CogWatch – Cognitive Rehabilitation of Apraxia and Action Disorganisation Syndrome

D5.2.3 Annual Dissemination Report III

Deliverable No.		**D5.2.3**	
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Task No.	**T5.2**	Activity Title	**Dissemination of Results**
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EXECUTIVE SUMMARY

This deliverable report focuses on dissemination efforts and activities during the third period of the project between months 25 and 40 (Nov 1st 2013 until Feb 28th 2015). In the first period of the project, dissemination efforts were focused on establishing a presence and raising the awareness of the project. In the second period, greater emphasis was given to disseminating research findings from academic progress made in the course of developing the CogWatch prototype. In the third period we have concentrated on promoting the work completed on the project to a wider audience.

Our dissemination efforts are threefold: Firstly, we communicated progress to a specialist audience of the scientific and technical communities by presenting posters and giving talks at academic conferences and workshops, as well as submitting journal articles for publication in high impact and reputable journals. This was made possible through the technological and clinical advances accomplished during the development of the CogWatch prototype. We report these dissemination activities in Section 1.

Secondly, efforts have been made to incorporate the use of the CogWatch system and continue its development by applying for further funding from various sources. Details of these can be found in section 4.6.

Thirdly, we communicated scientific and technical advancements to the wider community, in particular, by the efforts of The Stroke Association UK, which has excellent record of promoting stroke related research to interested parties including health professionals and policy makers. We continued to have an established presence on the World Wide Web with updates on the project website and social media. We report these dissemination activities in Section 3.

The audience we reached with our dissemination activities included: 1) specific scientific communities involved in similar or complementary scopes, 2) industry in the area of medical devices, 3) specialist healthcare professionals and communities engaged in patient rehabilitation, 4) stroke survivors and their careers, as well as 5) the general public. In summary, in this third period, all partners have successfully and continually disseminated information through various means, summarized in the body of the deliverable. These efforts will still continue following completion of the project in Feb 2015. These planned post project dissemination activities are presented in section 4 at the end of this document.

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REVISION HISTORY

Revision no.	Date of Issue	Author(s)	Brief Description of Change
V1	13th Feb 15	Jo Howe (UOB)	First Draft
V2	15th Apr 15	Jo Howe (UOB)	Second Draft
V4b	25th Apr 15	W Chua (UOB)	Post-Feb plans; formatting
V4c	27th Apr 15	W Chua (UOB)	TUM, BMT updates
V4d	30th Apr 15	W Chua (UOB)	Sec 3 text, formatting
V4e	1st May 15	W Chua (UOB)	TUM grants, papers in prep, formatting

LIST OF ABBREVIATIONS AND DEFINITIONS

Abbreviation	Abbreviation
BMT	BMT Group Ltd.
HW	Headwise Ltd.
RGB	RGB Medical Devices SA
TSA	The Stroke Association UK
TUM	Technische Universität München
UOB-EECE	University of Birmingham (Electronic, Electrical and Computer Engineering)
UOB-Psy	University of Birmingham (Psychology)
UPM-LST	Universidad Politecnica de Madrid – Life Supporting Technologies
UPM-ROMIN	Universidad Politecnica de Madrid – Centre for Automation and Robotics “Robots and Intelligent Machines“

1. INTRODUCTION

This current deliverable D 5.2.3 Annual Dissemination Report III presents the activities and progress made in Task 5.2 Dissemination of Results, Work Package 5 Dissemination and Exploitation.

The partners in this project consist of academic institutions, a charity organisation with influence on policy making, SMEs in the healthcare sector, as well as commercial partners developing and marketing medical devices from different geographical regions within the EU. This unique composition means that the consortium, as a whole, provides diverse yet complementary methods to reach a broad spectrum of stakeholders.

2. SPECIALIST AUDIENCE

In this section, we report dissemination activities to specialist communities regarding research and development which has taken place in the third period of the project. In engaging both national and international audiences, we addressed the scientific and technological impact of the project by strengthening the evidence base particularly in 1) the psychological understanding of and multimodal cues and cognitive strategies in rehabilitation of apraxia and action disorganisation syndrome (AADS), 2) technological development of intelligent systems and purpose-built instrumented objects, and 3) efficacy of the system as a rehabilitation tool.

2.1 Poster Presentations

Table 1: List of posters presented

Title	Conference	Main Author's Beneficiary	Main Author	Location
Tool Use Deficits in Multi-Step Actions: Predicting Deficits from Neuropsychological Symptoms and Lesion Analyses	33rd European Workshop on Cognitive Neuro-psychology	TUM	J. Hermsdörfer	Italy
Automatised error cueing during impaired execution of action sequence in stroke patients with apraxia	International Congress of Clinical Neurophysiology (ICCN) 2014	TUM	J. Hermsdörfer	Germany
Use of ecological sounds in facilitation of tool use in AADS	Hand, Brain and Technology Conference	TUM	M. Bieńkiewicz	Switzerland
The use of environmental sounds in the rehabilitation of apraxia in stroke survivors	International Congress of Clinical Neurophysiology (ICCN) 2014	TUM	M. Bieńkiewicz	Germany

Action selection in a computer-simulated everyday task	32nd European Workshop on Cognitive Neuro-psychology	UOB	A. Arnold	Italy
Cues in the execution of everyday sequential tasks: Support or interference?	Hand, Brain and Technology Conference	UOB	B. Drozdowska	Switzerland
RCT of CogWatch system efficacy in rehabilitation of ADL skills in stroke patients	UK Stroke Forum 2014	UOB	J. Howe	UK
RCT of CogWatch system efficacy in rehabilitation of ADL skills in stroke patients	UCLP Neuro-rehabilitation event	UOB	J. Howe	UK
Distinct neuronal effects of perspective and hand alignment on paired-object affordance: an fMRI study	Human Brain Mapping conference (HBM)	UOB	M. Wulff	Germany
Distinct neuronal effects of perspective and hand alignment on paired-object affordance: an fMRI study	International Conference on Cognitive Neuroscience (ICON)	UOB	M. Wulff	Australia
The neural and cognitive correlates of apraxia	Hand, Brain and Technology Conference	UOB	R. J. Evans	Switzerland

Affordance deficit: Selecting pairs of objects for action	32nd European Workshop on Cognitive Neuro-psychology	UOB	R. Laverick	Italy
Affordance deficit: Selecting pairs of objects for action	Vision Leads to Action Conference	UOB	R. Laverick	UK
Affordance deficit: Selecting pairs of objects for action	UCLP Neuro-rehabilitation event	UOB	R. Laverick	UK
IR Based Perception System for Evaluation of Human Hand Manipulation	IEEE Humanoids 2014 (Workshop on cognition, perception and postural control for humanoids)	UPM	J. Rojo	Spain

2.2 Conference Proceedings

Table 2: List of conference proceedings published

Title	Conference	Main Author's Beneficiary	Main Author	Location
Automatized error cueing during impaired execution of action sequence in stroke patients with apraxia.	ICCN 2014	TUM	J. Hermsdörfer	Germany
Using human-computer interface for rehabilitation of activities of daily living (ADL) in stroke patients: Lessons from the first prototype	2nd International Conference on Neuro-rehabilitation	TUM	J. Pflügler	Denmark
The use of environmental sounds in the rehabilitation of apraxia in stroke survivors	ICCN 2014	TUM	M. Bieńkiewicz	Germany
Harmonicity of the movement as a measure of apraxic behaviour in stroke survivors	International Conference on Bio-inspired Systems and Signal Processing	TUM	M. Bieńkiewicz	France
The use of ecological sounds in neuro-rehabilitation of apraxia	2nd International Conference on Neuro-rehabilitation	TUM	M. Bieńkiewicz	Denmark

Analysis of eye movements, kinematic and dynamic aspects of performance of activities of daily living in CVA patients	2nd international Conference on Neuro-rehabilitation	TUM	P. Gulde	Denmark
Assistive system for people with apraxia using a Markov Decision Process	European Medical Informatics Conference 2014	UOB	E. Jean-Baptiste	Turkey
Intelligent assistive system using real-time action recognition for stroke survivors	IEEE International Conference on Healthcare Informatics 2014	UOB	E. Jean-Baptiste	Italy
CogWatch: A web based platform for cognitive tele-rehabilitation and follow up of Apraxia and Action Disorganisation Syndrome patients	IEEE-EMBS International Conferences on Biomedical and Health Informatics (BHI)	UPM	M. Pastorino	Spain

2.3 Oral Presentations

Table 3: List of oral presentations/lectures/seminars

Title	Conference	Main Author's Beneficiary	Main Author	Location
CogWatch: Cognitive rehabilitation of apraxia and action disorganisation syndrome	Glenrose Rehabilitation Hospital: Stroke Forum	BMT	C. Giachritsis	Canada

CogWatch – Occupational Therapy and implications for current practice	Specialist section for OT's in stroke practice	HW	A. Hazell	UK
CogWatch and the use of technology in rehabilitation	Specialist section for OT's in neurological practice	HW	A. Hazell	UK
Case Study: CogWatch	Horizon 2020 event	HW	A. Worthington	UK
EU research at the Stroke Association	Stroke Alliance for Europe (SAFE) Board Meeting	TSA	G. Randall	Belgium
EU research at the Stroke Association	Stroke Volunteer Conference, Life after Stroke Centre	TSA	G. Randall	UK
EU research at the Stroke Association	INDIREA Workshop, University of Oxford	TSA	G. Randall	UK
EU research at the Stroke Association	HCI group workshop, University of York	TSA	G. Randall	UK
The patient voice and research trials	Second Annual Conference of the Advisory Council of Catalonia Patients	TSA	G. Randall	Spain

Tool use: Neural representations and approaches to treat deficits in daily living	Kolloquium Kognitive Neuro-wissenschaften, Inst. Neuro-wissenschaften und Medizin (INM-3) des Forschungs-zentrum Jülich	TUM	J. Hermsdörfer	Germany
CogWatch: Neue Technologien zur Therapie und Assistenz bei Störungen von Aktivitäten des täglichen Leben nach Schlaganfall	Workshop „Movement Science Meets Neuroscience“ Schön Klinik – Bad Aibling	TUM	J. Hermsdörfer	Germany
Deficits of tool use following stroke: Neural correlates and technological approaches to assist in activities of daily living	Hand, Brain and Technology Conference	TUM	J. Hermsdörfer	Switzerland
Motor Control and Rehabilitation in Tool Use and Posture	Rehabilitation Engineering Lab, Institute of Robotics and Intelligent Systems (IRIS)	TUM	J. Hermsdörfer	Switzerland
What happens in our brain when we unlock a door?	Wednesday Coffee Talk, Institute for Advanced Study (IAS)	TUM	J. Hermsdörfer	Germany

Tool Use Deficits in Multi-Step Actions: Predicting Deficits from Neuropsychological Symptoms and Lesion Analyses	33rd European Workshop on Cognitive Neuro-psychology,	TUM	J. Hermsdörfer	Italy
Actual tool use: Neural correlates across the lifespan and novel approaches in neurorehabilitation.	Universita Degli Studi Di Parma/Italy, Department of Neuroscience	TUM	J. Hermsdörfer	Italy
Using human-computer interface for rehabilitation of activities of daily living (ADL) in stroke patients. Lessons from the first prototype	2nd International Conference on Neuro-rehabilitation	TUM	J. Pflügler	Denmark
Harmonicity of the movement as a measure of apraxic behaviour in stroke survivors	International Conference on Bio-Inspired Systems and Signal Processing	TUM	M. Bieńkiewicz	France
CogWatch – rehabilitation of AADS	Invited seminar at QUB, UK	TUM	M. Bieńkiewicz	UK
The use of ecological sounds in neuro-rehabilitation of apraxia	2nd International Conference on Neuro-rehabilitation	TUM	M. Bieńkiewicz	Denmark

CogWatch - cognitive rehabilitation of apraxia and action disorganisation syndrome	European Project Space (8th International Joint Conference on Biomedical Engineering Systems and Technologies, BIOSTEC 2015)	TUM	M. Bieńkiewicz	Portugal
Analysis of eye movements, kinematic and dynamic aspects of performance of activities of daily living in CVA patients	2nd International Conference on Neuro-rehabilitation	TUM	P. Gulde	Denmark
Apraxia and action disorganisation syndrome; CogWatch: Development of an action recognition system for ADL rehabilitation	Invited talk by the University of Limerick	UOB	A. Arnold	Ireland
CogWatch	Clustering Workshop on eHealth and the Brain – ICT for Neuro-psychiatric Health	UOB	A. Wing	Belgium
CogWatch: Development of an action recognition system for ADL rehabilitation	Brain Injury and Technology, College of Occupational Therapists, London	UOB	A. Wing	UK
CogWatch	CUPID Technical Workshop, Oxford	UOB	A. Wing	UK

CogWatch: Development of an action recognition system for ADL rehabilitation	Vision Leads to Action Conference	UOB	A. Wing	UK
CogWatch: A new approach to apraxia rehabilitation	Birmingham NeuroSoc Conference, UOB	UOB	A. Wing	UK
Action recognition and task modelling in the CogWatch system – an application of spoken dialogue technology	Invited talk: University of Science and Technology China (USTC)	UOB	M. Russell	China
CogWatch: Supporting stroke survivors in activities of daily living	Health Design & Technology institute – RAatE conference	UOB	P. Rotshtein	UK
Testing CogWatch: A new approach to ADL training	UOB-Birmingham Community Healthcare NHS Trust Research Meeting	UOB	R. Laverick	UK
CogWatch: A new approach to ADL training	Birmingham Rehabilitation Research Forum, UOB	UOB	R. Laverick	UK

2.4 Journal Papers

Table 4: List of article publications

Title	Title of Journal / Series	Year of Publication	Main Author's Beneficiary	Main Author	Publisher	Place of Publication
Mechanisms underlying selecting objects for action	Frontiers in Human Neuroscience (special issue): Rehabilitation Neuroscience: Advancing translational recovery	2015	UOB	M. Wulff/R. Laverick	Frontiers	Switzerland
Selecting object pairs for action: Is the active object always first?	Experimental Brain Research	2015	UOB	R. Laverick	Springer Verlag	Switzerland

The application of SHERPA (Systematic Human Error Reduction and Prediction Approach) in the development of compensatory cognitive rehabilitation strategies for stroke patients with left and right brain damage	Ergonomics	2014	TUM	C.M.L. Hughes	Taylor & Francis	USA
The tool in the brain: apraxia in ADL. Behavioural and neurological correlates of apraxia in daily living.	Frontiers in Psychology	2014	TUM	M. Bieńkiewicz	Frontiers	Switzerland
The Neural Correlates of Planning and Executing Actual Tool Use	The Journal of Neuroscience	2014	TUM	M.L. Brandi	Society of Neuro-science	USA
An Innovative Solution Based on Human-Computer Interaction to Support Cognitive Rehabilitation.	Journal of Accessibility and Design for All	Nov 2014	UPM	Cogollor, J. M.		

Preliminary evaluation of a personal healthcare system prototype for cognitive eRehabilitation in a living assistance domain	Sensors special issue – Ambient Assisted Living (AAL): Sensors, Architectures and Applications	2014	UPM	M. Pastorino	MPDI	Switzerland
Experience in evaluating AAL solutions in living labs	Sensors	2014	UPM	M. Pastorino	MPDI	Switzerland

3. WIDER COMMUNITY

In this section, we report dissemination activities to the wider community including:

- Relevant players and potential industry investors in the area of medical devices and health services,
- Specialist healthcare professionals and communities engaged in rehabilitation services to patients with AADS,
- Stroke survivors and their carers,
- Policy makers,
- The general public.

Outreach is achieved by engaging in public events, organizing workshops, maintaining a web presence via social media and producing printed material for distribution.

3.1 Other Dissemination Activities

Table 5: List of other dissemination activities to the wider community

Title	Type	Main Author's Beneficiary	Main Personnel (if applicable)	Location
Introducing CogWatch and running focus groups at the life after stroke centre and UOB	Focus group/ demonstration	HW	A. Hazell	UK
Introducing system to users and carers at Redditch stroke group	Demonstration and focus group	HW	A. Hazell	UK
ESA Exhibition Stockholm	International Exhibition	RGB	M. Beck	Sweden
MEDICA 2014	International Exhibition	RGB	R. Ruiz	Germany
ASA 2014 New Orleans	International Exhibition	RGB	V. Rodón	USA

Tablets, not just pills, aid recovery	Newspaper article (The Times)	TSA	G. Randall	UK
Introducing CogWatch to stroke survivors and carers at the Life After Stroke Centre, Bromsgrove	Demonstration	TSA	G. Randall	UK
UK Stroke Forum, Harrogate 2014	Exhibition and Demonstration (1300)	TSA	G. Randall	UK
Therapists training day at the Life After Stroke Centre, Bromsgrove	Exhibition	TSA	G. Randall	UK
UOB – Birmingham Community Healthcare NHS Trust Research Meeting	Meeting to discuss research (50)	UOB	A. Wing	UK
IEEE RO-MAN14 (23rd IEEE International Symposium on Robot and Human Interactive Communication), Edinburgh	Exhibition and Demo (50)	UOB	A. Wing	UK
Visit to Sheffield Hallamshire Hospital, Sheffield, UK	Demonstration to occupational therapists (7)	UOB	A. Wing	UK
University of Birmingham Think Corner, Pavilions Shopping Centre, Birmingham	Exhibition and Public engagement (150)	UOB	J. Howe	UK

CogWatch – technology for cognitive rehabilitation of stroke patients	UOB-EECE Industrial Liaison Newsletter #4	UOB	M. Russell	UK
Vision Leads to Action	Conference (80)	UOB	M. Wulff	UK
UOB: Original magazine: Stroke of genius in CogWatch collaboration	Magazine article	UOB	P. Rotshtein	UK
British Science Festival	Oral presentation	UOB	P. Rotshtein	UK
Recent Advances in Assistive Technology & Engineering (RAatE)	Exhibition and Demonstration	UOB	P. Rotshtein	UK
CogWatch Training Day	Training (10)	UOB/HW	R. Laverick/ A. Hazell	UK
Introducing the CogWatch concept in the Annual Conference of partner of the EIP on Active and Healthy Aging	Meeting	UPM	M. Pastorino	UPM
Introduce the potential use of homemade 3D printed object with embedded sensor for automatic rehabilitation.	Demonstration	UPM	M. Pastorino / A. Fioravanti	EU, Belgium

Discuss the potential exploitation of PHS with Gonzalo Leon (director of the Centre for Support for Technological Innovation - UPM) and Santander Bank	Meeting	UPM	M. Pastorino / A. Fioravanti	Spain
Show case of CogWatch platform with IBM Spain	Demonstration	UPM	M. Pastorino / A. Fioravanti	Spain
Cognitive diseases researchers from "Carlos III" Health Institute.	Demonstration	UPM	J. Cogollor	Spain
CogWatch demonstration at Hospital "La Paz"	Demonstration	UPM	J. Cogollor	Spain

3.2 CogWatch Web presence

The project has maintained a web presence by continually updating the website (http://www.cogwatch.eu/) and social media with latest advancements within the project.

Figure 1: The web site displaying new developments and updates on news and events.

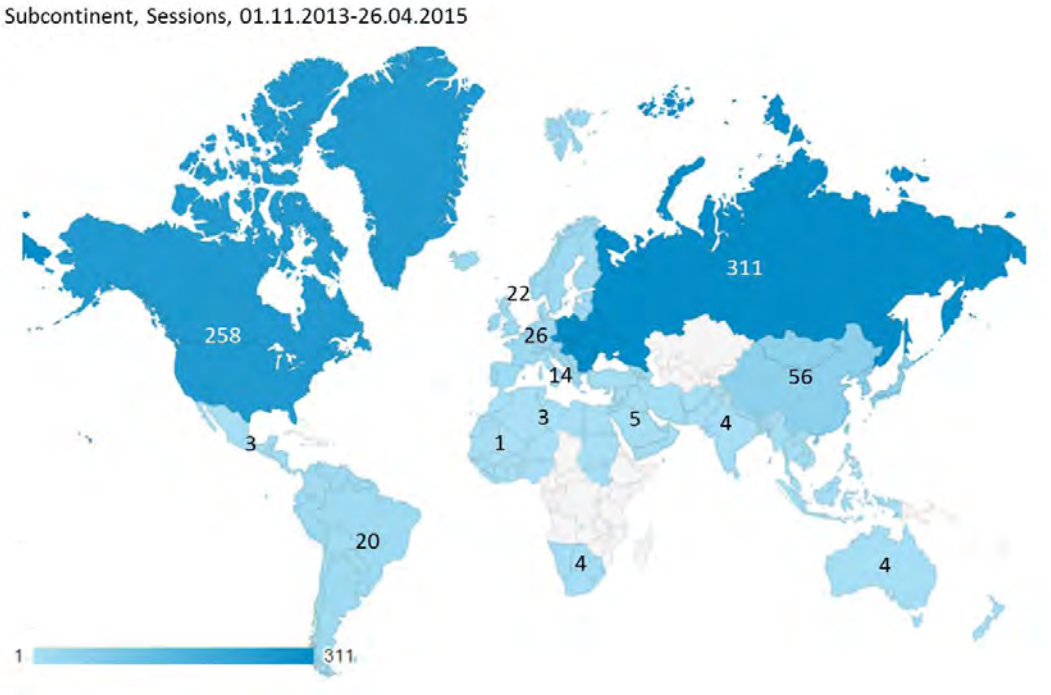

Figure 2: Number of sessions per subcontinent in the period 1st Nov 2013 to 2nd Apr 2015.

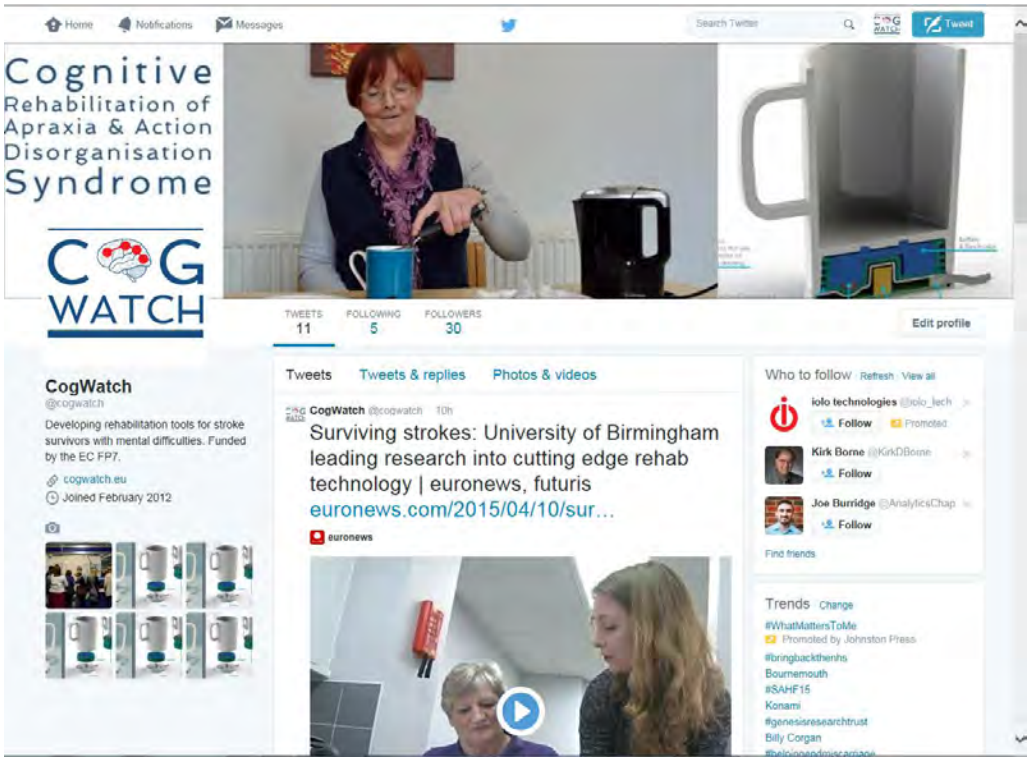

Figure 3: CogWatch on Twitter.

3.3 Other Dissemination Material and Public Engagement Events

3.3.1 CogWatch ID Card

The ID card has been updated to include information regarding both tea-making and toothbrushing using the CogWatch system (see Figure 4).

4(a)

CogWatch will help stroke patients who often have cognitive impairments causing errors in completion of everyday tasks that involve multiple steps or sequences. CogWatch uses intelligent objects to track patient behaviour during the tasks and gives early, frequent multimodal feedback to aid rehabilitation.

COGWATCH

Cognitive Rehabilitation of Apraxia & Action Disorganisation Syndrome

Objectives

Many stroke patients can suffer from Apraxia or Action Disorganisation Syndrome (AADS) which is shown by impairments of cognitive abilities when carrying out activities of daily living (ADL), such as washing, dressing and food or drink preparation.

CogWatch has developed prototype intelligent objects and tools which can help re-training patients on how to carry out activities of daily living, by providing persistent multimodal feedback to them whilst attempting to complete the tasks.

- Guide patients' actions and make them aware of cognitive errors when they occur
- Inform patients what actions that they need to take in order to correct their errors
- Alert patients if their safety is at risk when handling tools and objects inappropriately
- Conduct a literature review to gather up-to-date evidence on the effectiveness of the latest assessment and rehabilitation practices.
- Improve the assessment and classification of AADS patients by using established methods including cognitive screening and FMRI studies.

Description

CogWatch has increased the scientific knowledge of AADS and gained knowledge about: ii) the severity and diversity of symptoms; ii) multimodal cues needed to facilitate action guidance and make patients aware of errors committed and imminent risks; and iii) the intensity and frequency of rehabilitation needed to result in sustainable improvements. By gathering the requirements of healthcare professionals and caregivers through surveys, questionnaires and interviews, CogWatch identified system features that can maximise usability and minimise the effort of intervention. Scientists carried out action analysis based on video, markers and object data that were collected during the patient studies and using current psychological models of action to devise labels for the hierarchical labelling of these actions. Then engineers developed a recognition system that can identify when an action is performed based on heterogeneous data from multiple sensors. This was used to recognise an intention to carry out a specific task, when a task is performed and when it is completed. Advanced statistical techniques supported an action prediction system that was able to predict when specific actions and tasks were happening. This allows the development of outcome management that can predict the consequence of patients' behaviour and provide action guidance cues, error recovery and risk avoidance feedback. Two prototypes have been been developed to enabling patients to complete two ADL tasks: *tea making* and *tooth brushing*.

Prototype 1: Making a cup of tea

The set up includes sensorised everyday objects such as mugs, milk jar and kettle as well as a touch monitor, a Kinect device and a Meta-Watch. Patient uses the touch monitor to select the tea making task. The sensorised objects and the Kinect device are monitoring patient's actions and identify errors based on a task model associated with four different types of tea making (black tea, tea with milk, tea with sugar and tea with milk and sugar). If patient commits an error (e.g., forgets to put water in the jag before turning it on) then a notification and description of the error is provided through the Meta-Watch and the monitor. An auditory, visual or lexical cue is also provided if the patient fails to correct the error.

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eHealth

4(b)

Prototype 2: Tooth brushing

The set up includes sensorised toothbrush a LEAP sensor a sesnorised cup, a Kinect device and a Meta-Watch. Patient uses the touch monitor to select the tooth brushing task. The sensorised objects, the LEAP and the Kinect sensors are tracking patient's actions and identify errors based on a task model associated with the tooth brushing tasks. If patient commits an error (e.g., forgets to brush a certain part of his/her mouth) then a notification and description of the error is provided through the Meta-Watch and the monitor. In addition, an auditory, visual or lexical cue is also provided if the patient fails to correct the error.

Societal & Economic Impacts Expected

Achieving cognitive rehabilitation at home for patients with AADS will have a significant impact on their personal life and on their families. Physical independence improves the emotional life of the patient by improving self-image and confidence that in turn will boost a patient's motivation to continue rehabilitation.

Additionally, independence increases patient inclusivity leading to greater socialising with family members and friends rather than being served by them. CogWatch could also be used in the future to monitor and assist other neurological patients, such as dementia or closed-head brain injury patients, showing the same action disruption symptoms as AADS patients.

Personal independence also has great implication for the healthcare system that provides care for AADS patients. By developing a customised telesupervisory rehabilitation system, CogWatch will reduce the hospitalisation rate and number of home visits by healthcare professionals. This will have significant economic benefits for national healthcare systems. Stored data about the progress of rehabilitation at the central repository of the CogWatch manager will allow healthcare professionals to design a more effective model of disease management. The data will also be accessible by scientists and engineers who will use it to increase knowledge of the disease and improve rehabilitation modules and hardware.

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BMT Group Ltd (UK)
Headwise Ltd (UK)
The Stroke Association (UK)
RGB Medical Devices SA (ES)

Timetable: November 2011 to February 2015

Total cost: €4,622,821
EC funding: €3,649,658
Instrument: STREP
Project Identifier: FP7-ICT-2011-Call 9 – project 288912

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eHealth

Figure 4: The updated ID card includes information about the two CogWatch prototypes, tea-making (front, 4(a)) and toothbrushing (back, 4(b)).

3.3.2 CogWatch flyer

A CogWatch flyer was created by TSA for distribution during dissemination events.

Figure 5: CogWatch Flyer.

3.3.3 Demonstration and presentation CogWatch at various events

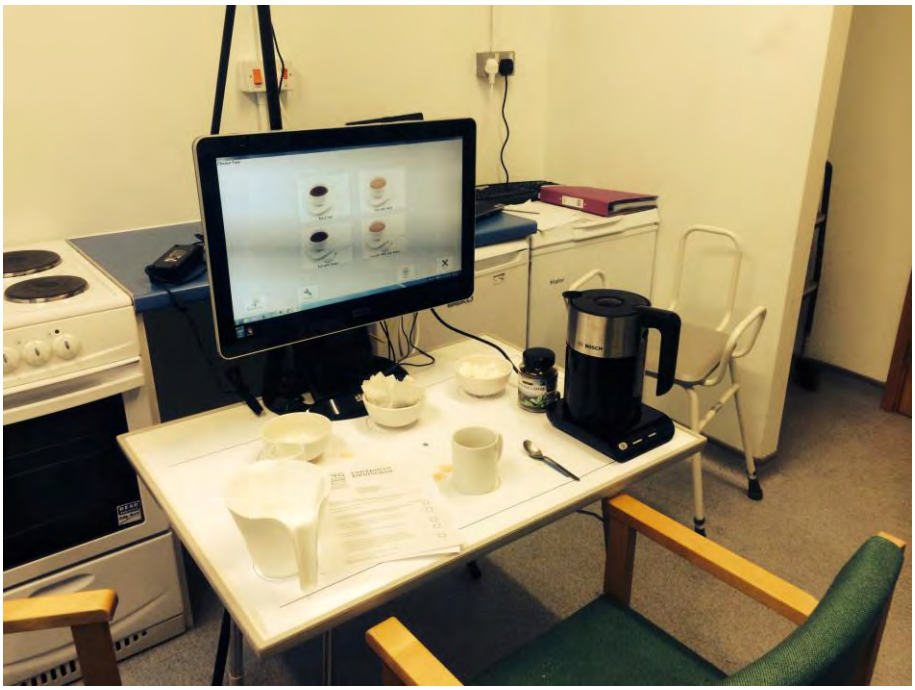

Figure 6: CogWatch system installed at Moseley Hall Hospital, UK.

Figure 7: Demonstration of the CogWatch system at the NEC (Recent Advances in Assistive Technology & Engineering), UK.

Figure 8: Demonstration of the CogWatch system at RO-MAN14 (23rd IEEE International Symposium on Robot and Human Interactive Communication), Edinburgh, UK.

Figure 9: Demonstration of the CogWatch system at University of Birmingham Think Corner, Pavilions Shopping Centre, Birmingham, UK.

Figure 10: Dr. Marta Bieńkiewicz from TUM at the 8th International Joint Conference on Biomedical Engineering Systems and Technologies (BIOSTEC 2015) in Lisbon, Portugal.

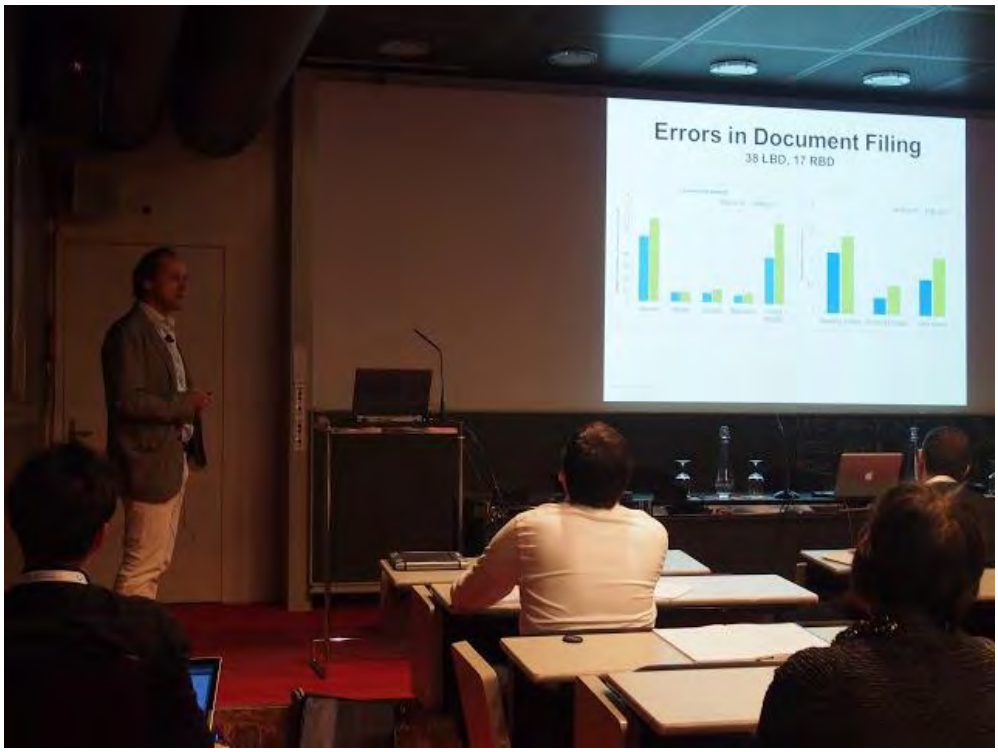

Figure 11: Prof. Joachim Hermsdörfer from TUM presenting at the Hand, Brain and Technology Conference, Monte Verità, Switzerland.

12(a)

12(b)

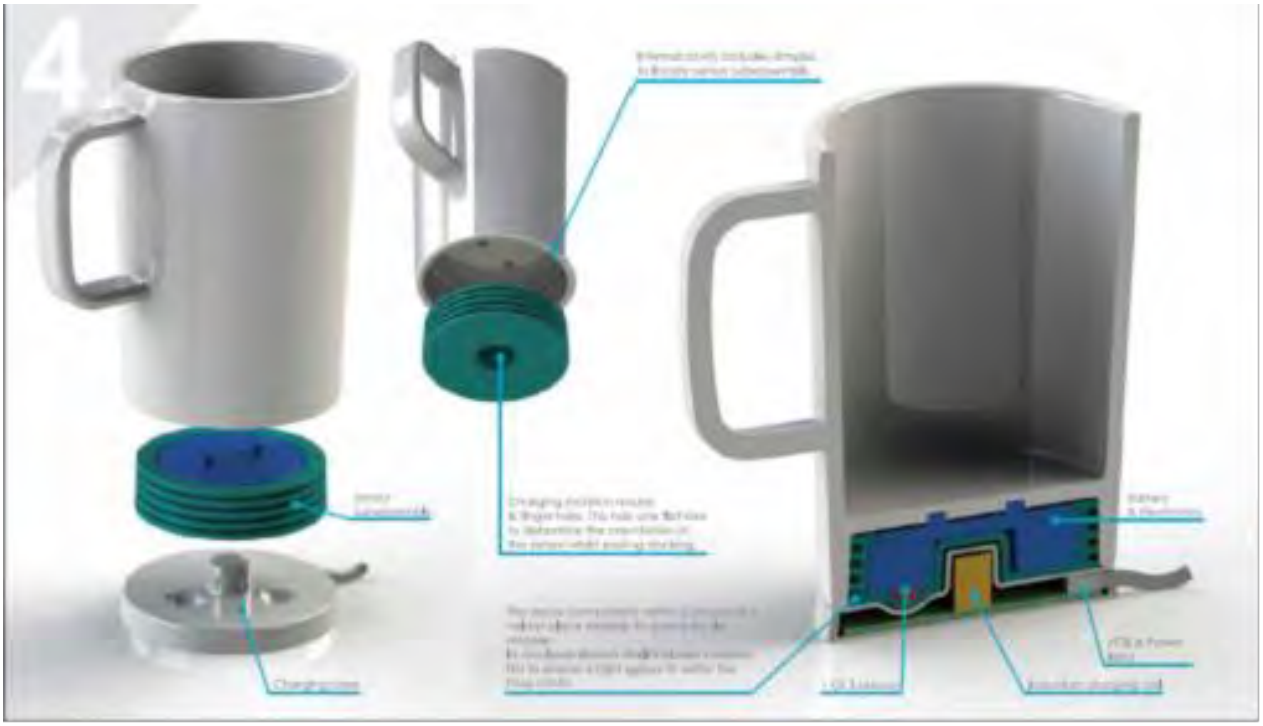

Figure 12: The near commercial prototype of an instrumented mug with the recharger base (12(a)) and the easily removable one-size-fits-all innovative electronic module (12(b)). The prototype was exhibited at the UKSF2014, in Harrogate, UK.

4. FUTURE DISSEMINATION PLAN: POST FEBRUARY 2015

The following details the dissemination for the project that the partners have committed to beyond the end of the project in Feb 2015.

4.1 Poster Presentations

Table 6: List of posters presented

Title	Conference	Main Author's Beneficiary	Main Author	Location
Chronic stroke: Hand kinematics in a multi-step activity of daily living	Active Healthy Aging 2015 Conference	TUM	P. Gulde	Germany
RCT of CogWatch System efficacy in rehabilitation of ADL skills in stroke patients	Joint Meeting of the British and Dutch Neuro-psychological Societies	UOB	J. Howe	UK
RCT of CogWatch System efficacy in rehabilitation of ADL skills in stroke patients	Congress of Neuro-rehabilitation and Neural Repair	UOB	J. Howe	Netherlands
The relation between recognizing errors and committing errors in an activity of daily living task	Joint Meeting of the British and Dutch Neuro-psychological Societies	UOB	R. Laverick	UK

4.2 Conference Proceedings

Title	Conference	Main Author's Beneficiary	Main Author	Location
Analysis of hand kinematics during activities of daily living after stroke	German Society of Sport Science Conference: The athlete's brain: Neural aspects of motor control in sports, Munich	TUM	P. Gulde	Germany
Analysis of gaze performance in patients suffering from stroke during multi-step activities of daily living	German Society of Sport Science Conference: The athlete's brain: Neural aspects of motor control in sports, Munich	TUM	S. Steinl	Germany
POMDP based Action Planning and Human Errors Detection during Activity of Daily Living	32nd International Conference on Machine Learning (ICML)	UOB	E. Jean-Baptiste	France

4.3 Oral Presentations

Table 7: List of oral presentations/lectures/seminars

Title	Conference	Main Author's Beneficiary	Main Author	Location
CogWatch and the use of technology in rehabilitation	Headway; Cardiff	HW	A. Worthington	UK

Disturbances of action organisation following stroke and how technology can support rehabilitation	Seminar; UPM, Madrid	TUM	J. Hermsdörfer	Spain
Achievements of the CogWatch Project for the neurorehabilitation of action impairments following brain damage	Sensorimotor Colloquium, Faculty of Sport and Health Sciences, Munich	TUM	J. Hermsdörfer	Germany
Analysis of hand kinematics during activities of daily living after stroke	German Society of Sport Science Conference: The athlete's brain: Neural aspects of motor control in sports, Munich	TUM	P. Gulde	Germany
CogWatch: An EU funded project to develop new approaches to stroke rehabilitation	Kinect Research Symposium Institute of Digital Health, Warwick University	UOB	A. Wing	UK
Effects of Object Affordance in a Visual Search Task	Vision Science Society (VSS)	UOB	M. Wulff	US

4.4 Journal Papers

Table 8: List of article publications

Title	Title of Journal / Series	Year of Publication	Main Author's Beneficiary	Main Author	Publisher	Place of Publication
CogWatch: a system for rehabilitation of stroke apraxia and action disorganisation syndrome	IEEE Trans Neural Systems and Rehabilitation Engineering	2015	UOB	A. Wing	IEEE	
POMDP based Planning for Cognitive Rehabilitation System	Advances in Micro-electronic Engineering	2015	UOB	E. Jean-Baptiste	Science and Engineering Publishing Company	USA
Distinct neuronal effects of perspective and hand alignment on paired-object affordance: an fMRI study	NeuroImage	2015	UOB	M. Wulff	Elsevier	

Effects of paired-object affordance in search tasks	Journal of Experimental Psychology: Human Perception and Performance	2015	UOB	M. Wulff	American Psychological Association	USA
Effects of broken affordance on visual extinction	Journal of Neuro-psychology	2015	UOB	M. Wulff	Wiley Online Library	
Assistive technologies for patients with Apraxia and Action Disorganisation Syndrome: Design recommendations based on Applied Cognitive Task Analysis	(under review)	2015	TUM	C. M. L. Hughes	Elsevier	Netherlands
Efficiency of interactive guidance in a naturalistic task in patients with apraxia and action disorganization syndrome	(in preparation)	2015	TUM	J. Pflügler		
A study on the complexities of impairment in everyday tasks for stroke survivors	(under review)	2015	TUM	M. Bieńkiewicz		

Hit the nail on the head. Does environmental sound associated with action goal facilitate tool use and pantomime in stroke survivors	(in preparation)	2015	TUM	M. Bieńkiewicz		
Age-related Changes in the Neural Correlates of Complex Object Manipulations	Neurobiology of Aging (ready for submission)	2015	TUM	M.-L. Brandi	Elsevier	
The neural correlates of deficits in activities of daily living in left brain damaged patients	(in preparation)	2015	TUM	M.-L. Brandi		
End-effector kinematics in a multi-step activity of daily living after cerebrovascular accident	(in preparation)	2015	TUM	P. Gulde		
Analysis of gaze performance in patients suffering from stroke during a multi-step activity of daily living	(in preparation)	2015	TUM	S. Steinl		

4.5 Other Dissemination Activities

Table 9: Other Dissemination Activities

Title	Type	Main Author's Beneficiary	Main Personnel (if applicable)	Location
COGWATCH: helping stroke patients to brew tea… and regain their independence	Newsletter published in CORDIS and Digital Agenda for Europe	UOB		Online
West Midlands Health Informatics Network April Newsletter	e-newsletter	UOB		UK
Social Media chat on stroke rehab	Twitter: Tweetchat	UOB	J. Howe	Online
Blog as a result of the tweetchat	Direct Link to blog	UOB	J. Howe	Online
PSyPag Masters Award	Competition	UOB	J. Howe	UK
Med-Tech Expo (Accelerating business knowledge base innovation activity (ABIA) research on assistive technology using CogWatch	Oral Presentation	UOB	M. Sinason	UK
CogWatch	Documentary on Futuris (Euronews)	UOB/TSA		Online
Showcase of CogWatch with Cristina Massegú from Centro de rehabilitación neurológica Lescer	Demonstration	UPM		Spain

Showcase of CogWatch with Prof May Wang of the Georgia Tech University (USA)	Demonstration	UPM		Spain
Visit of the Chief Technology Officer (maite Agujetas) of the Banco Santander	Demonstration	UPM		Spain
Introducing the CogWatch project to AppDate, Madrid	Meeting	UPM		Spain
Neuro-rehabilitation internal researchers from Hospital "Gregorio Marañón".	Demonstration	UPM	J. Cogollor	Spain
Proposal submitted for the Exhibition call at the “ICT 2015: Innovate Connect Transform”.	Demonstration and Exhibition	UPM	J. Cogollor	Portugal

4.6 Grant Applications

There have been 11 follow on grant applications submitted (and 2 planned submissions) based on the CogWatch project (see Table). These span EU, UK public and private funding sources. Abstracts are given below.

Table 10: CogWatch follow on grants

Title	Funding Body	Principle Investigator/ Partner	Sub-mission Date	Award Notification Date	Total Value of Award (€)
General cognitive training contributes to specific skill rehabilitation	The Stroke Association Priority Programme Award	P. Rotshtein UOB (UK)	28 Jan 2015	Jul 2015	625,500[1]
Efficacy of new technology for ADL skills training in acute stroke (ASTech)	The Stroke Association Clinical Trial Project Grant	P. Rotshtein UOB (UK)	6 Mar 2015	Jul 2015	264,100
Baking with CogWatch	Small Business Research Initiative (SBRI UK)	P. Rotshtein UOB (UK)	20 Apr 2015	Jul 2015	97,300
We can cook	Nesta Inclusive technology prize: Innovation for independence	H.F. Kwok UOB (UK)	14 Jan 2015	Jun 2015	69,500

[1] UK grants exchange rate = 1GBP = 1.39 EUR as of 15 Apr 2015

Investigating Barriers to Assistive Technology	Accelerating Business Knowledge Base Innovation Activity (ABIA) Industry partnership with Smallfry	M. Sinason UOB (UK)	30 Jan 2015	Mar 2015	20,850
Multi-modal Daily Living Assistance for Language, Speech and Planning Impairments (CogDial)	Horizon 2020 (European Commission)	D. Stein Fraunhofer, IAIS (DE)	23 Apr 2014	Application unsuccessful (to resubmit)	3,637,592
Older Living Intelligent Virtual Assistant (OLIVA)	Horizon 2020 (European Commission)	A. Liapis INTRASOFT International SA (BE)	20 Apr 2015	Sep 2015	3,989,938
Parkinson's disease IntElligent Robot for Rehabilitation Exercise (PIERRE)	Horizon 2020 (European Commission)	S. Hirche TUM (DE)	14 Apr 2015	Sep 2015	Est. 4.7 M
Advanced Intervention based on Early Detection of Functional Decline in the Ageing Population (AiDA)	Horizon 2020 (European Commission)	C. Giachritsis BMT (UK)	21 Apr 2015	Sep 2015	Est. 4.0M

Automatic Analysis of Fidelity of Motivational Interviewing with Diabetes Patients	Google Faculty Research Award	M. Russell UOB (UK)	15 Apr 2015	Aug 2015	52, 046
Effectiveness of animated avatars in cueing actions for patients with apraxia and action disorganisation syndrome	TUM University Foundation Fellowship	J. Hermsdörfer TUM (DE)	April 2015	Aug 2015	Est. 60,000
Neural correlates of tool use	German Research Foundation (DFG)	J. Hermsdörfer and A. Wohlschläger (TUM, Medical Faculty, DE)	May 2015	Nov 2015	Est. 400,000
"ACITVE HANDS" – Evaluation, rehabilitation, and assistance of hand function in ageing and chronic CNS diseases	"EIT-Health - Healthy Living and Active Ageing". Innovation Project Proposal	J. Hermsdörfer TUM (DE)	Jun 2015	Sep 2015	Est. 1,000,000

4.6.1 Grant Abstracts

4.6.1.1 General cognitive training contributes to specific skill rehabilitation

Stroke rehabilitation often focuses on specific skills such as those targeted by CogWatch (e.g. drink-making, tooth-brushing). However, difficulties in activities of daily

living (ADL) may arise from general cognitive impairments. It is therefore possible that training these general cognitive impairments will improve the patients' ability to re-lean the specific skills. Furthermore, despite anecdotal findings, it is typically assumed that the efficacy of rehabilitation is eliminated at 9-months post-stroke. The proposed feasibility study challenges this assumption by targeting stroke survivors at the chronic stage and examining whether rehabilitation of underlying general attention enhances performance of specific functional skills (tea-making, tooth-brushing, gait). 60 patients will be randomised to three general therapy groups: attentional training, art therapy (control), or no therapy (control). Following general therapy patients will complete specific functional skills therapy (tea-making and tooth-brushing using the CogWatch system, and gait-training). Assessments will be at three time points, at the beginning of the trial, following the general intervention and at the end. Outcome measures include performance on trained skills, stroke impact, and brain imaging. Our research will answer the following questions: i) can we improve functional specific skills in chronic stroke; ii) does attention training improve the rehabilitation of specific skills; iii) can lesions predict patient benefit from rehabilitation.

We anticipate that the research will impact in four main ways. First the training will have direct positive impact on the patients who participate in the study in terms of overall cognition, mood, and participation in society. Secondly, we will inform clinical practice as to the importance of attention training for improving general and specific functional skills. This will be done through the involvement of an Occupational Therapist and health professional workshops towards the end of the project and by paving the way for a full clinical trial. Thirdly, the results of the study will affect NHS policy, demonstrating the efficacy of low-cost rehabilitation even years after stroke that would reduce the overall burden of stroke to society. Fourthly, from a research perspective evidence for transfer of attention training to ADLs should re-focus efforts on developing effective attentional training techniques, and more specifically motivate research into the profile of those patients that would benefit most (using the proposed MRI results as a starting point).

4.6.1.2 Efficacy of new technology for ADL skills training in acute stroke (ASTech)

Current rehabilitation practices for acute stroke include re-training of ADLs; however there is limited research on the efficacy of ADL rehabilitation. Furthermore despite technology being widely used in physiotherapy, technology is rarely used in re-training of ADLs. Here we propose to introduce technology into occupational therapy and assess its efficacy. We will test two technological approaches: intelligent (CogWatch) and non-intelligent (AbleLink – Visual Impact app). Intelligent technology monitors behaviour and provides relevant feedback during the task, while non-intelligent technology cues the patient through the steps but does not provide feedback. 60 acute inpatient stroke survivors, who show deficits in ADL, will be randomised to three intervention groups: intelligent, non-intelligent technology or routine ADL rehabilitation. Outcome measures include; improvement on the trained task, transference of skills to non-trained ADL tasks and self-report ADL assessments. These will be measured immediately after and at a one month follow-up. In addition qualitative data will be collected to assess the acceptability of these technologies in ADL rehabilitation. Our research will answer the following questions: i) Which intervention provides the most gain, the most utility, and is the most accepted by stakeholders, ii) Using cognitive and structural data collected at the

screening phase, we will explore the ability to predict rehabilitation outcome. Furthermore, the research will also demonstrate the applicability of the CogWatch system to acute rather than chronic stroke survivors.

We anticipate that the research will impact in four main ways. Firstly, the training will have direct positive impact on the stroke survivors who participated in the study increasing their independence. Secondly, the tight collaboration with the clinical team in the stroke unit will directly benefit research and clinical practices facilitating translational research. Thirdly, we will inform clinical practice as to the potential future developments of technology in ADL rehabilitation. This will be done through publication and conference attendance and any local trust meetings with healthcare professionals. Fourthly, the results of the study will contribute to the future implementation of such technology within rehabilitation departments, demonstrating the utility of such technology to assist healthcare professionals. Furthermore, the detailed qualitative assessment will inform research on the attitudes of stakeholders to technologies. All data will be uploaded onto Cochrane database library. In addition, the investigation of neuro-cognitive markers in prediction of recovery in ADL's will also be an important contribution to the literature of ADL rehabilitation.

4.6.1.3 Baking with CogWatch

The proposed research will extend CogWatch to guide apraxic stroke survivors through the process of baking a Bara Brith cake (made with flour, dried fruit, sugar, and egg). CogWatch will keep track of the steps completed via an action recognition system that uses scales to measure the weight of the ingredients, Shimmer sensors to detect the movement of the hand and utensils, temperature sensors during cooking, and the time taken between steps. There will also be an option for the user to interact with the system using speech rather than the touchscreen. This has obvious practical benefits when using hands to mix ingredients but also makes the system more user-friendly for those patients who have difficulties processing visual information and making goal-directed movements. Finally, the interface will be available as an app on tablets and smartphones. This makes it more widely accessible to patients, carers, and healthcare staff and more practical to use in a kitchen environment.

The proposed research is the first important step towards extending CogWatch for use as an assistive technology rather than purely for rehabilitation. In turn, this increases the number of patient groups that would benefit from CogWatch, for instance those with Alzheimer's disease that need cueing through a sequence of steps.

4.6.1.4 We Can Cook

More and more adults with learning difficulties now live independently with various degrees of supervision. They need to cook for themselves. To be able to eat healthily is important for them. However, they often need significant help in cooking. Cooking is a complex task that involves many steps and variations. They may have problems sequencing (trying to remember the steps in sequence), memorizing the ingredients needed, or adjusting the quantity of the ingredients for different numbers of people. These difficulties are analogous to those that the CogWatch system aims to support in apraxic stroke patients. Thus, adults with learning difficulties may be able to make use of a similar system when preparing healthy meals. The cookbooks and

cooking apps that are currently available are often not suited for their needs as they present too much information on one page and offer no guidance as to the steps they have already completed. To date, there is no available mobile application that will provide a number of built-in nutritious recipes, a step-by-step guide, a timer for cooking time, audio instruction and options to allow users adjust the amount of ingredients to the number of diners. These are the features that we will be providing using an easy-to-use interface inspired by the CogWatch system. Users can also import and export recipes so they can share with their friends. The app will also provide users with a shopping list and allow them to put the name of the dishes that need cooking for a particular meal in the calendar of the mobile device.

The difficulties experienced by adults with learning difficulties means that living independently is not easy, especially when they have always relied on the support of their parents or carers. Working on the CogWatch system has enabled the researcher to understand the benefits of assistive technology for increasing independence. It is hoped that developing the We Can Cook app provides the support needed for adults with learning difficulties to make nutritious meals thereby improving their quality of life.

4.6.1.5 Investigating Barriers to Assistive Technology

In response to an ageing population in the UK and Europe, policy makers and health service providers have increasingly voiced support for new technologies that allow people to manage care within their own homes. Despite the notion that technology should enhance independence and well-being, the uptake of assistive technologies by end users has not been rapid nor has it been sustained. However, surprisingly little is known about the factors behind this low uptake or what motivates people to make use of these support devices. To address this issue, we have developed practical measures that provide a detailed picture of people's pre-conceptions (and perceptions) of assistive technology. The first phase of our research will use an online survey to examine why individuals may or may not show initial or sustained interest in assistive technologies. The data will provide insight into the psychosocial variables that differ between populations using assistive technologies, and whether the experience of interaction with technology transcends that of any disorder (health issue). Also, it will help identify perceptions of those whom do not yet use the devices, but are likely to come into contact with them in the future, providing an outline of the barriers that exist prior to contact and as experience builds over time. Phase 2 will apply more detailed measures to determine the factors that impact long-term commitment to using technological aids. We will profile populations of potential users of new technology to assess how these profiles may mediate their prior experience, future expectations and current concerns with novel devices. We will also commence field work, collecting interview data from patients currently using technology (including the CogWatch system). Our principle objective is to build a profile of the characteristics that predict a patient's willingness to engage with the technology over time. We can then model how the participants respond to information and design elements of novel assistive technologies in a lab-based experiment.

The data collected in these studies will allow us to define the characteristics of patients that are most likely to engage with assistive technology on a long-term basis. We will also discover which technological features exert positive impact on the adoption of assistive technologies, and if this pattern is robust enough to sustain use longitudinally.

By examining these issues we can make strides towards producing assistive technologies that patients are keen to use, thereby reducing the need for ongoing care.

4.6.1.6 Multi-modal Daily Living Assistance for Language, Speech and Planning Impairments (CogDial)

In Europe 1.9 million people suffer a stroke each year affecting many regions of the brain and causing a great range of disabilities. Survivors find everyday tasks difficult and around 40% will be left with a language disorder. More than half depend on others; hence assistive technology using effective patient interaction is a priority. However, the capabilities of stroke patients are varied and hard to anticipate. Physical input may be hampered by paralysis, while speech systems may face disorders at all levels of production and perception. There is a compelling need for multimodal interfaces that adapt to a patient's communicative abilities. CogDial is an adaptive multimodal dialogue manager that assists stroke survivors to complete everyday tasks independently. CogDial will assess the verbal and non-verbal communicative skills of its user and use modalities accordingly, determining the correct balance of verbal and non-verbal interaction. The patient will interact with the assistive technology through speech and gesture recognition, and the system responds using text, images, sound, video or speech. Uniquely, CogDial will also exploit information implicit in the patient's interaction with the task, by monitoring progress using automatic action recognition and instrumented objects. The user will be able to ask "What is this (that I am holding)?" or "What should I do next?" CogDial can ask: "Did you just put sugar in the cup?" CogDial will estimate the patient's emotional state, from the speech signal or from the patient's interaction with the task. For example, a patient's prosody may indicate positive or negative emotions, or frustration may be signaled by the patient's interaction with a tool. Emotion will be embedded in feedback, where speech synthesis will contain contrastive stress "No, pick up the *screwdriver*" (not the hammer). These characteristics make CogDial a comprehensive assistive system improving stroke patients' participation in everyday life.

4.6.1.7 Older Living Intelligent Virtual Assistant (OLIVA)

The main goal of OLIVA is to assist older people who have minor cognitive deficits and live independently who require prompting, reminders and orientation support in their daily lives, irrespective of the underlying specific cause of the functional impairment. The realisation of a loss of ability to manage daily chores (personal care, social commitments, use of tools and services) risks triggering a spiral of insecurity-withdrawal-fear-incapacity that can isolate people socially and accelerate decline. The assistive platform proposed by OLIVA will help this group with daily chores with the aim to reduce the dependency slope. The primary end users of the prototype will be urban dwellers living by themselves whose representatives (including family, friends and relevant others) will be actively engaged in requirements capture, development and evaluation of the OLIVA Smart Ageing Home Health Platform (OP). This participatory design method will specifically focus on what makes people lose their confidence and explore the real benefits and/or potential problems of having assistive technologies installed in their homes or in-use "on the move".

The project will apply expertise in cognitive psychology; the study of how people perceive, remember, think, speak, and solve problems, in combination with knowledge-

modeling and interactive ICTs to produce an innovative prototype. It will target miss-orientation situations, both physical and cognitive, with which persons are faced in real life. It will investigate Miss-orientation Behavioural Patterns in situations manifested when visio-spatial or temporal-sequential orientations are interrupted and fail to deliver the successful attainment of task-related goals. It will contribute to state-of-the-art sensor technologies, voice and emotion recognition tools and knowledge modeling, integrated with an innovative virtual assistant technology that offers complex dialogues and audio-visual cues for real domestic and personal situations, being however easy to configure.

4.6.1.8 Parkinson's disease IntElligent Robot for Rehabilitation Exercise (PIERRE)

The purpose of this project is to develop an autonomous robotic device for upper limb exercise in Parkinson's disease (PD) patients in order to promote effective neurorehabilitation in the clinical and home settings. The device development would incorporate the findings from the cutting-edge developments in the clinical research over the recent years suggesting that forced paced exercise based on cyclical motion brings potential neuroprotection benefits in PD along with the use of auditory based cueing approaches to facilitate pace and smooth performance. A plethora of research demonstrated direct and long-term benefits of specific exercise programmes in PD i.e. dance therapy, tandem biking in improving mobility, balance and quality of life. Technological development in the project would be focused on the high end version of the device that could be implemented in the clinical setting and further could feed in the development of home-based device in low-end version as a spin-off of the project. Rehabilitation robot developed in the project would be based on body with robotic arms that steer bilateral upper limb movement (i.e. for cyclical motion).

4.6.1.9 Advanced Intervention based on Early Detection of Functional Decline in the Ageing Population (AiDA)

The aim of AiDA is to develop an advanced ICT system that will detect risk of functional decline in the ageing population through unobtrusive monitoring of physical, physiological, psychological and social states. AIDA will use instrumented everyday objects to monitor ADL tasks, ambient and wearable sensors to monitor physiological changes as well as telecommunications and social media data to monitor social interactions. AiDA will collect large sets of data to develop advanced models of key decline profiles for individuals as well as the overall ageing population participating in the research. In addition, via user-friendly interfaces, AiDA will provide feedback and intervention at the early stages of behavioural change in order to prevent the onset of a decline. AiDA will carry out a continuous twenty month evaluation involving behavioural, sociological, health experts as well as relevant stakeholders (including formal and informal carers) to establish the effect of early detection and intervention on the quality of life of the older people and the sustainability of the healthcare system.

4.6.1.10 Automatic Analysis of Fidelity of Motivational Interviewing with Diabetes Patients

Motivational Interviewing (MI) seeks to facilitate and engage a patient's intrinsic motivation to change his or her behaviour. Its goal is to achieve behaviour change by helping clients to explore and resolve ambivalence. The therapist must try to achieve and demonstrate empathy with the patient, work to highlight the differences between the patient's aspirations and his or her current behaviour, avoid argument and direct confrontation, and accommodate rather than directly oppose, the patient's resistance to change. To achieve these goals it is essential that the therapist adheres to a set of guidelines. The objective of the proposed research is to create a speech and language processing system that is able, automatically, to monitor and assess the performance and competence of a therapist delivering motivational interviewing against these guidelines. The research will use a large corpus of recordings of MI sessions collected at Institute of Psychiatry, Psychology and Neurosciences (IoPPN), Kings College London, of which approximately 100 have been transcribed and assessed.

4.6.1.11 Effectiveness of animated avatars in cueing actions for patients with apraxia and action disorganisation syndrome

The conception of the use of Avatars was developed during the CogWatch study. Preliminary test at the end of the project suggested a great potential of this intervention. The main aim of the avatar study is to assess whether an animated avatar can be an effective cue for stroke patients. In addition to this, the experiment seeks to establish whether the type of visual perspective (first or third person) impacts the performance of the task. Patients are shown avatar videos before attempting to replicate the same task and their performance is assessed. Animations will be created and adjusted using the software MotionBuilder. While CogWatch has laid the foundation for understanding the most beneficial types of sensory cues that may help improve performance of patients in daily tasks, further research is needed in order to optimize these cues and to assess the real life impact they may have by testing with larger groups of patients and in the home setting. The funding provided by the TUFF should allow optimizing the cues in the avatar experiment and moving the CogWatch system towards the next stage of development, deploying the CogWatch system in a home setting.

4.6.1.12 Neural correlates of tool use

Based on the results from a previous DFG project titled "Neuronale Repräsentation von Werkzeuggebrauch und Handlungsplanung" and from the CogWatch project the new DFG proposal will further address the neural correlates of tool use in patients and healthy subjects using the tool carousel which was developed during the first funding periods. The fMRI part of the previous project identified key areas processing different aspects of actual tools use in the ventral stream (MTG, LOC), in the ventro-dorsal stream (SPL, PMV) and in the dorso-dorsal stream (SPL, PMd). The project part devoted to patient studies detected similar areas lesioned in apraxic stroke patients. There was a general agreement between the fMRI study in healthy and VLSM study in patients, but there are also noteworthy exceptions. Opposite to the strongly left-lateralized fMRI activation, deficits were also obvious in right brain stroke patients. Following topics should be

approached in the next funding period: Continuation of tests in stroke patients with the tool carousel to increase spatial precision, extend involved lesion areas, define RBD involvement, focal perturbation of key areas for tool use with TMS to proof behavioral functions, investigation of possible improvement of praxis functions by anodal stimulation tDCS of key areas, and connectivity analyses to reveal functional connection between the key areas. In addition, apraxia of actual tool will be investigated in detail in patients with Alzheimer and mild cognitive impairment (MCI). Behavioral as was as functional imaging studies will be performed in this patient group.

4.6.1.13 ACTIVE HANDS – Evaluation, rehabilitation and assistance of hand function in aging and chronic CNS diseases

The “ACTIVE HANDS” approach uses innovative technologies to monitor the use of the hands and provide guidance cues in activities of daily living. A particular emphasis is put on basic daily activities related to nutrition, grooming, and dressing but also on individual tasks such as professional activities and hobbies. Technology includes sensors to measure position, velocity, acceleration, forces, proximity, depth etc. as well as methods of computer vision. Sensor signals as well as the output of computer vision are processed to evaluate, characterize and identify the users’ activities. Statistical methods are used to supervise task progression. This information is used (1) to evaluate performance, (2) provide feedback and define training scenarios, (3) provide assistive cues for errorless learning environments, or (4) emit cues when errors are detected to enable successful task completion. In a recent EU-funded project (CogWatch) we showed that cues emitted by an automatized, task supervising system successfully guided stroke patients with action disorganization through a daily activity (making a cup of tea) so that the task goal was obtained. The present project will base on that proposal and further develop and evaluate tasks and devices with the goal of rapid market penetration.

4.7 Other Dissemination Activities (Student Projects)

There have been 10 student projects involving CogWatch (see Table 11).

Table 11: Student Projects

Title	Type	Date	Main Author's Beneficiary
Efficiency of interactive guidance in a naturalistic task in patients with apraxia and action disorganisaiton syndrome	Masters Student Project	2015	TUM
Toothbrushing deficits in patients with apraxia and action disorganisation syndrome (AADS) following stroke	Masters Student Project	2015	TUM[2]
A RCT of ADL training for stroke apraxia and action disorganisation	Masters Student Project	2013- 2014	UOB
Quantity-error estimation for stroke rehabilitation using the CogWatch Instrumented Coaster	Masters Student Project	2013- 2014	UOB
Real-time detection of quantity errors in tea-making using electronic scales	Masters Student Project	2013- 2014	UOB

[2] The CogWatch approach was lectured in the Master Program “Movement & Health. Diagnostics, Prevention & Intervention in the Life-Span” offered by the Department of Sport and Health Sciences at TUM. A special course in the second part of the Master concentrates on a project in Neurology. In the “CogWatch project”, students study the clinical conditions of apraxia, test patients and analyze their ADL performance as well as their responses to cues.

Design and development of an embedded system for the detection of the Activities of Daily Living directed towards patients with cognitive disorders, combining multiple open source technologies.	Masters Student Project	2015	UPM
Design and development of a communication protocol for the microduino® based tools to be used in the cognitive rehabilitation	Internal academic	2014-2015	UPM
Analysis of grips and hand gestures through sensors based on infrared technology.	Undergraduate Degree Project	2014	UPM
Identity protection for videos recorded by a camera with a depth sensor.	PhD Student Project	2014	UPM
Non-Intrusive User Monitoring in Daily Tasks for Cognitive Rehabilitation.	PhD Student Project	2012 - 2015	UPM
Modeling of Daily Tasks Applied to the Field of Cognitive Rehabilitation.	PhD Student Project	2012 - 2015	UPM

5. CONCLUSION

In addition to the post project activities and grant applications listed in this document, the partners will continue to ensure that the project foreground is accessible and ensure the long-term availability of the CogWatch system.