

Managing millions of SenseCam Images, Events are Key

Alan F. Smeaton

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CLARITY SenseCam team

Alan Smeaton	Noel O'Connor
Gareth Jones	Cathal Gurrin
Hyowon Lee	Ciarán Ó Conaire
Aiden Doherty	Daragh Byrne
Liadh Kelly	Yi (Yuki) Chen
Zhengwei Qiu	Peng Wang
Niamh Caprani	Carolina Camacho
Dian Zhang	

Who we are ...

Computer Scientists !

Background in image/video analysis, image processing for the purpose of content management ...

Our 'other' work is on image and video retrieval preceded by image and video analysis and followed by image and video searching and browsing

We're particularly interested in scale

Initially, and for some time, our interest in SenseCams was as a data source, so we wore SCs all day, and then we got really interested

What do people want ?

Memory science says ... to effectively provide memory retrieval cues using SenseCam images and sensor readings, we need to automatically:

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

Called *cued recall*, trigger our own memories, not a prosthesis

Daily Browser Overview

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SenseCam Images of a day (about 3,000)

Event Segmentation

EVENT SEGMENTATION
Using SenseCam sensors - very quick & accurate

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Visual Search Facilities

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SenseCam Images of a day (about 3,000)

Event Segmentation

Event-Event Comparison within the Multi-day Event database

Best Compare Event Averages
Best Compare Event Averages (from middle of event)

Event database containing best 7 days' Events

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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

Best QUALITY image around MIDDLE of event

Landscape image selection

Event database containing best 7 days' Events

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SC Image Quality

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Category	Quality Score
Average	3.43
Focus	39.2
OK	58.6
High	33.7
Photo Actions	4.2

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

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Suggest Interesting Events

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Monday
Tuesday
Wednesday
Thursday
Friday
Saturday
Sunday

SenseCam images of a day (about 2,000)

Similar Events - Aiden waiting for bus
Similar Events - Aiden at the office corridor
Unique Events

Interactive Overview

Event database containing last 7 days' Events

FACE DETECTION

VISUAL NOVELTY

CALCULATE INTERESTINGNESS OF EVENTS

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Automatic Face Detection

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Event augmentation

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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...

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Event augmentation – more cues

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- 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!

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Event Augmentation Croke Park



Here's an image from a SenseCam after a big match in Croke Park, Dublin. We'd really like to see other people's pictures of this match.

Let's search by location...



Event augmentation Croke Park



Receive the following pictures...

Then filter out to just those results from around the same time as event



Event Augmentation

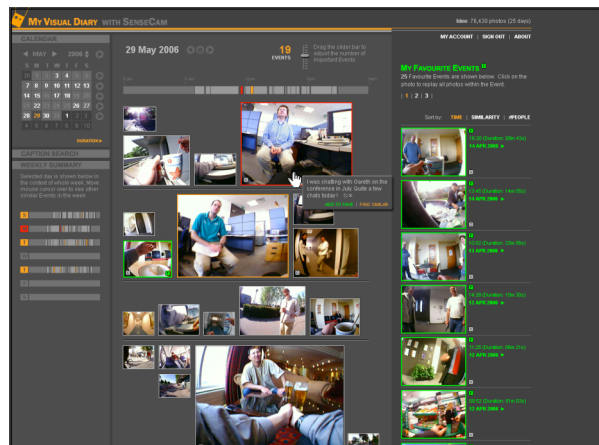


Does it work?

Yes – 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



Previously Released Software

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Features:

- Event Database – image management
- Quick “event” (2 seconds per folder)

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Event Segmentation S/W

- Carnegie Mellon University
- CWI, Amsterdam
- Lulea 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

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Now we've a new version!

Check SenseCam wiki!

SenseCam Viewer

Wednesday 14 October 2009
1970 Photos (10:26 - 14:49)
You can touch one of the events below to view the photos within it.

Touch the buttons above to view different dates

Add Help

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Welcome to the SenseCam Wiki!

SenseCam is a wearable digital camera that takes photos automatically. Originally conceived as a personal "Black Box" accident recorder, it soon became clear that SenseCam had great potential in a wide variety of application areas. This wiki is a forum for the exchange of information about SenseCam, primarily for the researchers and clinicians around the world who are exploring a multitude of uses for the device. Use the navigation bar on the left to find out more.

SenseCam was conceived and developed by Microsoft Research @, in the Sensors and Devices Group @ in Cambridge, UK. There is more information on the Microsoft SenseCam website @ along with various resources including downloadable images @ and videos @.

Contribute to SenseCam Wiki

If you would like to contribute information about your SenseCam research to the SenseCam Wiki you can register by sending an email to sensecamwiki@computing.dcu.ie with your request. Please ensure to provide your full name within the email.

Latest news

- Gordon Bell's and Jim Gammon's book on Total Recall @ has a nice website with news, discussion, comments, etc.
- Life Recorder May Be This Century's Wheel @ - 06 September 2009, TechCrunch
- This is Your Life @ - 02 September 2009, Gordon Bell speaks about SenseCam @ Business Week
- New study proves that Microsoft's sensory innovation aids memory recall @ - 13 March 2009, Microsoft Research press release
- Utilising Wearable Sensor Technology to Provide Effective Memory Cues @ - January 2009, ENICM News

Please refer to the news archive for older news.

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Organisations - SenseCam Wiki

Navigation: Home, Summary, Contents, CLARITY, Conferences, DCCP, HCCP, DCCP Mail, Search, Books, TRECIV, Contact, Travel, Teaching, Interviewing...

CLARITY, Dublin City University

CLARITY is a research centre that focuses on the intersection between two important research areas - Adaptive Sensing and Information Discovery - to develop innovative new technologies of critical importance to today's busy industry base and contribute to improving the quality of life of people in areas such as personal health, digital media and management of our environment. As part of CLARITY, Dublin City University are involved in numerous Weblog projects using SenseCam. The problem addressed is selecting from a large set of SenseCam images (just after logged data, a representative summary of landmarks, or significant events from a daily assembly or kringel log). The problem areas, and is well-acknowledged, because of the large number of images captured by a SenseCam. The approach used is based on using together multiple sources of diverse information including low-level image similarity, image similarity based on semantic tags, GPS and location information, and biometric readings. Some of the areas that this research covers include automatically determining the viewer's location using an annotated image database, described using SURF interest point descriptions, displaying a touch-screen image browser for older adults, determining location based on GPS and accelerometer data and using SenseCam to develop the stories. Dr. Cathal Gurrin, a researcher in DCCU, has collected the most extensive collection of living images in the world. He has been wearing his SenseCam since June 2009, recording 15 hours per day, and he has now collected 3.5 million SenseCam images. For more information see <http://www.clarify.dcu.ie/CLARITY/CLARITY.html>

Microsoft Research Cambridge

Since Microsoft Corporation established in 1991, Microsoft Research has become one of the largest, fastest-growing, most respected software research organizations in the world. Its distinguished researchers and scientists help shape the computing experience of millions of people worldwide, with innovations that enhance virtually every product Microsoft now releases. The Sensors and Devices Group is based at the Cambridge UK research lab, works with technologies such as sensors, flexible electronics, novel displays, wireless communications, ubiquitous and mobile devices. They collaborate closely with researchers from other disciplines with the goal of understanding how advances in technology will impact traditional computing and the ways in which people use and interact with computing devices. SenseCam was conceived and developed in the Sensors and Devices group, for more information see <http://research.microsoft.com/sensecam/>

CLARITY, Dublin City University

CLARITY is a research centre that focuses on the intersection between two important research areas - Adaptive Sensing and Information Discovery - to develop innovative new technologies of critical importance to today's busy industry base and contribute to improving the quality of life of people in areas such as personal health, digital media and management of our environment. As part of CLARITY, Dublin City University are involved in numerous Weblog projects using SenseCam. The problem addressed is selecting from a large set of SenseCam images (just after logged data, a representative summary of landmarks, or significant events from a daily assembly or kringel log). The problem areas, and is well-acknowledged, because of the large number of images captured by a SenseCam. The approach used is based on using together multiple sources of diverse information including low-level image similarity, image similarity based on semantic tags, GPS and location information, and biometric readings. Some of the areas that this research covers include automatically determining the viewer's location using an annotated image database, described using SURF interest point descriptions, displaying a touch-screen image browser for older adults, determining location based on GPS and accelerometer data and using SenseCam to develop the stories. Dr. Cathal Gurrin, a researcher in DCCU, has collected the most extensive collection of living images in the world. He has been wearing his SenseCam since June 2009, recording 15 hours per day, and he has now collected 3.5 million SenseCam images. For more information see <http://www.clarify.dcu.ie/CLARITY/CLARITY.html>

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People - SenseCam Wiki

Navigation: Home, Summary, Contents, CLARITY, Conferences, DCCP, HCCP, DCCP Mail, Search, Books, TRECIV, Contact, Travel, Teaching, Interviewing...

Listed A-Z by Last Name

Title	First Name	Last Name	Organisation	Region	Details
Professor	Ronald	Becker	University of Toronto	Ontario	Ronald's details
Dr	Emma	Berry	Microsoft Research	UK	Emma's details
Professor	Martin	Conway	University of Leeds	UK	Martin's details
Dr	Adrian	Deary	DCU	Ireland	Adrian's details
Dr	Cathal	Gurrin	DCU	Ireland	Cathal's details
Dr	Steve	Hodges	Microsoft Research	UK	Steve's details
Dr	Hyeyoun	Lee	DCU	Ireland	Hyeyoun's details
Dr	Chris	Maulin	University of Leeds	UK	Chris's details
Professor	Alan	Smeaton	DCU	Ireland	Alan's details

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Events - SenseCam Wiki

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2010

- April 10-15th - CHI 2010, Atlanta, GA, USA

2009

- October 16-17th - SenseCam Workshop @ Chicago, Illinois
The SenseCam 2009 Symposium will be held at the Hotel Allegro in downtown Chicago on 16-17 October. The symposium will cover the latest research results, ideas and the exciting future of SenseCam. There will be two scheduled keynote speakers, 20 presentations by leading researchers from around the world, poster sessions, open panel discussions and an evening dinner. SenseCam 2009 is open to Academics, Clinicians, Researchers and anyone with an active interest in SenseCam.
- October 1-3rd - IJCAI'09 @ Orlando, Florida
The 11th International Conference on Ubiquitous Computing includes a couple of papers very relevant to SenseCam.
- May 12th - Lifesensors workshop: Active Digital Memories of Collective Life, Chiswick Manor, Southampton, UK

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Publications - SenseCam Wiki

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The SenseCam device was originally described in a paper at the Eighth International Conference on Ubiquitous Computing, 2008. This is a good paper to cite for a background on the technology and the first clinical trial.

Contents (hide)

- 2009
- 2008
- 2007

2009

- Beal, G. and Gemmel, J. *Total Recall: How the Memory Revolution Will Change Everything*. Penguin Books, 2009.
- Berry, E., Hampshire, A., Rowe, J., Hodges, S., Kabur, N., Watson, P., Biwona, G., Smyth, G., Wood, K. & Owen, A. The neural basis of effective memory therapy in a patient with limbic encephalitis. *Journal of Neurology, Neurosurgery, and Psychiatry*, with *Practical Neurology*, 2009.
- Kumpulainen, S., Järvelin, K., Sorri, S., Deary, A.R., Byrne, D., Smeaton, A.F. & Jones, G. (2009). Data Collection Methods for Analyzing Task-Based Information Access in Molecular Medicine. *MobilHealth'09 - 1st International Workshop on Mobilizing Health Information to Support Healthcare-related Knowledge Work*, Porto, Portugal, 14 January 2009.
- O'Connor, C., Bligh, M. & O'Connor, N. E. (2009) SenseCam image location using hierarchical SURF trees. In *MMM 2009 - 15th International Multimedia Modeling Conference*, 7-9 January 2009, Sophia-Antipolis, France.

2008

- Brown, M. (2008). An investigation of the therapeutic efficacy of SenseCam as an autobiographical memory aid in a patient with temporal lobe amnesia. *University of Exeter MSc project*, October 2008.
- Byrne, D., Deary, A.R., Smeaton, A.F., Jones, G.F., & Smeaton, A.F. (2008). Validating the Detection of Everyday Concepts in Visual Lifelog. *SAINT 2008 - 3rd International Conference on Semantic and Digital Media Technologies*, Koblenz, Germany, 3-5 December 2008.
- Deary, A.R., O'Connor, C., Bligh, M., Smeaton, A.F. & O'Connor, N. (2008). Combining Image Descriptors to Effectively Retrieve Events from Visual Lifelogs. *MMR 2008 - ACM International Conference on Multimedia Information Retrieval*, Vancouver, Canada, 30-31 October 2008.
- Lee, H., Smeaton, A.F., O'Connor, N., Jones, G., Bligh, M., Byrne, D., Deary, A.R., & Gurrin, C. (2008). Constructing a SenseCam Visual Diary as a Media Process. *Multimedia Systems Journal, Special Issue on Conceptual Processes of Media Production*, (in press) 2008.

2007

- Berry, E., Kopur, N., Williams, L., Hodges, S., Watson, P., Smyth, G., Smeaton, A.F., Smith, R., Wilson, B. & Wood, K. (2007). The use of a wearable camera, SenseCam, in a clinical trial to improve autobiographical memory in a patient with limbic encephalitis. *Special Issue of Neurophysiological Rehabilitation*, 2007, 17 (4), 362-381. "Epileptology: Assessment and Rehabilitation Across the Lifespan (Special Issue of Neurophysiological Rehabilitation)".
- Hegele, R., Randall, D., Smyth, G., Evans, C., Heade, J. & Moore, R. (2007). Thanks for the Memory. *MCI* 2007.

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- What else can we do with SenseCam images ?
 - Activity Recognition
 - Diet Monitoring
 - Scene Detection
 - Trajectory Estimation

THIS IS WHERE THE REAL FUN STARTS !

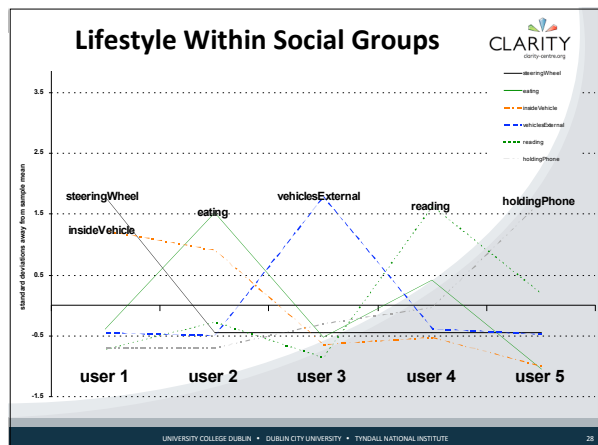
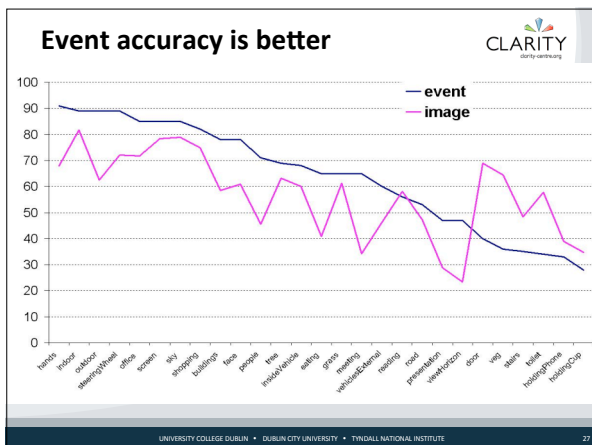
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Dublin SenseCam Work Activity Recognition

27 "concepts"

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

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Dietary habits

Consider using even only the "Eating" concept...

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



Advanced Image Matching



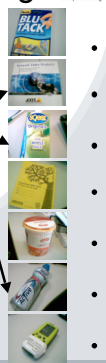
SURF feature are extracted



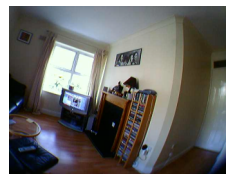
Bi-directional Match Verification & re-ranking of Top results

Each feature point casts a weighted vote for multiple database images

Votes are accumulated & the best match is found



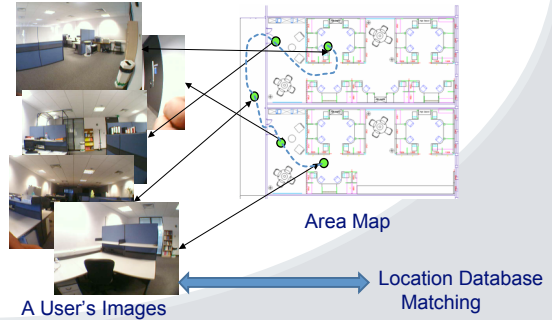
Setting Detection – Watching TV



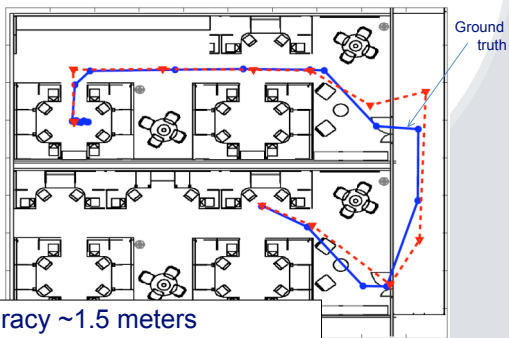
Setting Detection – In the Park



Trajectory Estimation



Trajectory Estimation Results



Accuracy ~1.5 meters

Other work ...



- Creating digital life stories ... Daragh Byrne poster
- Touchscreen interface for older adults browsing SenseCam images ... Niamh Caprani
- Exploiting context to browse large SenseCam archives ... Yi Chen
- Leanback and gesture interfaces to SenseCam browsing ... Cathal Gurrin
- Using biometric information in lifelogging ... Liadh Kelly

Conclusion



SenseCam data is very rich, especially the sensors

We can 'mine' a lot of very useful information from this data source - sensors and visual

Aim is to provide multiple axes for navigating (search a/o browse) SC archives

Several novel spin-out applications with promising results

Thanks to ...

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Irish Research Council

