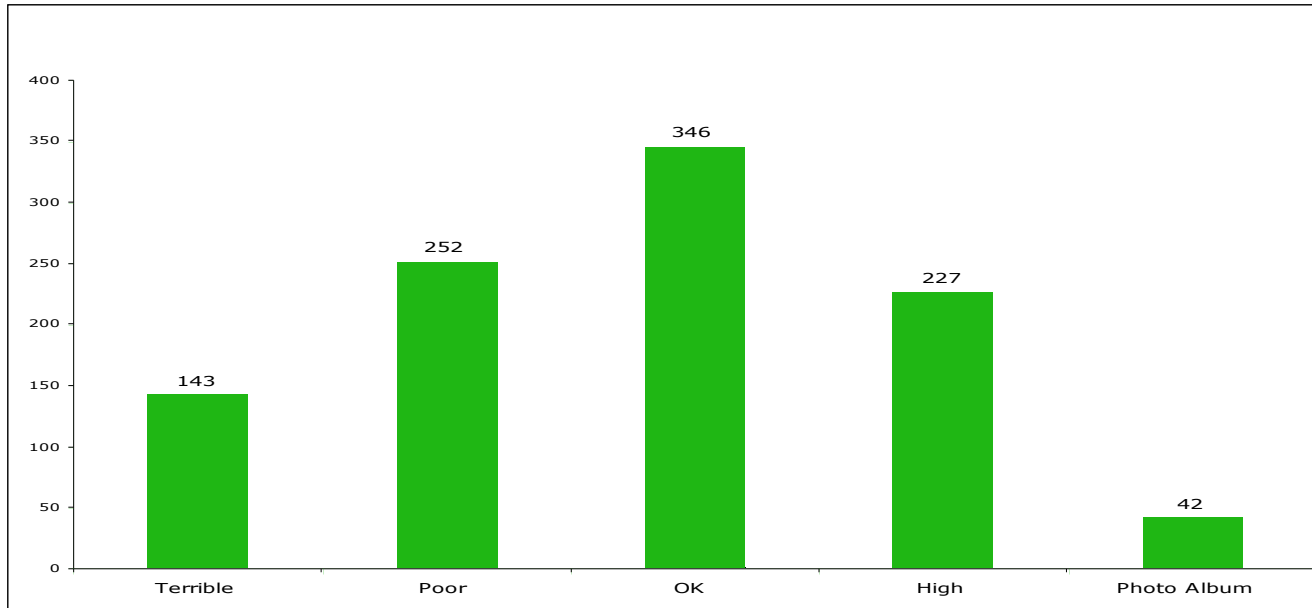
- 40% of images are of low quality

- Many "boring" images of mundane tasks

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

… so our work is mostly technologically-driven rather than based on user pull … lets 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 …

4 key points … 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

SenseCam Images of a day (about 3,000)
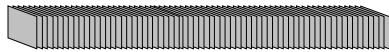
Event Segmentation
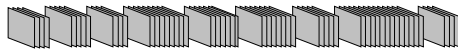
EVENT SEGMENTATION
Using MOTION sensors – very quick & accurate
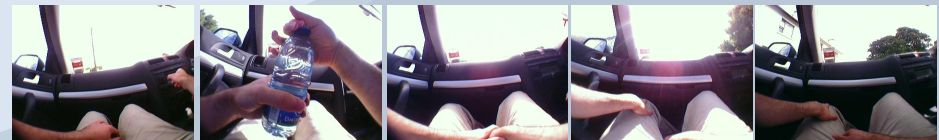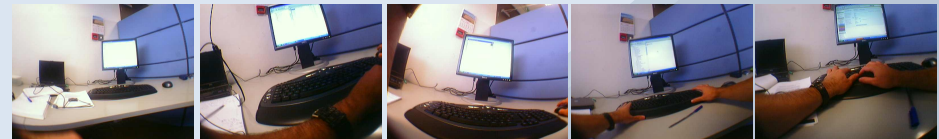
Visual Search Facilities

SenseCam Images of a day (about 3,000)
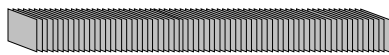
Event Segmentation

Event-Event Comparison within the Multi-day Event database

Day -1

Day -2

Day -3

Day -4

Day -5

Day -6

Event database containing previous Events

?

Best: Compare Event Averages

Better: compare Event averages

(from middle *n* images)

…

…
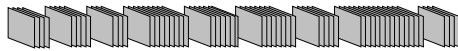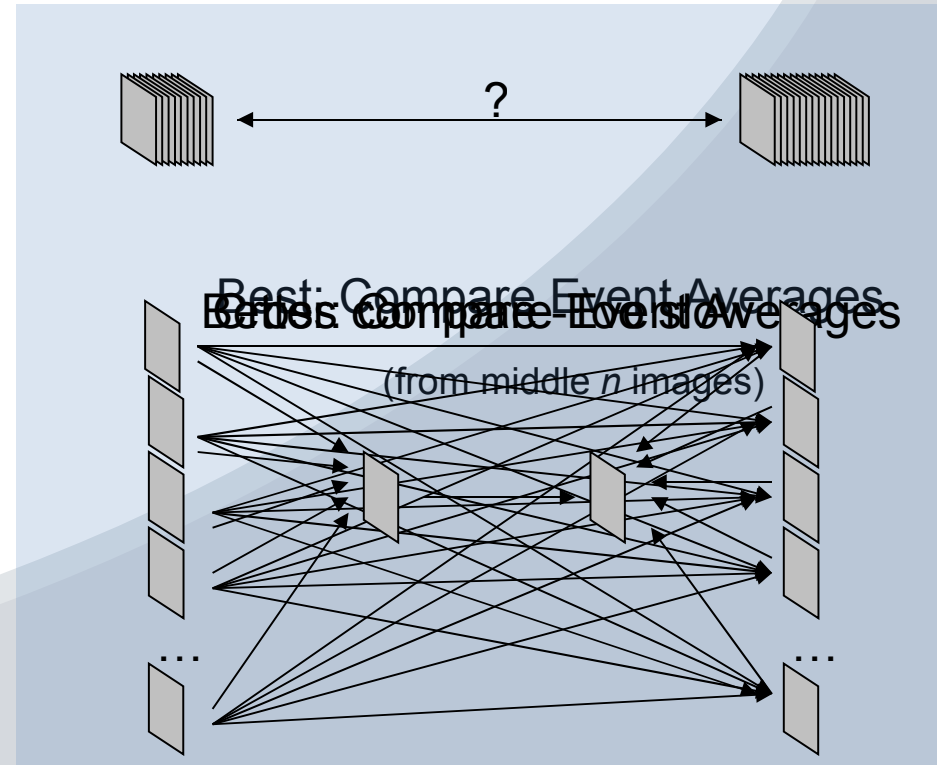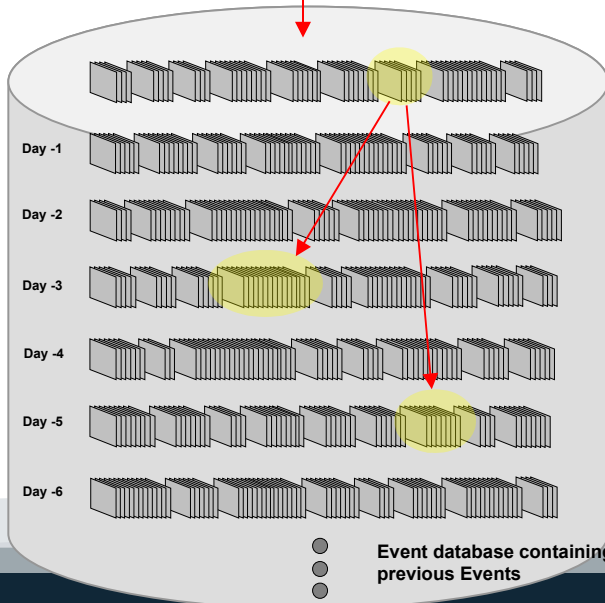
Selecting Event "Keyframe"
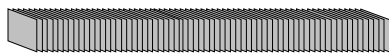
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SenseCam Images of a day (about 3,000)

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 previous Events
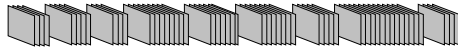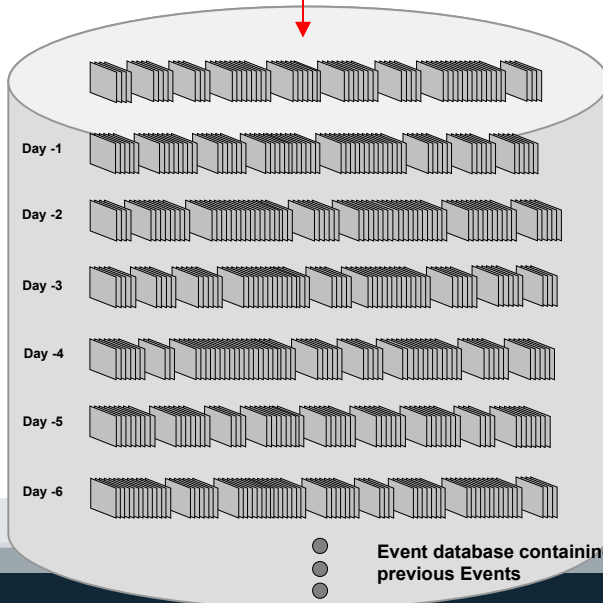
Best QUALITY image around MIDDLE of event

Landmark Image Selection
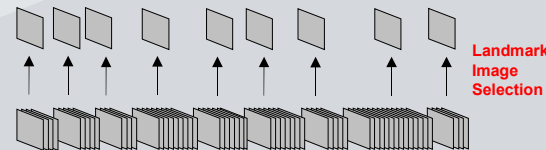
Suggest Interesting Events

Mon

SenseCam Images of a day (about 3,000)

Tue

Wed

Thr

Fri

Event-Event Comparison

Sat

Sun

Mon

Similar Events - Aiden waiting for bus

Similar Events - Aiden at the office corridor

Similar Events - Aiden working on the desk

Unique Events

2 Sept 06

Interactive Browser

VISUAL NOVELTY

CALCULATE INTERESTINGNESS OF EVENTS

+ FACE DETECTION

Landmark Image Selection

Event database containing previous 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!

- And then … visual filtering to choose those for SC event augmentation
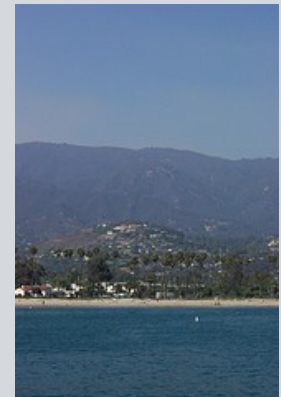
Event augmentation

Does it work ?

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

Bringing the threads together ... event segmentation, KF selection, event importance, event searching, and event augmentation ...

... we have a system to manage a lifelog

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 cursor 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
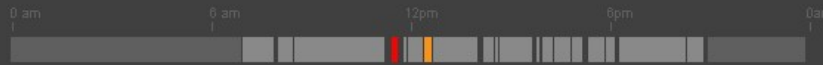
I was chatting with Gareth on the conference in July. Quite a few chats today ! ↻ ✕
ADD TO FAVE | FIND SIMILAR

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 ►
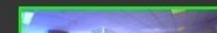
Released Software

Features:

- Database – image management

- Quick "event segmentation" (1-2 seconds per folder)

Event Segmentation S/W

- **Carnegie Mellon University**

- **CWI, Amsterdam**

- **Lulea University of Technology**

- **Oliver Zangwell Centre**

- **"Mrs. W."**

- **University of Leeds**

- **University of Limerick**

- **University of Toronto**

- **University of Utrecht**

- **University of Illinois**

- **University of Tampere**

Gesture Recognition Interface

- Bring the Lifelog browsing experience into a lean-back environment

- Use the event segmentation to define a day, and allow user browsing at the event, day, week level...

We defined a suite of gestures that make sense :

- Next/previous event

- Next/Previous image

- Next/previous day, week, ...

Possibility of pivot view across multiple axes, e.g. People, locations...

User experiment planned

Overview

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- 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**

This is where the real 'fun' starts !

- THE FUTURE

Dublin SenseCam Work
Activity Recognition

27 "concepts"

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

Vehicles External (46%) | Road (47%) | Steering wheel (72%) | Inside of vehicle (60%)
Indoors (82%) | Toilet/Bathroom (58%) | Door (69%) | Staircase (48%)
Outdoors (62%) | Buildings (59%) | Tree (63%) | View of Horizon (23%)
Grass (60%) | Sky (79%) | Vegetation (64%) | Screen (78%)
Reading (58%) | Meeting (34%) | Office (72%) | Presentation (29%)
Food/eating (41%) | Hands (68%) | Holding cup (35%) | Holding phone (39%)
Faces (61%) | People (45%) | Shopping (75%)
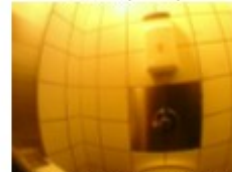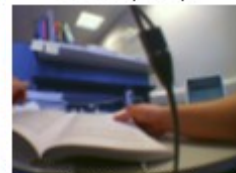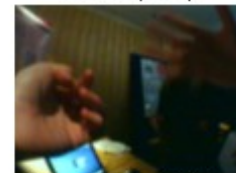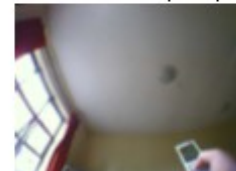
Comparison of Lifestyle Within Social Groups

Dietry habits - ongoing

Consider using 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

> CALENDAR

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

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

Little

Oil / Fats
Milk
Meat
Vegetables
Fruits
Bread / Rice
Other Starch

Meal 2
1:20pm

Little   Much   243 Calories

Sweets
Oil / Fats
Milk
Meat
Vegetables
Fruits
Bread / Rice
Other Starch

Meal 3
3:15pm

Little   Much   80 Calories

Sweets
Oil / Fats
Milk
Meat
Vegetables
Fruits
Bread / Rice
Other Starch

Meal 4
8:08pm

Little   Much   845 Calories

Sweets
Oil / Fats

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

UNIVERSITY COLLEGE DUBLIN   DALL NATIONAL INSTITUTE   30
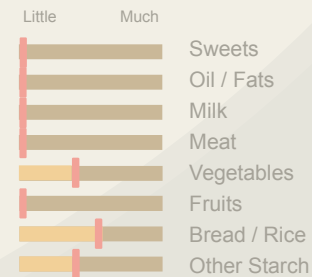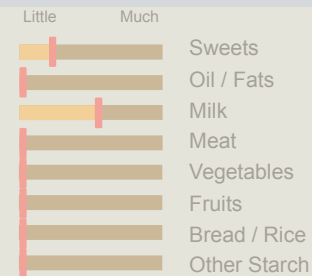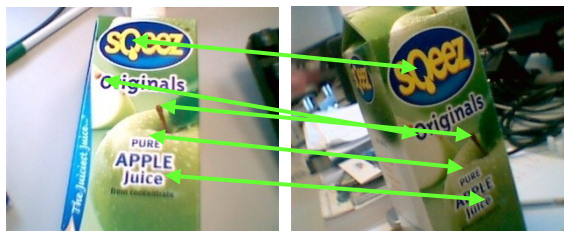
Advanced Image Matching

SURF features are extracted

Each feature point casts a weighted vote for multiple database images

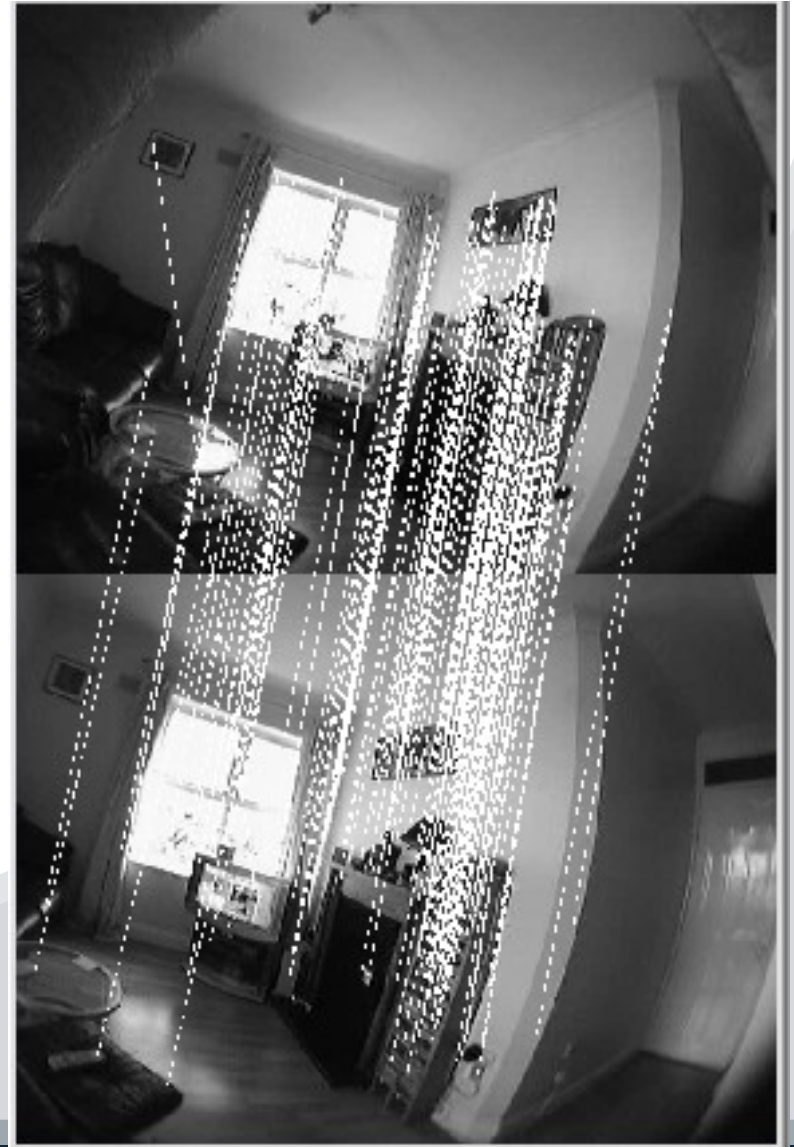Votes are accumulated & the best match is found
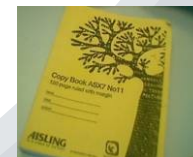
Bi-directional Match Verification & re-ranking of Top results
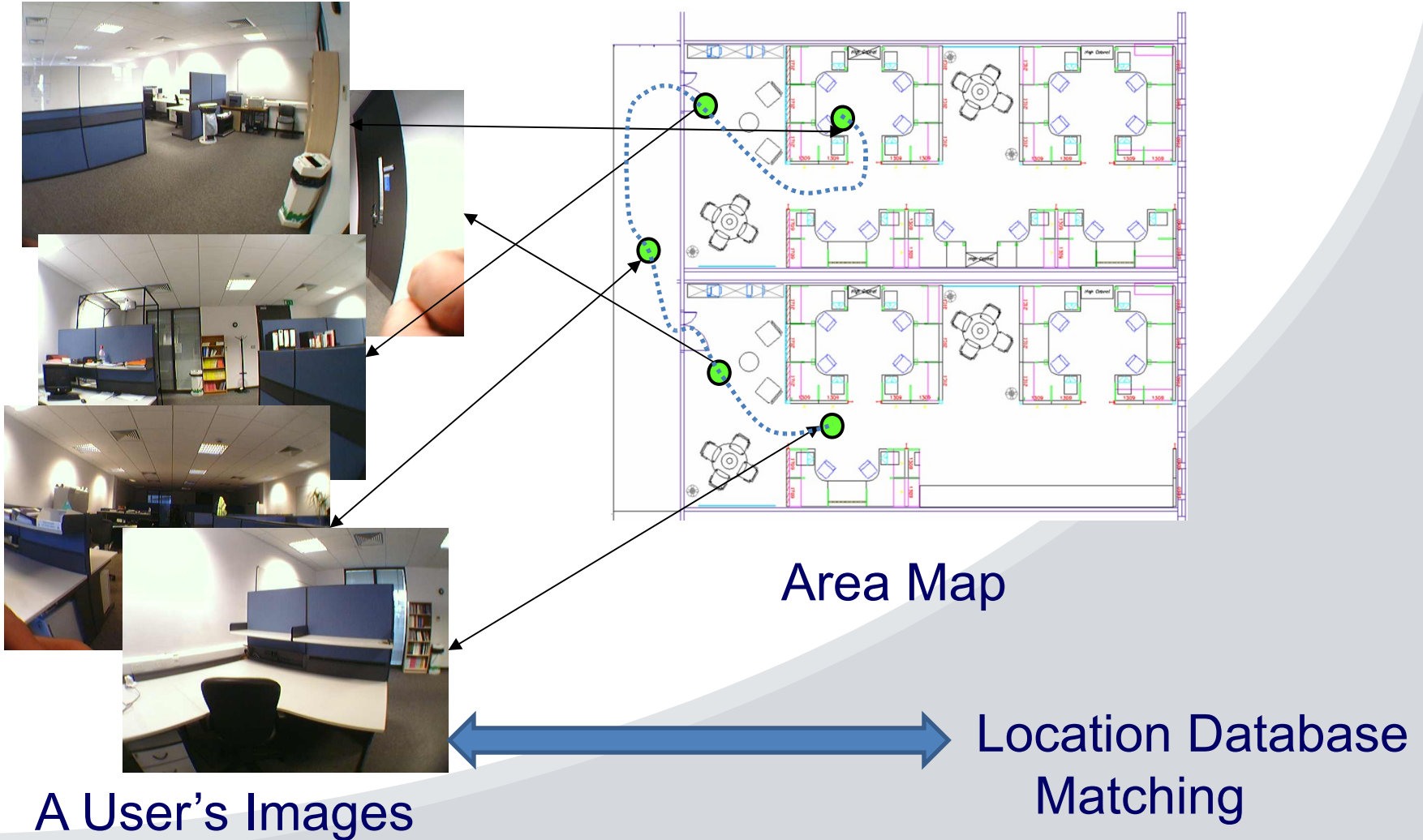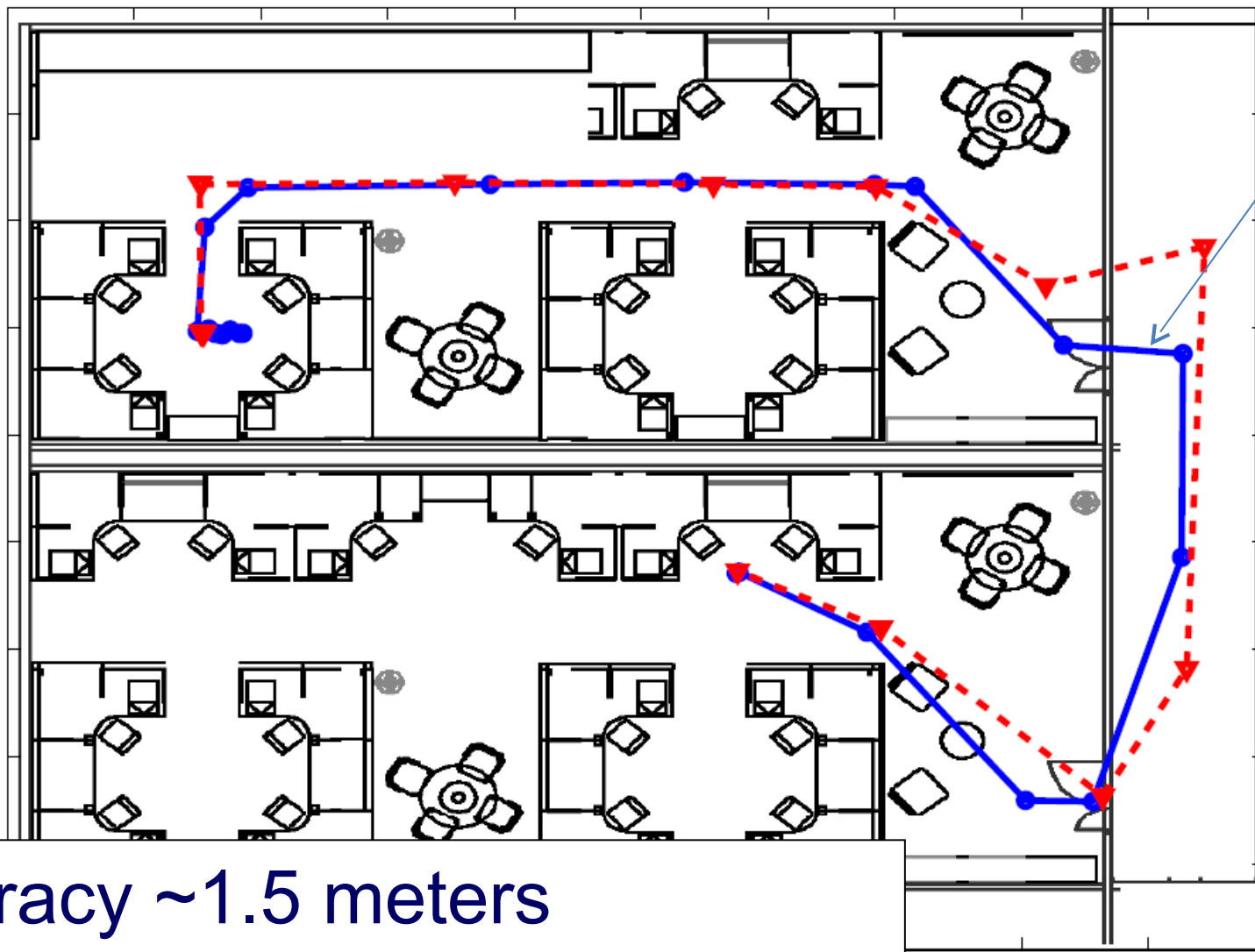
Setting Detection – Watching TV

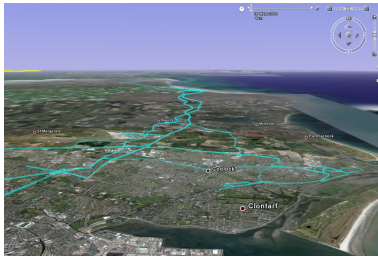# Setting Detection – In the Park

Trajectory Estimation

Area Map

Location Database Matching

A User's Images

Trajectory Estimation Results

Ground truth

Accuracy ~1.5 meters

Combining 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*

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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

- BROWSING & SEARCHING SENSECAM DATA

- 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.

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. Story form communicates experience effectively & enables reflection and introspection

Lifelogs & Storytelling

One project is on building 'stories' from a lifelog

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?

1. 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?

1. 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?

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

Designing for Older Adults

Summary

- **More SenseCams**
  - we'd love more

- **Increased accuracy/flexibility in recognising a person's lifestyle**
  - More SenseCam data = better recognition of lifestyle "norms"

- **Increased collaboration with memory experts e.g. as with Leeds**
  - we're good at processing SenseCam data, but not at explaining why

Managing a Life of Lifelogged SenseCam Images

further information:

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

(case sensitive)