



Lisbon, Portugal, 21<sup>st</sup> October 2015

# ICT 2015 Networking Event on Augmented Cognition



# Introduction

Technology has always had a direct impact on how and what humans remember as it can radically change the nature and scale of the cues that we can preserve outside our own memory in order to trigger recall. Recent technology advances mean that the time is ripe to attempt the creation of memory augmentation technology that provides the user with the experience of an extended and enhanced memory, but which is based on improvements in the collection, mining, and presentation of information to facilitate memory recall.

In October 2015 we organised a networking session at ICT 2015 in Lisbon to help promote scientific exploration of this topic in Europe. In this report we describe the activities of the event and highlight the key findings.

We would like to thank all of the participants who actively contributed to make the session an outstanding success. We hope that this report does justice to their input.

Prof. Nigel Davies, Prof. Marc Langheinrich,  
Prof Albrecht Schmidt and Dr. Sarah Clinch

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Session

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## Attendees

- Andrea Gaggioli, Catholic University of Milan
- Andreas Emrich, DFKI
- Anne-Mette Nortuig, Aalborg University Copenhagen
- Atta Badii, University of Reading
- Cisar Carrion, AIJU
- Daniel Vander Vorst, Vicomtech
- David Coyle, University College Dublin
- Eirini Eleni Tsiropoulou, National Technical University of Athens
- Eduardo Bacelar Pinto, Universidade do Minho
- Evangelos Niforatos, Università della Svizzera Italiana
- Fabio Paternò, Consiglio Nazionale delle Ricerche (CNR)
- Filipa Ferrada, Uninova-Instituto Desenvolvimento De Novas Tecnologias
- Francisco Alvarez, Universidade Nacional de Educação à Distância
- George Lekakos, Athens University of Economics and Business
- Gerard Kennedy, Enterprise Ireland
- Guido Herrmann, University of Bristol
- GülayBüyükkaksoy Kaplan, Tübitak Bilgem
- Hanna Halbroth, University of Duisburg-Essen
- Isabel Pina, NOVA IMS Information Management School
- João Carlos Lopes Batista, Universidade de Aveiro
- Jordi Fernandez, Ywarp
- Julien Torrent, Fondation Suisse Pour Les Téléthèses
- Katerina El Raheb, University of Athens
- Marc Langheinrich, Università della Svizzera Italiana
- Mario Bazzani, Istituto Superiore Mario Boella
- Mario Chiesa, Istituto Superiore Mario Boella
- Michail N. Giannakos, Norwegian University of Science and Technology
- Mihalis Doumas, Queens University Belfast
- Monica Pedro, UL
- Nelson Alves, Centro De Computacao Grafica
- Nigel Davies, Lancaster University
- Nikolopoulos Spiros, CERTH
- Nicolas Chiquet, Life Plus
- Paolo Giuliodori, University of Camerino
- Passant El.Agroudy, University of Stuttgart
- Pedro Omedas, Universitat Pompeu Fabra
- Peter Matthews, CA Council for Technical Excellence
- Richard Millwood, Trinity College Dublin
- Saira Saleem Pathan, Fraunhofer Institute for Factory Operation and Automation IFF
- Santi Fort, Eurecat Technology Centre of Catalonia
- Sarah Clinch, Lancaster University
- Stefano Bromuri, University of Applied Sciences Western Switzerland
- Tilman Dingler, University of Stuttgart
- Timo Ylikongas, Kainuun ETU
- Tincuta Heinzl, University of Architecture Bucharest



## An Interactive Workshop

Our networking session was organised as a highly interactive event designed to promote interaction and foster new collaborations.

Following a brief scene-setting presentation from Prof. Nigel Davies attendees were posed three challenges:

- (I) working individually to identify one or more small areas of research (e.g. an individual PhD thesis) that they would like to conduct in the field,
- (II) working in groups of three or four people, collaboratively outline a possible EU project in the area, and,
- (III) working in groups of eight to ten people create a ten year mission statement for a possible institute in the field.

The level of discussion was intense with numerous ideas flowing throughout the session. The feedback on the event was overwhelmingly positive with everyone agreeing that they had successfully networked with new people.





## Activity One: PhD Project Ideas

In the first activity every participant was asked to write down an idea for a potential small research initiative such as a PhD thesis topic.

Several themes emerged. One strong focus was on identifying domains for augmented cognition, e.g., ageing, autism, but also in business contexts.

Another set of ideas revolved around visualisation and controlling memories - understanding what needs to be visualised, how it is visualised, and how this can be used to control one's memories. Of particular interest was also the exploration of alternative cues, e.g., smell, touch, and emotions. The full list of thesis ideas is given in Appendix A.

Personalized  
social  
Augmented  
Reality

"Mediating  
between  
in-memory and  
outmemory:  
visualizing todos  
and augmenting  
memory"

What people  
think about?  
~~the~~  
~~memory~~  
Human memories  
Augmentation  
for "memories"  
analytics.

Intelligence  
at the Edge  
Saima Pathan

Augmenting cognition to  
evaluate cognitive level

Erasing traumatic memories  
affecting the personality

PhD Post-Title  
Augmenting cognition in  
persons with intellectual  
disabilities, especially  
autism, using novel ICT  
members  
ICT  
Institute with 10 year frame  
2010-2020 - Subtopic, Key features:

Improving customer  
service and sales  
with more accurate  
recall of customer  
data

How to use data and  
→ SMELL  
→ SIGHT  
→ LOW COST  
→ EASY TO USE

BRINGING  
THE  
UNCONSCIOUS  
TO  
CONSCIOUS

Affect - how I  
feel about the  
presentation of  
my memories

short term  
events

Brain in the computer  
10 years : Singularity

Help aging people living  
better by preventing falls  
with exercises: physical  
and mental (Senses like smell  
and sound) Nicolas Chipaut

Investigate how  
memories (cognition)  
correlates with  
smells and how  
it could be used  
to facilitate in  
diseases like  
Alzheimer.

HELPING THE  
ELDERLY TO  
LIVE LONGER  
AT HOME  
(INDEPENDENT LIVING)

"Dealing with emotional  
cues"

→ Using emotional memories  
to help people suffering  
from Alzheimers

Controlling the  
Augmentation  
tagging, valuing  
and forgetting

AGE RELATED CHANGES  
IN THE POSITIVITY  
EFFECT USING  
AUGMENTED COGNITION

Supporting and  
making decisions

How BRAIN LEARN  
(OR FORGET) HABITS

Augmenting Professional  
Relationships  
- LinkedIn / Facebook  
ResearchGate?  
what's missing?

Support decision making  
in real time via data  
Visualize of complex info  
sets

Net Futures  
http://ec.europa.eu/digital-agenda/

Net Futures  
http://ec.europa.eu/digital-agenda/

Net Futures  
http://ec.europa.eu/digital-agenda/

psychology  
semantic search strategy

THE PROXIMITY EFFECTS:  
SOCIAL AND CULTURAL  
MEMORY LANE OF  
NATIONS

Context-aware  
objected cognition

"Augmenting Human Memory  
through multimodal  
interaction"

BEHAVIOURAL  
CHANGES INTO

What is  
memory and  
memory

Cross-context/  
mode,  
Cross-media  
situation  
Cognition

shared memories,  
reflection

How can  
we measure  
Capacity

Developing a  
way to make

Topic:





**I**NNOVATE  
**C**ONNECT  
**T**RANSFORM

## Activity Two: EU Project Ideas

After forming groups of three to four people, participants jointly identified common interests within the group and came up with “EU Proposals” - short project ideas in the space that they described using challenges and outcomes.

Examples of these proposal ideas included “Augmented Cognition to Improve (Business) Relationships”, where human memory would be augmented to help people connect and stay in touch - both professionally and for private relationships. One participant motivated the idea as follows: “people with a good memory are better in business - what can we do to ‘level the playing field’ so that people with not so good memory can equally excel?” This was also motivated by one participant’s observation that software “robots” are increasingly taking over semi-skilled jobs, and that such a project may help humans improve their cognitive skills to have better job prospects.



## Activity Two ... contd.

A second proposal centered on “Memory Analytics” - the challenge of “materializing memories”, as one of the group members responsible for the idea explained: “once we can visualize our memories, we lay the foundation for better analyzing and hence understanding our memories”.

A third project idea was called “Collective Sensory Augmentation”, where research would focus on the best way to capture a wide variety of sensors - accurately but more importantly unconsciously.

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## Activity Three: Centres

In the final step, pairs of groups joined to form new teams of eight to ten participants and tried to coalesce their ideas so far into long-term, large-size “Research Centres” with an 8-10 year horizon. We captured three ideas for such centres: a “Centre for Multidimensional Cognition” would look at understanding the challenges and requirements for capturing a situation - both from a physical perspective and a cognitive context. This would involve properly identifying how different media can be captured and used in this process: from visual to audio to touch and smell. Such capture and replay processes would also need to be custom-tailored to individuals, groups, and cultures.

A second idea for a centre was called “Decision-making technology for rehabilitation and healthcare”. Apart from a particular domain focus, the idea was also to more actively explore alternative media, such as smell and touch, and, additionally, music as a particularly interesting type of audio capture.

The third idea could be described as a “Centre for enhancing ‘wetware’ memory”, with which participants wanted to attempt to measurably improve the actual human memory capacity, rather than relying on external tools (e.g., an electronic agenda) for in-situ recall. This is very similar to the vision currently being explored as part of the on-going RECALL FET-OPEN project. Of particular interest to the participants suggesting this third idea was the act of sharing memories: “it is really about enhancing collective cognition, not just for a single individual”, as one group member explained.





## Additional Resources

In September 2014, RECALL project members Nigel Davies, Marc Langheinrich, and Albrecht Schmidt, together with Prof. Mark Billinghurst from the Univ. of Canterbury, NZ, organised a Dagstuhl Seminar on “Augmenting Human Memory – Capture and Recall in the Era of Lifelogging”. The seminar brought together researchers from a wide range of computing disciplines, such as mobile and pervasive computing, privacy and security, social computing and ethnography, usability, and systems research, as well as related disciplines such as psychology and economics, in order to discuss how recent trends in capture, storage, and display technology are changing our existing research on capture and playback technologies, privacy and society, and existing theories of memory. The seminar homepage can be found at <http://www.dagstuhl.de/14362>, which includes not only a full list of participants but also a detailed report (<http://dx.doi.org/10.4230/DagRep.4.8.151>).

# Security and Privacy Implications of Pervasive Memory Augmentation

*Traditional research into memory-augmentation devices has focused on privacy concerns for third parties captured in video footage or for individuals wishing to anonymize their location traces. What about new security and privacy threats that aim to manipulate individuals' memories?*

**T**echnology fundamentally affects how and what humans remember, radically changing the nature and scale of the external cues we have available to help trigger recall. Such change is not new—it occurred as we transitioned from story-telling to written books, from paintings to photographs to digital images, and from individual diaries to collective social networks. However, in recent years, three separate strands of technology have developed that, collectively, open up entirely new ways of augmenting human memory:

- The near-continuous collection of memory cues has become possible using technologies such as Microsoft's SenseCam,<sup>1</sup> social networks, and interaction logs

complex networks by others.

- The presence of the environment such as Google provides opportunities for digital recall.

Consequently, pervasive sensing to capture about an individual and then to use it to trigger the recall of temporary psychological traces can then be used to attenuate human memory of new applications. These devices could emerge with significant security concerns.

Traditional research has typically focused on third parties capturing individuals' location traces. Here, we

## Additional Resources .. contd

RECALL team members have published results of the project across several high profile venues, often with a view towards making results accessible across disciplines. A good overview of the challenges in the space can be found in:

Davies, N., A. Friday, S. Clinch, C. Sas, M. Langheinrich, G. Ward, and A. Schmidt. 2015. January. "Security and Privacy Implications of Pervasive Memory Augmentation." IEEE Pervasive Computing Special Issue on Pervasive Security and Privacy, January. <http://recall-fet.eu/wp-content/uploads/2014-Davies-RecallSecurityPrivacy-IEEEPervasive.pdf>

For more publications, see <http://recall-fet.eu/publications/>

Nigel Davies, Adrian Friday,  
Sarah Clinch, and Corina Sas  
Lancaster University

Marc Langheinrich  
Università della Svizzera Italiana  
(USI)

Geoff Ward  
University of Essex

Albrecht Schmidt  
University of Stuttgart

## Further Information

The ICT 2015 networking session on Augmented Human Cognition was organised by members of the RECALL project, which has received funding from the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement no. 612933. The project coordinator, Prof. Nigel Davies from the University of Lancaster, UK, can be reached at [nigel@comp.lancs.ac.uk](mailto:nigel@comp.lancs.ac.uk). The project maintains a web page and a blog at [www.recall-fet.eu](http://www.recall-fet.eu)





# Collected PhD Project Ideas

- Intelligence at the edge
- Augmenting cognition in persons with intellectual disabilities, especially autism, using novel memory ICT
- Controlling the augmentation - tagging, valuing, and forgetting
- Age-related changes in the positivity effect using augmented cognition
- Mediating between in-memory and out-of-memory: visualising todos and augmenting memory
- What do people think about? Augmentation for 'memory' analytics of human memory
- Dealing with emotional cues - using emotional memories to help people suffering from Alzheimer
- Erasing traumatic memories affecting human personality
- Shared memories, reflection, and emotional well-being
- Cross-context, cross-mode, cross media situative cognition - Considering the situation, its contents, and the media through which it is perceived; personalised and situation-aware
- Support decision-making in real-time via data visualisation of complex information sets

## Appendix 1

# Collected PhD Project Ideas

- The proximity opportunity: social and cultural memory lane of nations
- How can memory be enhanced without just distributing memory digitally
- Behavioural changes into an energy efficiency context
- How the brain learns (or forgets) habits
- Bringing the unconscious to conscious
- Enhancing human ability to predict the future (short-term), i.e. extending working memory
- How can we measure capacity building in a Fab Lab?
- How to use other cues (smell, sound)
- Short term future events
- Affect - how I feel about the presentation of my memories
- Improving customer service and sales with more accurate recall of customer data
- Augmenting human memory through multimodal interaction
- Developing a way to make the techies think differently and really understand human cognition

## Appendix 1

# Collected PhD Project Ideas

- Augmenting professional relationships (LinkedIn / Facebook / ResearchGate -- what's missing?)
- Supporting and making decisions
- Investigate how memories (cognition) correlates with smells and how it could be used to facilitate in diseases like Alzheimer's.
- Helping the elderly to live longer at home (independent living)
- Brain in the computer 10 years
- Help ageing people living better by preventing falls with exercises: physical and mental (senses like smell and sound)
- Context-aware augmented cognition
- Personalised social augmented reality
- Augmenting cognition to evaluate cognitive load of disabled people

## Appendix 1

