**Proceedings**

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KA2 - Cooperation for Innovation and the Exchange of Good Practices
Strategic Partnerships for higher education

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Yolanda Gonzalez
Carlos Guerrero

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# Message from the general chairs

Welcome to the AIRtech 2018 (Accessibility, Inclusion and Rehabilitation using Information Technologies) edition, celebrated in Palma, Mallorca, Spain.

AIRtech 2018 aims to establish an open exchange dedicated to the presentation and discussion about accessibility, inclusion and rehabilitation using Information Technologies. The term Information Technologies in context to this conference refers in general to the development, maintenance, and use of computer systems, software, and networks for the processing and distribution of data specific to the community or individual in relation to issues of accessibility, inclusion and/or rehabilitation.

All the submitted papers were reviewed by members of the program committees of the workshops and symposia. The papers address the following topics: inclusive education, care assistance, cognitive impairment, information systems in healthcare, smartBAN, medical informatics and therapeutic applications.

We thank all authors for submitting their articles to AIRtech 2018, and to program committee members for their thorough evaluation of submissions. We think AIRtech can be an interesting discussion meeting about these subjects, and repeat the conference in other locations.

Finally, we invite all the authors to submit an extended version to the special issue Accessibility, Inclusion and Rehabilitation using Information Technologies in the Journal of Healthcare Engineering indexed at the Science Citation Index Expanded with 1.261 impact factor. The submission deadline is Friday, 8 February 2019.

Antoni Jaume-i-Capó
Richard Picking

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# Comunication with screen interface and 3D switches in school context.

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***Abstract*—The research and innovation on education conducted by an interdisciplinary group, promotes the use of the "on screen interface". This is a software tool meant to facilitate communication to three students affected by mobility impairments and preserved intelligence, cerebral palsy (CP) by means of the use of the computer along with customized push buttons, in their school period. 3D printing techniques are used to personalize switches. Their development undergoes different stages: design, implementation, adjustment and then testing throughout several academic years. Results show a satisfactory development. The students achieve a sufficient level of autonomy in the teaching – learning process. The also prove the need for the personalization of the push buttons. The level of satisfaction is also perceived among the academic staff and even the student's family. We highlight the assistance these technologies provide to the teachers who have motoric disabled students in the classroom. As a result, we emphasize the importance of prevention at an early age, leading to the development of different resources and personalized devices and their introduction in the educational process in order to promote personal and social autonomy and therefore, inclusion.**

***Index Terms*—On screen interface, Information Technologies, inclusive education, autonomy, learning-teaching.**

## I. Introduction

Soro-Camats, Basil y Rosell (2012, p. 56) [1], remark, in relation to the degree of disability that, "not being able to perform a certain action does not depend only on personal limitations but also on the environmental condition around", this meaning that it is necessary to enforce inclusive environments. Observations conducted by Sevillano and Rodríguez (2013, p. 121) [2] on the use of IT, picture the student as a main actor on the learning process. This motivates the student, awakening interest for learning and understanding and enabling immediate transmission and reception of information and as a result, a more flexible learning pace. Harding, speaking about the ability to interpret children behavior at the early years of their communication skills development: "may be compromised since they do not communicate in a conventional manner o because their expression may be the result of physical rather than communicational factors". According to Coronas, Rosell y Pastallé (2012 [3]), when discussing about not using conventional keyboards and mice, there is a fair variety of alternatives employing switches of different kind. The degree of autonomy their use provides depends on the acquisition of specific skills. Changes on technology lead to regular update of the electronic assisting devices and especially in the computer. Improvements on these devices are also driven by changes in student's capabilities and the appearance of new needs. We propose to take advantage of the characteristics of the on-screen interface [4] (opacity, velocity, size, etc) along with the use of 3D printed switches (versatility, flexibility, fast prototyping, personalization, cost reduction, sustainability and short series), according to Verbeeten y alt (2017) [5]. We consider that the intervention of students with special educational needs requires precise prevention to make the development of self-concept and self-esteem possible. It is also necessary in order to compensate low personal competence and the lack of motivation for learning. Rossato et alt (2014, p.150) [6] "...should support the development of cognitive, sensory, visual and musculoskeletal systems, involving play activities to enhance social integration". . . . " the environmental enrichment issued to provide physical activity, learning experiences, increased somatosensorial inputs and social interaction. It induces plastic changes in the brain and recovery of sensorimotor function" and "the early stimulation with an enriched environment is able to prevent further deficits on motor skills" (p.156) According to Sakash et atl (2018, p. 136) [7] "Children with CP who do not have impairments in speech or language may be at risk for EF difficulties which may negatively affect social communication, academic performance, and functional independence".

## II. Materials and methodologies

According to McMillan y Schumacher (2010) [8] a case study is characterized by a reliable measurement (many observations as a data collection technique), repetitive measurements (the same feature is measured repeatedly), description of the conditions (as precise and detailed as possible), base line, treatment condition (duration and stability) and one by one variation rule. The initial hypothesis assumes that the use of the on-screen interface and de design, development and adjustment of the personalized switches, from the elementary school, as an educational resource, enhances autonomous learning among students affected by motoric disabilities, enforces self-esteem and improves work environment in the classroom and along with personal and social autonomy. In the first stage stu-


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dents are observed, paying attention to their learning progress in relation to different issues such as: mobility, language and communication, cognition, sensorial, social-affective, welfare and health. In the second stage the most difficult tasks are analyzed: assistance requirement, fatigue and attention. In the third stage proposals for new devices are made: on-screen interface (virtual keyboard) and 3D printed personalized switch. Implementation in the classroom comes at the fourth stage. The members of the research group test different types of switches show up in the classroom and assess different options. Time is adjusted to the methodological recommendations for the educational level of the students. In the case of elementary school, it is usually 10 to 15 minutes a day, progressively increasing depending on the student's personal conditions. In the fifth stage, the research team assesses the evolution of the students and the need for an adjustment of the devices.

## III. Results

After the implementation of the on-screen interface and the personalized switches over the course of three academic years we encountered:

- The three students under test have the feeling of a well.
- enables results in an enhanced self-esteem and the perception of a better personal competence.
- assess their results applying normalization criteria.
- Both the on-screen interface and the 3D printed switches become the tools that enable the realization of the necessary adjustments for the student's evolution in terms of mobility, cognition, perception and sensorial.
- These resources are meant to prevent learning and motoric difficulties inherent to students affected by CP.
- They also prevent further problems on students affected by learning and mobility impairments.
- These tools have helped to overcome fear of failure and enforced desire for self-improvement.
- Interest on self- achievement, motivation and satisfaction for the knowledge acquired has also been obtained.
- Through the fine tuning of the switches students have been able to initiate in the acquirement of literacy skills.
- The academic results obtained by the students have been perceived highly satisfactory by the academic staff, families, and the leading team of the school. They have been assessed by means of interviews and tutorials.
- Other schools, hosting students with similar characteristics, have shown great interest on the tools proposed in this work.

## IV. Discussion and conclusions

Referring to the progressive elimination of assistive devices, Soro-Camats, Basil y Rosell (2012) [9] suggest that there are two ways for the kid to achieve autonomy: attenuation (gradual reduction of the intensity of the assistance provided) and structured wait (should the student fail, the aids are reinforced to regain success). The process would begin with physical assistance, and then move to verbal instructions. They may also be combined. It is necessary to change the perception of the individual affected by motoric disabilities unable to displace or manipulate objects autonomously, not being able to perform other tasks requiring movement. Ochoa (2010) [10] argues that, although technology is present in many areas, it has not spread enough, maybe due to the difficulty in its use, compatibility issues, or the different criteria applied to the design. On–screen interface along with personalized switches have enabled students to perform tasks autonomously, and improve self-esteem. The academic staff is aware of the benefits of IT and knows the important role they should play in the teaching – learning process. Nevertheless, they blame the lack of training and time to think about the precise needs to address. Training is available but, usually not connected with the needs and the conditions in the classroom. It is a shared endeavor that demands a large amount of dedication on each one. Families are usually willing to collaborate in the implementation of the resources. We could sustain that motoric disability does not depend solely on physical limitations, but also on the situations that emerge from the interaction between that personal limitations with the barriers present on the environment. For Pereira et alt (2018, p.46) [12] "The existence of rules and routines promotes autonomy and the sense of responsibility, especially regarding school demands". To recap, Garcia [11] states that education must not respond only to the impositions of the market since it implies promptness and benefit. We defend a slow and sensible learning, emerging from participative and collaborative environments. It is most important the sense of what we do and the student's perception of being learning. (2013, p. 113)

## References


[1] Soro-Camats, E., Basil, C., y Rosell, C. (2012). Pluridiscapacidad y contextos de intervención. Barcelona: Universitat de Barcelona- Institut de Ciències de l'Educació.

[2] Sevillano, M.L. y Rodríguez, R. (2013). Integración de tecnologías de la información y comunicación en educación infantil en Navarra (Spain). Píxel-Bit. Revista de Medios y Educación, 42, 75-87

[3] Coronas, M., Rosell, C. y Pastallé, N. (2012). Productos de apoyo y su uso para la participación, la educación y el juego. (pp. 5-32). Barcelona: Universitat de Barcelona- Institut de Ciències de l'Educació.

[4] AA.VV. (2012) Interfaz en pantalla. http://www.interfazenpantalla.com/caracteristicas.html

[5] Verbeeten, W.M.H. y alt. (2017). Laboratorio 3D de la Escuela Politécnica Superior. http://hdl.handle.net/10259/4400

[6] Rossato, M. et alt. (2014). Beneficial effects of early environmental enrichment on motor development and spinal cord plasticity in a rat model of cerebral palsy. Behavioural Brain Research 263, 149-157.

[7] Sakash, A., Broman, A., Rathouz, P., Hustad, K. (2018). Executive function in school-aged children with cerebral palsy: Relationship with speech and language. Research in Developmental Disabilities 78 136–144.

[8] McMillan, J. H. y Schumacher, S. (2010). Investigación educativa. Madrid: Pearson Addison Wesley.

[9] Soro-Camats, E., Basil, C., y Rosell, C. (2012). Pluridiscapacidad y contextos de intervención. Barcelona: Universitat de Barcelona- Institut de Ciències de l'Educació.

[10] Ochoa, E. (2010). Nuevos avances en la accesibilidad TIC. 25 Años de Integración Escolar en España: Tecnología e Inclusión en el ámbito educativo, laboral y comunitario. Murcia: Consejería de E, Formación y Empleo.

[11] García, T. (2013). Experiencias y posibilidades de articulación entre Universidad-Escuela-Comunidad. Revista Interuniversitaria de Formación del Profesorado 78 (27.3), 201-206..

[12] Pereira, A ; Magalhaes, C ; Magalhaes, P ; Lopes, S ; Sampaio, A; Magalhaes, C ; Rosario, P. (2018). Why is he special? The importance of educational diet in children with Hemiplegic Cerebral Palsy: a case study. European Journal of Investigation in Health Psychology and Education, 8, 1, 37-51.


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# Coach Assistant via Projected and Tangible Interface*

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***Abstract* – The increasing population implies increased cases of older adults living with cognitive impairment, functional disabilities and other related diseases. Considering elders' preference to live at their homes as long as possible, constant supervision and assistance are necessitated. CAPTAIN is a project that proposes a "transparent" technology designed to turn seniors' homes into a ubiquitous assistant capable to cope with the requirements of seniors' daily activities and providing assistance whenever this is needed. Four main technologies are proposed from CAPTAIN including specialized input and output technologies (3D sensors, cameras etc.), to develop a platform for collecting and analysing of elderly data and to coach different intervals from the users.**

***Keywords—*** *elderly; cognitive impairment; dementia; care assistance; projective interface.*

## I. Introduction

Ageing population is increasing year by year. Based on WHO interventions, the number of people aged 60 years or older will rise from 900 million to 2 billion between 2015 and 2050 [1]. Along with the increased ageing world population however, the number of older adults living with cognitive impairment has also increased as this group is more vulnerable to mental impairments and other related diseases [2].

Performance disorders are among the most common aspects of cognitive impairment and include the ability to concentrate, communicate and act accordingly in specific circumstances. Cognitive impairment is often accompanied by psychomotor dysfunction and the inability to perform certain functions, leading in loss of patients' social autonomy and the ability to take care of themselves. If a person's ability to think or remember events experienced is impaired, then the person may be present in unwanted situations or in the worst scenario may be placed in a situation involving considerable danger. Furthermore, functional impairment that elderly are subject to, is another reason which necessitates assistance and care on a daily basis. Elderly people require special attention and need carers by their side to provide them with knowledge-based care [3].

Considering that elderly people prefer to live at their homes, telecare and mobile technology has a key role to play in supporting them and facilitate their home monitoring, enabling them to stay in familiar surroundings [4]. Properly designed electronic Health (eHealth) applications can support symptom reporting and management for elder patients and promote medication adherence [5]. Also, home-based eHealth systems can result in a positive influence on perceived support, decision making and information competence [6]. This can lessen patients' depression and allow them the comfortability of their home [7].

The project is funded under the Horizon 2020 - Research and Innovation Framework Programme, H2020-SC1-2017-CNECT-1, SC1-PM-15-2017 RIA: Personalised coaching for well-being and care of people as they age, Title of Proposal: CAPTAIN: Coach Assistant via Projected and Tangible Interface.

The aim of this paper is to introduce the Coach Assistant via Projected Tangible Interface (CAPTAIN) H2020-funded project which focuses at the early diagnosis and management of physical and mental disorders by recording and analysing emotional, behavioral and physiological data of the patients while they are at home. The emphasis of this work is given to the way the proposed project will serve the needs of the previous mentioned problem and enable daily assistance for the elderly population.

## II. Materials and Methods

As mentioned above, the CAPTAIN is targeted at the elderly population and especially those with cognitive and memory impairments. The project's purpose is to ensure constant assistance for the elderly and maintain their independence by providing them with technologies that preserve their physical, cognitive and social well-being. In order to achieve this goal, CAPTAIN tries to transform their own home into a transparent and tangible interface where users can interact with projected screens whenever is needed. Fourteen partners from nine European countries are involved in this project which includes five Living Labs (LLs) and a nursing home. The project's partners' expertise is combined to implement four main technologies:

- *Projective Augmented Reality (PAR): this technology will enable content and instructions to be projected onto a real context augmenting.*
- *Gamified-coaching experience: is the implementation of a gamified story and a virtual coach for any user experience.*
- *Non-invasive physiological and emotional data analysis: analysis of micro-expressions and human body pose.*
- *Non-invasive movement and gait data analysis: analysis of patient's movement through 3D sensors.*

### *A. Hardware and Software*

The proposed technologies require special equipment and software. The CAPTAIN will use several sensors, pico projectors, cameras, video cameras and microphones to apprehend and record a patient's pose, indoor movement and emotions. All input sensors (cameras, projectors, microphones, etc.) have to interact consistently therefore, the communication protocol between each device as well as cloud services as FIWARE and universAAL frameworks will be included [8]. The software to be used for each system's component is yet to be specified.

### *B. Methodology*

The involvement of final users during the implementation of a system plays a critical role to the system's adoption and u sage. The C APTAIN a dopts agile methodologies. The implementation phase is divided into four sprints which will enable progressively check of project's progress and evaluation of the deliverables. Seniors from five partner LLs will be involved at each sprint to identify system's potential weaknesses, through their feedback and evaluation, and enhance end-user acceptability.

## II. Expected Results And Benefits

The CAPTAIN aspires of being a future system that delivers the right services, at the most appropriate time, in an effective manner, wherever it is needed. Each of the four proposed technologies will be developed to serve certain purposes as described next.

### *A. Personalized recommendations and follow-up*

The CAPTAIN focuses at the physical, cognitive, mental and social well-being of the patients. Through the PAR technology, contextualised instructions will be projected on a screen urging the senior to complete several actions (such as cooking, exercising, etc.).

The senior will be encouraged to exercise in a context of a game (collecting virtual apples, virtual fishing, virtual hiking, etc.). Gaming instructions and recommendations projected on a wall will urge the senior to improve his physical condition. The senior's movements will be detected by the input devices and by the end of the "game" his results will appear on the wall. Instructions will also be projected to direct the senior at the place where the health monitoring devices are stored, inviting him to measure his vital health parameters. The new measurements along with the past values will be projected on a surface next to him.

Contributing to seniors' social well-being, the CAPTAIN will attempt to reduce feelings of loneliness and isolation with appropriate greetings, for example, welcoming them home after a walk and asking whether they followed their scheduled program. Additionally, seniors' relations with friends and relatives will be supported by the project. The coach will present some videos and photos of the senior's family and friends, thus enlarging his welfare and good mood. Furthermore, reminders and notifications will notify the senior regarding missed calls and online friends, since the CAPTAIN will be linked to seniors' social media accounts.

### *B. Prevention of unwanted situations*

Elders are the most vulnerable age group and often encounter undesirable circumstances due to cognitive impairment or functional disabilities that they might face. One of the CAPTAIN's expected outcomes is the prevention of such situations through a series of reminders and analysis of input data.

Daily reminders will be projected through the PAR technology to ensure that the senior will never leave the house without essential stuff such as keys, money, phone and coat. Additionally, the CAPTAIN will inform the senior to switch off all the lights and electronic devices before leaving the house. Beyond these, the physiological and emotional data analysis will be able to detect whether the senior has fallen asleep and wake him up in case of need (e.g. forgotten food in the oven).

Furthermore, movement and gait data analysis will detect the seniors' walking path and reveals whether they have a high risk of losing balance and fall. In such cases, recommendations will be projected for the senior to sit for a while and the coach assistant will be alert to contact a relative or a professional.

## IV. Conclusion

Ageing population constitutes a considerable concern for the health sector. As the most vulnerable age group it requires special attention and care that thankfully the technological advances can provide.

The CAPTAIN is a project oriented towards older adults and their daily assistance. It is hoped that the CAPTAIN will provide continuous provision of incentives, support and available assistance to elderly people who need continuous guidance and care and cope with the needs of this age group. A special attention is given to user requirements as these constitutes a reference guide for the development of CAPTAIN's functions and technologies. It is also expected that CAPTAIN's outcome will provide evidence of user-centered design and validation of non-obtrusive technology for physical cognitive and social well-being.

We believe at CAPTAIN's success as the involvement of seniors through the implementation phase will act as a catalytic privilege in meeting all the requirements. Considering seniors' perceptions as a point of reference we can generate certain recommendations that may lead to a higher level of beneficial realization.

## Acknowledgment

The project is funded under the Horizon 2020 - Research and Innovation Framework Programme, H2020-SC1-2017-CNECT-1, SC1-PM-15-2017 RIA: Personalised coaching for well-being and care of people as they age, **Title**: CAPTAIN: Coach Assistant via Projected and Tangible Interface. **Leading Partner**: Aristotle University of Thessaloniki (AUTH).

## References

[1] WHO at http://www.who.int/mediacentre/news/releases/2014/lancet-ageing-series/en/; last access May 2018.

[2] C. Ryd, L. Nygard, C. Malinowsky, A. Ohman, A. Kottorp. Can the everyday technology use questionnaire predict overall functional level among older adults with mild cognitive impairment or mild-stage alzheimer's disease? - A pilot study from Scandinavian Journal of Caring Sciences, 2015.

[3] Panagiotis D. Bamidis, Evdokimos I. Konstantinidis, Antonis Billis, Christos Frantzidis, Walter Hlauschek, Marios S. Neofytou, Efthyvoulos Kyriacou, Constantinos S. Pattichis, "A web services-based exergaming platform for senior citizens: the Long Lasting Memories project approach to e-health care", submitted to 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'11), August 30 - September 3, 2011, Boston, MA, USA.

[4] Pal, Debajyoti, et al. "Smart Homes and Quality of Life for the Elderly: Perspective of Competing Models. "IEEE Access 6 (2018): 8109-8122.

[5] Malwade, Shwetambara, et al. "Mobile and Wearable Technologies in Healthcare for the Ageing Population."Computer Methods and Programs in Biomedicine (2018).

[6] T. M. Burkow, L. Vognild, T. Krogstad, N. Borch, G. Ostengen, A. Bratvold, & M. J. Risberg, "An easy to use and affordable home-based personal eHealth system for chronic disease management based

on free open source software”. Studies in Health Technology and Informatics, 136, 83–8, 2008.

[7] V. N. Slev, P. Mistiaen, H. R. W. Pasman, I. M. V. de Leeuw, C. F. van Uden-Kraan, & A. L. Francke, “Effects of eHealth for patients and informal caregivers confronted with cancer: A meta-review.”, International Journal of Medical Informatics, 87, 54–67, 2015.

[8] Demongeot, Jacques, et al. "Multi-sensors acquisition, data fusion, knowledge mining and alarm triggering in health smart homes for elderly people. Comptes Rendus Biologies 325.6 (2002): 673-682.

[9] Sun, Zhiwei. “User involvement in system development process.” In: Proceedings of the 2nd International Conference in Computer Science and Electronic Engineering, France. 2013. p. 410-413.

[10] Johnson, I., and P. Ianes. "Frail Elderly Persons and Smart Home Technologies."Rehabilitation Medicine for Elderly Patients. Springer, Cham, 2018. 119-123.


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# Use of blockchain methods for data integrity in information systems in healthcare

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***Abstract*—Blockchain (BC) is well known regarding cryptocurrency systems like Bitcoin. Indeed, these methods can also be used in electronic record systems, like electronic data capture (EDC) or electronic patient record (EPR) systems in healthcare. In this work we introduce a solution to realize a similar functionality as compared to an advanced electronic signature in an EPR system. The application of BC methods offers a user-friendly and safe procedure to comply with regulatory requirements concerning data integrity in information systems in healthcare.**

***Keywords*—*blockchain, informations systems, healthcare***

## I. Introduction

Medical record systems, like electronic patient record (EPR) systems in hospitals, or electronic data capture (EDC) systems for clinical trials, contain sensitive data. Several laws and regulations require validation and data integrity of these systems, especially for EDC systems, like the FDA 21 CFR Part 11 [1,2]. These regulations require electronic signatures as well as a tracking of changes, also known as audit trails. An audit trail should provide comprehensive information about every single change in the data of electronic records. Utilizing the electronic signature should lead to an equivalent result as with the paper based standard, to reveal who made the entry or the change in the document and what was signed. For this purpose, advanced electronic signature methods are required by the EU signature law [2], if the same level as on paper should be reached. Nevertheless, systems with advanced electronic signature (AES) methods are rare. System providers usually claim that technological efforts are high and this will raise the costs. Users complain about poor usability, especially with regard to the handling of the private-/public-key infrastructure, that is needed for an AES functionality.
Since the emergence of cryptocurrency systems like Bitcoin, BC methods are highly discussed in the IT community [3]. BC methods can be combined with AES-systems or replace them. We will show and discuss ways to implement and use BC methods in electronic record systems like EPR or EDC.

## II. METHODS

We implemented BC functionality into the medical documentation (MD) module of an EPR system (piX4Healthcare$^{R}$). The BC functionality consists mainly of one database table that holds the blockchain, and further functions to create new entries into the table. The BC implementation can be seen as a central audit trail structure, like it is used in some EDC systems, but in this case the central audit trail is extended with BC functionality.
If a new entry in the MD module is added, or if a record is changed, an event driven function triggers a new entry in the central audit trail with additional blockchain information.
The process runs in the background without interfering with the work of the users.

## III. RESULTS

The added functionality worked as expected and creates a blockchain within the central audit trail table, where all changes in the MD module are tracked.

## IV. DISCUSSION

By utilizing the blockchain in the audit trail it is possible to detect unauthorized changes to the medical documentation. This functionality is comparable to advanced electronic signature methods. The advantage of the BC method lies within its simplicity and independence from interactions with the user. The users don't have to handle private-/public-keys and there is also no need for a specific user action to sign an entry. All required actions are automatically and completely executed in the background, unnoticed by the user.
Basically, a manipulation of the central audit trail table with a recalculation of the whole blockchain would be possible, but requires a timeframe for calculation, excluding any further actions like changes and transactions. So, the system itself is pretty safe and gets even safer if it comprises a lot of transactions per time. To improve the safety and integrity of the system, the central audit trail table with the blockchain information can be replicated to other servers, for example in a clustered architecture.

## V. CONCLUSION

Blockchain methods can be very useful in electronic systems, like EPR or EDC, in healthcare. They could add a security value similar to the advanced electronic signature but with much more user friendliness and lower costs.


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## References


[1] *CFR - Code of Federal Regulations Title 21, Electronic records - electronic signatures; U.S. Food & Drug Administration. U.S. Food & Drug Administration, 1997, revised April 1, 2017*

[2] *REGULATION (EU) No 910/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC; Official Journal of the European Union L 257/73, 8.8.2014*

[3] *Blockchains: The great chain of being sure about things". The Economist. 31 October 2015*




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# Energy-Efficient and Delay-Constrained MAC for Periodical Traffic in SmartBANs

Jaume Ramis-Bibiloni and Loren Carrasco-Martorell[1]

***Abstract*— This work presents a SmartBAN MAC configuration that significantly increases sensors battery lifetime through reducing transceivers energy consumption. To that end, the proposed resource allocation scheme determines the inter-beacon intervals ($T_{IBI}$) and sensors transmission periods ($Tt_i$) in order to allow sensors transceivers remain in sleep mode as long as possible while satisfying delay requirements of scheduled and contention traffic. Numerical results demonstrate that battery lifetime can be significantly expanded with the proposed scheme, specially for sensors with long transmission periods.**

## I. Introduction

A key to the widespread use of body area networks (BANs) for healthcare and assisted living applications is the use of low power sensors with long battery lifetime. Consequently, one of the main requirements of the PHY and MAC layers in these networks is the support of the different strategies used by sensors to decrease power consumption. ETSI SmartBAN standard (2015) [1], [2] has been designed with simplicity and low power in mind, and first comparative analyses [3], [4] with the more complex IEEE 802.15.6 BAN standard [5] show lower connection times and energy consumption. Although periodic uplink transmissions conform the majority of BAN traffic, there are very few works that analyze the scheduled access of existing standards. Authors in [4] present an optimal time framework for periodic scheduled traffic based on the SmartBAN MAC, whose main objective is to minimize delay while trying to improve energy efficiency. Since it is not worth wasting energy in reducing delay when this is not a requirement, our proposal focus on minimizing energy consumption while satisfying traffic delay requirements, yielding improved energy efficiency through prolonging the time transceivers remain in sleep mode.

## II. Smart BAN standard

In a SmartBAN, the data communication between nodes and hub is performed through a data channel (DCH) [1], [2]. The DCH is partitioned into inter-beacon intervals (IBI) of duration $T_{IBI}$ seconds, marked by the data channel beacon (D-Beacon) transmitted by the hub. Each IBI is further divided into $L_D$ time slots of duration $T_S$. Apart from the D-beacon, three periods can be distinguished in every IBI, known as scheduled access period (SAP, corresponding to scheduled data transmissions, TDMA based with $N_S \geq 0$ time slots), control and management access period (CMAP, corresponding to unscheduled data transmissions, and management and control signaling, consisting of $N_{CM} > 0$ time slots), and the inactive period (InP, no transmissions). $T_{IBI}$, $N_S$ and $N_{CM}$ are all adjustable paramenters.

A node can obtain scheduled allocation in SAP by requesting connection to the hub (C-Req message) in the CMAP using slotted Aloha access. Upon reception of the scheduled access grant by the hub (C-Ass message), the node may transmit/receive using the scheduled access intervals. In the C-Ass message, the hub specifies the sequence number of the next IBI in which the node needs to wake up for reception/transmission. It also indicates the number of beacon periods between the start of successive wakeup beacon periods in which the node needs to wake up. This way, duty cycling sensors with off periods greater than $T_{IBI}$ are supported.

## III. System model and procedure

We consider a SmartBAN organized into a star topology, consisting of $N$ nodes that periodically sense specific physiological parameters and directly communicate the sensed values to the hub. Sensing node $i$, with $i = \{1, 2, \dots, N\}$, is characterized by:

- its data generation period, $Tg_i$, corresponding to the elapsed time between successive sensing intervals;
- its data volume, $V_i$, which specifies how many bits of data are generated during a sensing interval;
- its maximum allowed delay, $Dmax_i$, designating its traffic delay requirements.

Accordingly, we determine:

- the number of allocated slots to sensor $i$, $ls_i$,
- the transmission period of sensor $i$, $Tt_i$, corresponding to the elapsed time between successive allocated transmissions of sensor $i$, obtained by grouping multiple data generation periods of this sensor,
- and the interbeacon transmission interval $T_{IBI}$.

To that end, a simple algorithm is proposed and illustrated in Figure 1, whose main objective is to minimize the energy consumed by sensors and hub, while ensuring the delay requirements of the different traffic types [6]. As it was shown in [4], the IBI length is inversely proportional to the energy consumed by sensors and hub. Our proposed eeAlgorithm maximizes $T_{IBI}$ while fulfilling the traffic delay requirements. To that end, multiple data generation periods of sensor $i$ may be grouped to form the *transmission period* of this sensor, $Tt_i = p * Tg_i, p \in N^+$.

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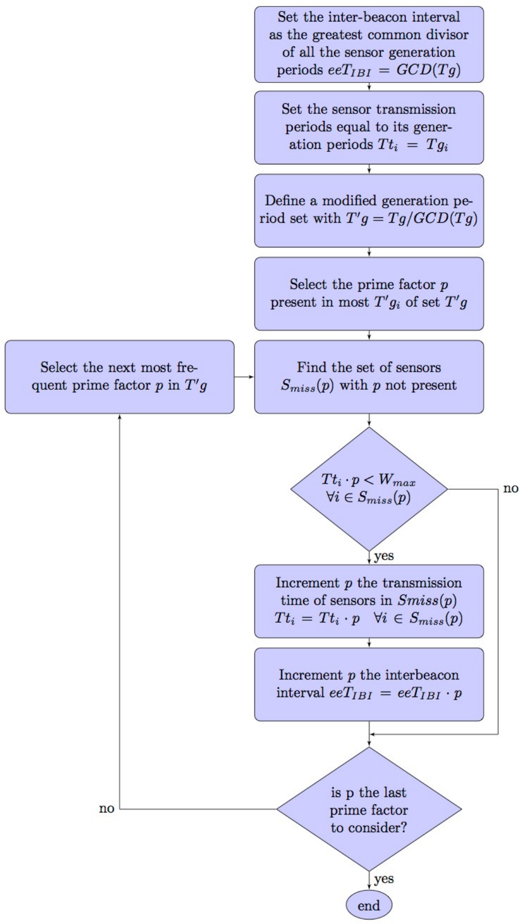


Fig. 1. eeAlgorithm

## IV. Performance Evaluation and results

In order to characterize the performance of the proposed eeAlgorithm we develop analytical expressions for delay, transceiver energy savings of sensor nodes and hub, and battery lifetime. In this Section, he behavior of the proposed eeAlgorithm is analyzed and numerical results are contrasted with the proposal of [4], labeled as *optimal-IBI*.

We consider a SmartBAN with 6 on-body sensors ([4], Table II). According to [7], $D_{Alrtmax} = 200$ ms and $Dmax_i = 3$ s, while $Q_{TOTALi}$, $T_{Wup}$, $I_{Rx}$, $I_{Tx}$, $I_{Wait}$, $I_{Wup}$ and $I_{Slp}$ values are detailed in [3].

Figure 2 plots the energy savings and battery lifetime for all sensors (horizontal axis corresponds to sensors sorted by increasing values of $Tg_i$). According to the SmartBAN PHY layer specifications [1], $N_{REPi} = \{1, 2, 4\}$ repetitions of the PPDU (Physical-Layer Protocol Data Unit) can be considered. It can be observed that the results corresponding to *optimal-IBI* are enhanced when the proposed $eeAlgorithm$ is utilized. The obtained $T_{IBI}$ value is 100 ms with *optimal-IBI* independently of the number of repetitions, while with $eeAlgorithm$, $T_{IBI}$ values are 2000, 1000 and 400 ms for

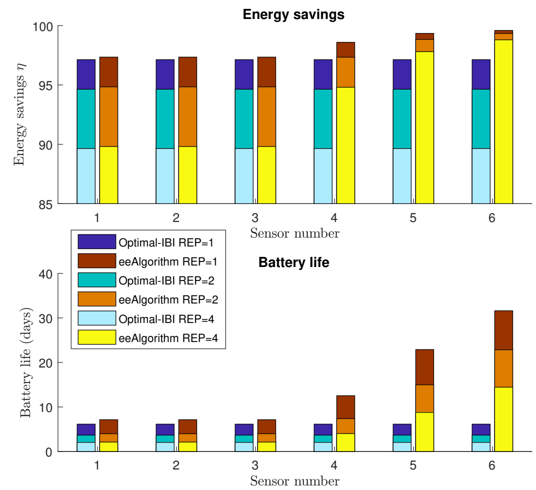


Fig. 2. Energy savings and battery lifetime for SmartBAN with 6 on-body sensors

$N_{REPi} = \{1, 2, 4\}$, respectively. It is observed that the energy savings and battery lifetime are reduced as $N_{REPi}$ increases. The reason is that a higher $N_{REPi}$ value means longer packets need to be transmitted and, consequently, more energy is required. It is worth noting that the proposal in [4] obtains the same behavior for all sensors, while when using the $eeAlgorithm$, the longer the $Tt_i$ value, the higher the energy savings improvement. The reason for this enhancement is that with our proposal, sensors with higher $Tt_i$ can remain in sleep mode longer periods, thus reducing the energy consumption. These results show that battery lifetime can be significantly expanded with the proposed $eeAlgorithm$, specially for sensors with higher $Tt_i$ values (it can be observed a nearly $500\%$ increase for sensor 6).

## V. Conclusion

The $eeAlgorithm$ for periodic monitoring in SmartBANs has been presented. This is an energy-efficient resource allocation scheme that sets the duration of $T_{IBI}$ as long as possible and may group multiple data generation periods of sensors, while satisfying traffic delay requirements.

## References

[1] *ETSI TS 103 326 v1.1.1, Smart Body Area Network (SmartBAN); Enhanced Ultra-Low Power Physical Layer*.
[2] *ETSI TS 103 325 v1.1.1, Smart Body Area Network (SmartBAN); Low Complexity Medium Access Control (MAC) for SmartBAN.*
[3] R. Matsuo et al., *Performance of simple and Smart PHY/MAC mechanisms for Body Area Networks*, IEEE ICC, London, 2015, pp. 501-506.
[4] L. Ruan et al., *SmartBAN with Periodic Monitoring Traffic: A Performance Study on Low-Delay and High Energy-Efficiency*, IEEE Journal of Biomedical and Health Informatics, 2016, n.99.
[5] *802.15.6-2012 - IEEE Standard for Local and metropolitan area networks - Part 15.6: Wireless Body Area Networks* - http://standards.ieee.org/findstds/standard/802.15.6-2012.html.
[6] J. Ramis et al., *An Energy-Efficient and Delay-Constrained Resource Allocation Scheme for Periodical Monitoring Traffic in SmartBANs*, BioCAS, 2017.
[7] *Draft Health Informatics - Point-of-Care Medical Device Communication - Technical Report - Guidelines for the use of RF wireless technology, IEEE Unapproved draft Std P11073-00101/D5*, June, (2008).


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# Towards a Computer-Supported Collaborative Learning Approach for Deaf Children

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***Abstract*—The education of children with disabilities requires to be adapted to meet their special needs. Different strategies have been used to promote and engage children into learning, one of this is Computer-Supported Collaborative Learning (CSCL), which is a pedagogical approach where technology serves as a bridge to allow learners to interact, share and construct knowledge through a computer. The development of technological tools to allow CSCL is necessary to support teaching and learning processes, especially for children with special needs. Unfortunately, designers and developers of such tools do not create products that are accessible or adaptable to be used by children regardless of their abilities or disabilities, mainly because there is not a clear guide on how to implement such strategies. This study focuses on deafness which is a particular disability that affects the auditory channel and thus the development of social and communication skills. We propose an approach to foster the development of tools that can promote CSCL among deaf children.

***Keywords*—collaborative learning, deaf children, education, ICT***

## I. Introduction

According to the World Health Organization, about 15% of the world's population are estimated to live with some form of disability and 5% (466 million people) have disabling hearing loss, mainly in lower-income countries, which affects disproportionally vulnerable populations [1]. This disability affects the auditory channel, and this is associated to other issues like the development of social, cognitive and communication skills. These issues isolate deaf community from the rest of society, especially when their main language is a sign language which most hearing people do not understand, and this creates a communication barrier between people. Literacy skills are also affected for deaf people [2], which restricts the access to information and the creation of new knowledge. Therefore, technology should intermediate to eliminate such barriers and make the world more accessible.

Researchers play a key role in the development of technological tools aimed at deaf children and promote collaborative learning (CL) among them, but a review made by Flórez et al. [3] shows a lack of research regarding the implementation of CL strategies to support the education of these children.

The study presented is part of a larger project that aims to propose a framework for the design of interactive collaborative tools. With this framework we want to provide the necessary elements to develop systems that can be adapted to meet children's and teachers needs inside the classroom. One of the main aspects of the framework, is to define the collaborative learning activities and strategies that can be implemented in a technological tool. Therefore, the aim of this work is to analyze different frameworks and models to map game mechanics, collaborative game mechanics, learning mechanics and positive interdependences.

## II. Related Works

Different frameworks and models have been proposed to foster collaborative learning environments.

The CoTree framework designed in [4] is based on a mechanism that employs a binary tree structure and an heterogeneous method to assign and organize a collaborative group. This study used the web-based environment to carry out a series of collaborative learning activities and to facilitate learners' co-construction of knowledge. Their experimental results showed that most learners can effectively construct a consensus with peers.

In [5], a framework was proposed for the design and development of collaborative games that can stimulate a reflection and exchange of information. This framework is composed by a coherent relation among game mechanics, skills and learning.

A framework for designing interactive digital learning environments for young people was developed by Tiradentes in [6][7]. This framework does not include collaborative learning aspects, but it can be helpful for designing interactive collaborative tools. This framework includes learning, user interaction and visual elements.

## III. Proposal

We propose a CSCL approach that could guide designers and developers in the development of tools that allow deaf children to construct knowledge by working with peers through computers. To achieve this, different frameworks and models have been analyzed to map game mechanics, collaborative game mechanics, learning mechanics and positive interdependences.


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TABLE I. MAPPING OF CSCL APPROACH

| Positive Interdependence (PI) | Game Mechanics (GM) | Collaborative GM (CGM) | Learning Mechanics (LM) |
|---|---|---|---|
| Role Identity | Role play<br>Behavioral momentum | | Guidance<br>Instructional |
| Goal | Collaboration<br>Cooperation | Common objectives | Participation<br>Demonstration<br>Action/Task |
| | Token<br>Selecting/ Collecting<br>Goods/ Information | | Observation<br>Generalization/ Discrimination<br>Feedback |
| | Cascading information<br>Cut scenes/Story | | Questions & answers |
| Environmental | Questions & answers<br>Communal Discovery | Questions<br>Common discovery<br>Exploration of real places | Identify<br>Explore<br>Discover |
| Resource | Resource management<br>Strategy planning<br>Pareto optimal<br>Appointment | Information exchange<br>Group Planning<br>Sharing Ideas<br>Generation of ideas | Plan<br>Objectify |
| | Tiles/ Grids<br>Capture/ Eliminate<br>Infinite gameplay | | Experimentation<br>Hypothesis |
| Task | Action points<br>Game turns<br>Levels | | Repetition |
| | Pavlovian interactions<br>Time pressure<br>Feedback | Feedback | Reflect/ Discuss<br>Analyze |
| Outside enemy | Protégé effect<br>Meta-game | | Imitation<br>Shadowing |
| Fantasy | Movement<br>Design/Editing<br>Simulate/ Response<br>Realism | Suggestion of images<br>Participatory design | Modelling<br>Simulation |
| | Assessment<br>Tutorial | Self-assessment | Assessment<br>Tutorial |
| | Competition | | Competition |
| | Ownership<br>Urgent optimism | | Ownership<br>Motivation<br>Accountability |
| Celebration/ Reward | Status<br>Reward/ Penalties<br>Virality | Common stimuli | Responsibility<br>Incentive |

This mapping will allow us to determine how collaborative learning could be implemented during the design of a system by deciding which of these elements can be used according to the purpose of the tool being developed which is influenced by learning goals, potential users' skills and limitations.

## IV. CONCLUSIONS

Collaborative learning strategies have been proven to promote different skills in learners, but its implementation is not easy, even with technology as a mediator. Tools should be designed taking into account the differences between learners, especially those with some type of disability. By creating systems that support CSCL, children with disabilities (deafness in this study) may have the opportunity to collaborate not just with other deaf peers, but also with normal-hearing children.

## ACKNOWLEDGMENT

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## REFERENCES

[1] World Health Organization, World Health Organization and World Bank Group, World Bank Group. 2011. *WORLD REPORT ON DISABILITY*.

[2] Flórez Aristizábal, Leandro, Cano, Sandra, del Sol Vesga, Luz and Collazos, César A. 2017. Towards the Design of Interactive Storytelling to Support Literacy Teaching for Deaf Children. 115–126. https://doi.org/10.1007/978-3-319-55666-6_6

[3] Flórez Aristizábal, Leandro, Cano, Sandra, Collazos, Cesar Alberto, Solano, Andrés and Slegers, Karin. 2017. Collaborative learning as educational strategy for deaf children: A systematic literature review. In *ACM International Conference Proceeding Series*. https://doi.org/10.1145/3123818.3123830

[4] Lan, Yu-Feng and Huang, Shin-Ming. 2009. Designing an Efficient Collaborative Learning Model to Construct a Consensus Based on Binary Tree Structure. *INC, IMS and IDC, 2009. NCM '09. Fifth International Joint Conference on*: 182–187. https://doi.org/10.1109/NCM.2009.98

[5] André, Janaina and Tiradentes Souto, Virgínia. 2014. À procura de um framework para jogos colaborativos. In *Proceedings of SBGames 2014*, 185–192.

[6] Tiradentes Souto, Virgínia. 2012. Towards a framework for desining interactive digital learning environments. In *IADIS International Conference Interfaces and Human Computer Interaction 2012*, 65–72.

[7] Tiradentes Souto, Virgínia. 2014. A Framework for Designing Interactive Digital Learning Environments for Young People. 429–447. https://doi.org/10.4018/978-1-4666-4623-0.ch022

# *Clinical evaluation of a mobile app for therapeutic exercise for neck pain*

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***Abstract*— Musculoskeletal disorders of the cervical area are common, with an increasing presence and economic cost in modern society. One of the therapeutic tools used in its treatment is therapeutic exercise. This paper presents the planning of the clinical evaluation of an app for neck therapeutic exercise with mobile devices. The aim is to determine the effectiveness of a serious game designed as a therapeutic exercise tool for neck pain rehabilitation. A clinical study will be performed, with two intervention groups, with pre and post measurements of pain, range of movement and neck disability. It is expected that this clinical evaluation process will demonstrate valid clinical evidence of the safety, performance and effectiveness of the interaction system.**

***Keywords*— Medical informatics application, exercise therapy, neck pain**

## I. Introduction

Musculoskeletal disorders of the cervical area are common, with an increasing presence and economic cost in modern society. One of the therapeutic tools used in its treatment is therapeutic exercise.

The common treatment, usually supervised by a physiotherapist, includes mobility exercises, strengthening, resistance and motor control exercises, since they showed to be one of the most effective treatments for neck pain. The long-term beneficial effect is achieved by performing the therapeutic exercise constantly and over time, which requires high motivation and adherence to treatment when done at home. The adherence to the treatment will therefore be essential for the maintenance of the effects.

The area of technology applied to healthcare (eHealth) has potential in the development of specific applications that manage and analyse the fulfilment of therapeutic exercises at home. It can have advantages when it comes to individualisation, providing accurate information about the patient's evolution, allowing a follow-up and adaptation of exercises. During eHealth design and development process, a clinical evaluation is needed in order to prove safety and effectiveness of the interface or device.

The present paper explains the development of interactive systems for rehabilitation in mobile devices focused on cervical area. Specifically, this paper presents the planning and development of the clinical evaluation of an app for neck therapeutic exercise with mobile devices.

The aim of the study is to determine the e effectiveness of a serious game designed as a therapeutic exercise tool for neck pain rehabilitation, in terms of pain decrease, range of motion increase and disability index decrease.

## II. Methodology

In order to prove the effectiveness and safety of the mobile app, a clinical study will be performed.

The hypothesis managed is that patients that do their therapeutic exercise by means of a serious game in a mobile device will decrease or maintain their pain, increase their ROM and decrease their disability in similar terms as patients that do their therapeutic exercise supervised by a physiotherapist.

Participants will be patients with neck pain. The recruitment will be through the rehabilitation centers in Majorca with neck pain patients that do therapeutic exercise supervised by physiotherapists.

After assessed for eligibility and confirmed the participation, by obtaining written consent, subjects will be randomly allocated into two study groups.

Before starting the intervention, pain, cervical ROM and neck disability will be assessed (T1). Pain will be assessed by asking subjects to indicate their pain on a VAS (Visual Analogic Scale). The VAS scale used will be a 10cm horizontal line divided into 10 equal parts, unnumbered. ROM will be measured by a physiotherapist by means of a goniometer and a software for cervical range of motion measurement Basic Pro (Werium Solutions). Neck disability will be assessed by using the Neck disability Index (NDI), a validated questionnaire to obtain information of how the neck pain is affecting a person's ability to manage in everyday life.

### *A. Intervention group 1.*

They will start intervention with 2 months of 2 or 3 weekly sessions of therapeutic exercise by means of the mobile device with the serious game. Then, pain, ROM and


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disability will be assessed (T2). After the 2 months, they will proceed to continue 2 more months of therapeutic exercise supervised by their physiotherapist.

### *B. Intervention group 2.*

They will start intervention with 2 months of 2 or 3 weekly sessions of therapeutic exercise supervised by their physiotherapist, followed by pain, ROM and disability assessment (T2) and 2 months of therapeutic exercise by means of the mobile device with the serious game.

After the intervention, pain, ROM and disability will be assessed again (T3).

Outcomes of VAS, ROM and NDI of both groups will be compared in order to prove the hypothesis..

## III. CONCLUSION

It is expected that this clinical evaluation process will demonstrate valid clinical evidence of the safety, performance and effectiveness of the specifically designed interactive system for rehabilitation in mobile devices focused on cervical area.


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# Robot companion cats for people living with dementia: a case study on companotics

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***Abstract*— This study sets out to explore the effects of a robot cat for people living with dementia in their own homes. We recruited participants with symptoms from mild-to-moderate to severe dementia, with the aim of exploring the impact of the robot cat on the patient and their carer. This paper reports on a qualitative research study utilizing phenomenology to interpret the data gathered during group interviews involving people who live with dementia and their families. Photo elicitation was also utilized with those who had taken photographs and who wished to discuss them. We present the acceptability and impact of the robot cat on symptoms of dementia represented as a trajectory, through early, mid and late dementia in the form of a case study with data presented across, and within, the group of participants.**

***Keywords—robot companions, companotics, dementia, mental health***

## I. Introduction

The study of companotic[1] [1] animals is long established, demonstrating the comfort and improvements in wellbeing that they bring to people. Cherniak and Cherniak [2] discussed the benefits of pet assisted therapy. In particular, the effects on people with memory impairments are profound; a longitudinal observational study in the USA found that integrating pets in the care home environment created a sense of purpose and life, helping the person engage [3]. Moyle et al [4] found that engagement increased and agitation decreased for people with dementia using the robotic seal PARO. Robot pets have also been found to reduce loneliness in residential care settings [5]. The effect of robot pets has been researched in the care home setting often [6,7,8], but of the 33 studies examined in the scoping review undertaken by Abdi [9], only one study has been undertaken in the home, and this was a humanoid robot rather than a robot pet [10].

[1] Companotics: "The research and development of computerized companion devices, especially companion robots".

## II. Methodology

This research comprises a qualitative investigation into the use of robot cats (Hasbro's *Joy For All*) as companion robots for six people living at home with family and/or carer support. The results are presented as a case study, since each person had varying degrees of dementia or dementia-like symptoms. Some people had a diagnosis of Alzheimer's Disease, but some people were identified by their family as having dementia symptoms and so had come forward for inclusion in the study. Due to the variability in their symptoms, and their specific needs in relation to these, what follows is underpinned by a multiple case study methodology, analysed within and across cases.

All but one of the participants were female and all had retired. Of the three participants without a diagnosis, but who had early symptoms of dementia, two were female and one male. Age was not recorded, as the participants' dementia condition was the only characteristic of interest.

As part of the data collection, interviews were undertaken with the people living with dementia and their families. In order to elicit further, more detailed information about the nature of the impact of the robot cat, participants and their families were encouraged to take photographs, which has been identified as a way to encourage discussion and recall when doing research involving people living with dementia [11]. Where a photograph was available, as part of the second round of interviews, photo elicitation was used to help the participants discuss the impact of the cat on their lives, and conversation flowed well when the participants presented these photographs during the interviews.

## III. Results and Discussion

There was no guarantee when presenting the robot cat to a person with early symptoms of dementia that it would be accepted. However, people who had no dislike of cats were


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more amenable to accepting it. Conversely, there was also the possibility of a person immediately disliking the cat because it looked close to lifelike, which could possibly be attributed to the 'Uncanny Valley' phenomenon. One participant noted that she would much rather "*stick to her teddies, thank you*" as they were "*much more of a comfort*" (Participant two: research diary notes).

What seemed to be more predictive, but by no means applicable to all, was the stage of dementia and acceptance of the dementia symptoms. Participant four's family noted this, discussing:

*"She rejected it, it never really worked for her. The daughter (Granddaughter of the speaker) has a dog, which she brings and she sits there and strokes it. That's why I thought it would work for her (Daughter one).*

This person rejected most interventions, and although the family had a diagnosis of dementia for their mother, they felt that they were unable to always "*reach her*" and didn't "*know what to do to help her a lot of the time*" (Daughter one). Because of this, the family asked for the cat to be taken away.

Where the participant was more accepting of her symptoms, such as participant five, and was known to be a cat lover, the cat was accepted. Her husband was pleased to have a photo taken, which he chatted about, saying the cat was always by his wife and that she seemed to enjoy it's 'company' (Husband one).

For people with mid and late dementia symptoms, the cats became a subject of conversation between the participants, their families, and carers. In this way, communication was stimulated, and families particularly noted this where communication had previously decreased.

Participants, family and carers identified that conversations were stimulated as a response to the meow, purr, and movement of the cat, and that this promoted conversations with family and others.

Other participants and families found that there was a real stimulation occurring that went beyond motivating conversation. One of the strongest reactions came from participant six. This lady had suffered a recent deterioration of mood, functioning and communication.

On visiting, the lady was said to be really fond of cats but would be unable to care for a real cat. She loved the little toy cat that was in the communal space in the complex, and often spent time petting it. This may well have been a predictor of the immediate and strongly positive reaction on first meeting the robot cat. As the cat was brought into the room, she held out her hands to the cat saying, *"Where have you been?"*, addressing the cat, and took it into her arms and straight to her lap where she stroked it and spoke to it with affection.

During the interview, Participant six was happy, and would talk to the cat at intervals. The family, delighted with their mum and grandmother's calm, settled and happy *demeanour*, explained the improvement in her communication since she had the cat, even noting some improved memory:

*"Cat: Meow*
*Participant six: (In response to the cat's meow – speaking to the cat) Hello, there's a good girl…*
*Interviewer: And she talks to you, doesn't she?*
*Participant six: Yeah.*
*Granddaughter six: The whole family like her don't they (Grandma)? The girls came from (Country) and they seen her, haven't they? And they like her.*
*Daughter six: Yeah, they were here last week for a week.*
*Participant six: Yeah, it was lovely, wasn't it?*
*Daughter six: It was lovely. You see (to interviewer), she's remembered that, as well!*
*Interviewer: is that unusual?*
*Daughter and Granddaughter six together: Yeah*
*Interviewer: Is it?*
*Daughter six: Definitely.*

## IV. Conclusion

In this research, the benefits of the robot cat were clear, and although this was a very small-scale study, where they were accepted, they provided positive outcomes for the participants and their families.

## References


[1] Picking, R. and Pike, J. (2017) "Exploring the effects of interaction with a robot cat for dementia sufferers and their carers" in Proceedings of 7th International Conference on Internet Technologies and Applications (ITA 17), Wrexham, UK.

[2] Cherniak, E.P. and Cherniak, A.R. (2014) "The benefit of pets and animal-assisted therapy to the health of older individuals." Current gerontology and geriatrics research, Article ID 623203.

[3] Winner, S.F. (2014) "Positive effect of pets on memory-impaired residents at Silverado communities" Working with older people vol. 18 no. 3 2014, pp. 134-141 doi 10.1108/wwop-05-2014-0012.

[4] Moyle W, Beattie E, Draper B, Shum D, Thalib L, Jones C O, Dwyer, S, Mervin, C (2015) "Effect of an interactive therapeutic robotic animal on engagement, mood states, agitation and psychotropic drug use in people with dementia: a cluster-randomised controlled trial protocol". BMJ Open 5 (8): e009097. doi: 10.1136/bmjopen-2015-009097.

[5] Robinson, H., Macdonald, B., Kerse, N. and Broadbent E, (2013) "The psychosocial effects of a companion robot: a randomized controlled trial.", Journal of American Med Dir Assoc. vol. 14(9), pp. 661-7.

[6] Kidd, C. D., Taggart, W., & Turkle, S. (2006). "A sociable robot to encourage social interaction among the elderly". In Proceedings 2006 IEEE International Conference on Robotics and Automation, ICRA 2006. (pp. 3972–3976).

[7] Wada, K., & Shibata, T. (2007). "Social effects of robot therapy in a care house - Change of social network of the residents for two months". In Proceedings - IEEE International Conference on Robotics and Automation (Vol. 23, pp. 1250–1255). IEEE, Japan.

[8] Shibata, T. (2012) "Therapeutic Seal Robot as Biofeedback Medical Device: Qualitative and Quantitative Evaluations of Robot Therapy in Dementia Care". Proceedings of IEEE, 100,8, 2527- 2538.

[9] Abdi J, Al-Hindawi, A, Ng. T, Vizcaychipi M. P. (2018) "Scoping review on the use of socially assistive robot technology in elderly care'" *BMJ Open* 8:e018815. doi:10.1136/bmjopen-2017-018815

[10] Tanaka M, Ishii A, Yamano E, Ogikubo H, Okazaki M, Kamimura K, Konishi Y, Emoto S, Watanabe Y. (2012) "Effect of a human-type communication robot on cognitive function in elderly women living alone". Medical Science Monitor;18 (9):CR550–7.

[11] Beuscher, L., & Grando, V. T. (2009). Challenges in conducting qualitative research with individuals with dementia. *Research in Gerontological nursing*, *2*(1), 6-11.



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# MyProprioception: an iPhone app to assess range of motion and proprioception

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***Abstract*—Proprioception is a key information to monitor the optimum motor control in diary life and sports performance. However, its evaluation is often difficult because requires laborious tasks or sophisticated tools. New capabilities in the smartphones like gyroscope, QR code recognition and high definition cam may facilitate the design of apps for the proprioceptive evaluation with immediate feedback in field conditions. In this term, an iPhone app has been designed to assess proprioception and range of motion as main parameters of the motor control. For its use, a study to evaluate its concurrent validity against AutoCAD® and reliability has been designed. According to the app's performance during the testing phase, high concurrent validity and reliability are expected. Health and sport professionals could take advantage for the use of this app to obtain useful information during the rehabilitation and training sessions.

***Keywords* — *smartphone application, evaluation, proprioception, motor control.***

## I. INTRODUCTION

Proprioception is an afferent information that allows the motor control during activities of daily living and the optimum movements during the sports performance [1]. Among the skills derived from proprioception, joint position sense (JPS) informs about where our body is and how it is positioned by obtaining errors during repositioning tasks. Therefore, errors from JPS play an important role in the injury prevention and the rehabilitation process, as well as in sports performance due to its meaning in the accuracy and efficiency of movement [2, 3]. Despite the fact that health and sports professionals could consider errors from JPS to monitor the training or rehabilitation sessions, its evaluation frequently requires laborious process and/or sophisticated devices that makes impossible the immediate feedback and/or evaluation in field conditions [1]. The iPhone 6 and subsequent models from Apple Inc (USA) have a system to detect QR codes, as well as a gyroscope to perfectly align the smartphone in an only plane. These capacities in a same mobile device have allowed the development of an appropriate application to instantaneously acquire the joint position through photo-analysis while ensuring the proper alignment of the mobile phone and the subject in the same plane, without perspective errors. Although some smartphone apps have been designed to determine the motor control through the range of motion (ROM) and JPS evaluation, for the authors' knowledge, none of these have been designed to calculate the errors during the JPS test and ROM while fixing possible perspective errors [1]. Therefore, we aimed to evaluate the validity and reliability of a specifically designed iPhone application (My Proprioception) to measure ROM and JPS errors of healthy young people.

## II. MYPROPRIOCEPTION: HOW DOES IT WORK?

MyProprioception evaluates JPS and ROM based on photo-analysis and recognition of QR codes located in previously determined anatomical references. The smartphone should be correctly positioned in vertical plane on a tripod. The gyroscope ensures the rigth position by showing green numbers on the top corners. In this moment, the app is ready to start the test. According to the parameter to evaluate (ROM or JPS), procedures are slightly different:

### *A. Range of motion (ROM)*

Subject is passively guided to a starting joint position that is different according to the joint to test. Tester should take a photo with MyProprioception app in this initial joint position, prior to perform the joint movement. Once the initial position is captured, the entire joint movement should be performed. When the joint movement is completed, tester should take another photo with MyProprioception app in the final position. Once both initial and final positions have been captured, the app will ask you to confirm the markers' location in the initial and final position (important if the marker recognition is manual) (Supplemental file). Therefore, the app will analyze the joint angles to obtain the ROM as follows: *ROM = joint angle in the initial position (degrees) – joint angle in final position (degrees)*

### *B. Joint position sense (JPS)*

Procedures are quite similar to ROM evaluation. However, now subject should wear a mask to blocked visual inputs. Again, subject should be previously guided to a starting position that is different according to the joint evaluated. From this starting position, tester should guide subject to a previously determined joint angle: Target position. At this precise moment, subject should actively keep this position for 5 seconds to recognize the exact joint angle. This is the *Target* position that subject should recognize and reproduce. After the 5 seconds, subject should be returned to the starting position. At the voiced "reposition" order, subject should reproduce the target joint angle as closely as possible during 3 trials. In this case, to obtain proprioceptive errors, tester should take four photos: in the target position, and in the *trial 1*, *trial 2* and *trial 3*. Once the four images are captured and markers' location are confirmed, the app will analyze the joint angles to obtain the following proprioceptive errors [4]:

Absolute angular error, informs about the size of the proprioceptive error = *[|(Target – Trial1)| + |(Target – Trial2)| + |(Target – Trial2)|]/3*

Relative angular error, informs about the direction of the proprioceptive error (underestimate or overestimate) = *[(Target – Trial1) + (Target – Trial2) + (Target – Trial2)]/3*


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Variable angular error, informs about the proprioceptive precision during the repositioning task = *standard deviation (Target —Trial1), (Target —Trial2), (Target —Trial3)*

## III. Procedures to validate MyProprioception app

### A. Study design

A repeated-measures concurrent validity and reliability study was performed on young and physically active participants. Since MyProprioception app has been designed to evaluate several joint movements, the validation study should be designed for every joint by following similar procedures. Every joint will be evaluated in different sessions to avoid fatigue of the participants during test. The order of the evaluation for every body region will be: neck (flexion, extension and lateral flexion) (session 1), shoulder (flexion, extension, rotations, aduction and abduction) (session 2), elbow and wrist (flexion and extension) (session 3), hip (flexion, extension, rotations, aduction and abduction) (session 4), knee and ankle (flexion and extension) (session 5). Time apart between sessions should be at least a week. All the test should be scheduled during the morning to avoid time of day influence.

### B. Participants

To the sample size estimation, calculation is based on the method described by Walter et al. [5], for $\alpha = 0.05$ and $\beta = 0.2$, the sample size needed is 15 participants in each session (8 males and 7 females; age: 23.4 ± 3.4 years; height: 1.74 ± 0.09 m; mass: 68.5 ± 10.9 kg).

As eligibility criteria, participants should be between 18 and 30 years old and perform physical activity at least twice per week. Also, they should no to have suffered injuries in the previous six months, any surgery in the evaluated joints or visio-vestibular disorders.

As ethical aspects, all participants will be informed about the study and signed informed consent according to the Declaration of Helsinki. The ethical committee of the University of the Balearic Islands approved the present study.

### C. Procedures

Every session is compounded by a short warm-up (3 minutes of aerobic activity, 3 minutes of active joint stretching and 3 minutes of general joint mobilization), a familiarization process and three repetitions of ROM and JPS tests with the pertinent joint. A health professional, external to the present study should guide the sessions by ensuring that JPS and ROM test are correctly performed. Meanwhile, images should be taken with the iPhone app by another health professional. When JPS and ROM test are finished, the photo-analysis should be performed by two testers: tester 1 should analyze all the images twice (T1 and T1') with MyProprioception app and tester 2 should analyze images once (T2) with the same app. Images should be also analyzed once with AutoCAD® by tester 1 ($T1_A$) [4].

### D. Statistical Analyses

The mean and standard deviation (SD) will be obtained for the ROM and JPS errors data. Pearson's product-moment correlation coefficient with 95% confidence interval (95% CI), the slope analysis and y-intercept of the resulting regression lines, and the standard error of estimate (SEE) will be used to compare the validity of the iPhone app with that of the AutoCAD® with respect to values obtained from every session. The intra-class correlation coefficient (ICC) with 95% CI and Bland-Altman plots will be used to analyze the agreement between the two software for obtaining ROM and JPS errors. Furthermore, the minimal detectable change (MDC) and standard error of the mean (SEM) will be also calculated. The ICC (2,1) with 95% CI and SEM will be employed for the intra-tester reliability by comparing data obtained from tester 1, first trial (T1) and second trial (T1'). The ICC (2,1) with 95% CI and SEM will be similarly employed to analyze the inter-tester reliability by comparing data from tester 1, first trial (T1) and tester 2 (T2). The ICC interpretation will be: poor (<0.0), slight (0.0–0.20), fair (0.21–0.40), moderate (0.41–0.60), substantial (0.61–0.81), or perfect (>0.81) [6]. The software SPSS for Windows version 20.0 (Chicago, USA) will be employed for data analysis and the level of significance will be determined at p>0.05.

## IV. Results

According to the app's performance during the testing phase, ICC values for the concurrent validity of the MyProprioception app against AutoCAD® are expected almost perfect in all the joints and movements with an almost perfect agreement among both devices (ICC < 0.81), an almost perfect correlation ($r > 0.91$, $p < 0.001$) and no statistically significant differences between the two devices with respect to the evaluation of ROM and JPS errors ($p > 0.05$). The slope analysis and y-intercept of the resulting regression lines, SEE and Bland-Altman plots will be also obtained.

The intra-tester reliability of MyProprioception app in assessing ROM and JPS in all the joints is expected to be almost perfect for all movements (ICC > 0.81, $p < 0.001$).

The inter-tester reliability of MyProprioception app in assessing ROM and JPS in all the evaluated joints will be expected to be also almost perfect for all movements (ICC > 0.81, $p < 0.001$). The SEM and MDC will be also obtained.

## V. Practical Applications

Health and sport professionals could take advantage for the use of this app to obtain useful proprioception information during the rehabilitation and training sessions.

## References


[1] Q. Mourcou, A. Fleury, B. Diot, C. Franco, and N. Vuillerme. " Mobile phone-based joint angle measurement for functional assessment and rehabilitation of proprioception". BioMed. Res. Int., vol. 328142, October 2015.

[2] L. Konradsen. "Factors contributing to chronic ankle instability: kinesthesia and joint position sense". J. Athl. Train. vol 37, pp. 381-385, October 2002.

[3] V. Sevrez, and C. Bourdin. "On the role of proprioception in making free throws in basketball". Res. Q. Exerc. Sport., vol 86, pp. 274-280, March 2015.

[4] Nasseri, M.R. Hadian, H. Bagheri, S.T.G. Olyaei. "Reliability and accuracy of joint position sense measurement in the laboratory and clinic; utilising a new system". Acta. Med. Iran., vol 45, pp. 395-404, August 2007.

[5] SD. Walter, M Eliasziw, and A. Donner. "Sample size and optimal designs for reliability studies". Stat. Med., vol 17, pp. 101 – 110, January 1998.

[6] J.R. Landis, and G.G. Koch. "The measurement of observer agreement for categorical data. Biometrics". Biometrics., vol 33, pp. 159 – 174, 1977.




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# *Keynotes*


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# Let's Change before we have to

Miguel Cabrer
CIO at TopDoctors / Founder &
Investor at Idonia.com

Health technology can transform healthcare but only with implementation of basics such as collaboration, communication and transforming some traditional workflows.

AirBNB, TripAdvisor, Uber, OpenTable, WhatsApp and many others have appeared in a disruptive manner and have changed the market and the approach to it. They each have two very important things in common: they are global concepts applied locally and are led by users who are the main beneficiaries of these platforms.The user is not only in the centre but is the centre. It is the user who directs, decides and values.

# Humanization of technology applied to teaching in health studies

Ariadna Graells, Esther Insa & Maria
Figueras
Fundació Sant Joan de Déu

Introduction: One of the challenges posed by teaching in the health sciences, is the training of care and humanized attention. To do this, we use technology to simulate spaces that represent situations that are as faithful to the professional reality as possible. Although the technical simulation aims to bring the student closer to real practice, it continues to pose challenges and dilemmas for teachers. On the one hand, when training non-technical skills, also called soft skills, which despite being indispensable in the humanization of assistance are cold, and on the other hand the need for interprofessional collaboration in the design and creation of technology of simulation. Aim of the session: To acquire strategies that can be undertaken in the field of teaching in eHealth to work both the humanization of the technology used in simulation and to improve the interprofessional communication.

Methodology: The session will bring together teachers from the field of health and technology to discuss the needs of teachers in eHealth, the possibilities of humanization of technology and how to foster interprofessional communication.

Simulated cases will be presented in digital format that give rise to a professional situation and from which a reflection will be established on the dilemmas that this raises.


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# Obtaining a normal dataset of the thermography of the human body

Tibor Kesztyüs
Hochschule Ulm University

Although a lot of efforts were done in the past regarding clinical diagnosis of thermoregulation via thermography, is there no detailed overview of normal findings of the human body. The goal of this was to create a thermographic dataset of healthy persons. Skin temperatures were measured of 75 body regions in 8 thermographic pictures. 63 healthy volunteers participated (27 female, 36 male). All probands were informed/consent.

Two thermal cameras were used, a FLIR i7 and a Testo 875. All thermographic pictures were taken under the same defined conditions, following a strict guideline. Every proband was questioned regarding deseases, medication and lifestyle. Every examination was thoroughly documented.

The results of this work give detailed overview about the thermal distribution of the healthy human body. The obtained dataset can be used for further research.

# PRISM: The Palma Robot Interaction System Model

Richard Picking, Joanne Pike, Denise Oram
Glyndwr University

This session proposes to develop a system model that considers the impact of companion robots in terms of their place in a social setting. Our previous research has documented how a companion robot influences not only its primary ‘owner’, but also those around her, including family, carers, professionals, as well as the wider community.

Our proposal is derived from the Neuman System model (1995), which is orientated towards wellness, based on a person’s reaction to stressors within not only the internal environment, but also the external environment. The model is drawn from, and there is some similarity to, Gestalt theory, in that the person is surrounded by a perceptual field, said to be in dynamic equilibrium. The model also declares that each part of the system (the person) is interrelated with others and all are interdependent, so that in terms of reactions to possible stressors, the whole system reacts.

We will present an initial version of PRISM, and participants will be encouraged to critique and enhance the model in a workshop setting, drawing from their personal, professional and academic experiences. Following the workshop, we aim to refine and publish the model in a respected journal, and with a view to it being recognized and adopted in the eHealth curriculum.


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# Application of Item Response Theory to e-Health

Irene García Mosquerra
Balearic Islands University

Although it was initially developed in the area of Psychometrics, the Item Response Theory (IRT) has been applied in several areas, including e-Health. During the talk we will discuss two of these applications. On one side, we will explain how to use models based on IRT in order to measure the e-Health literacy level. On the other hand, we will explain how IRT could be integrated into mainstream Computer Aided Diagnosis/Prognosis Systems, and the performance of this approach is discussed using a case study. Finally, during a practical session, participants will be taught how to use R language libraries that have been developed to implement the models based on IRT.

# Using AI techniques for healthcare. Application in a smart rollator

Atia Cortes Martinez
Universitat Politècnica de Catalunya

Assistive technologies play a key role in today's' society, especially when it comes to the older adults. They have enabled improvements in their Quality of Life, extending their autonomy and community living. This is important, as they can stay active safely and independently. The use of different types of sensors embedded in these devices provides huge amounts of data. Machine learning techniques have been useful to generate a new type of ubiquitous, continuous information that can be useful for patients, caregivers and health professionals. Efforts are focused especially on mobility assistance, fall prevention and activity recognition, which could be used, for instance, to monitor elderly population living in autonomy and community-dwelling.


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# Patient-Centric Healthcare Services

Eirini Schiza, Melpo Pittara
University of Cyprus

This session wants to satisfy the elderly and cover the need for supervision so that they can continue to live in their home. To provide best practices to achieve a common understanding on eHealth, patient empowerment, based on existing guidelines and other information. The objective is to understand the necessity of having the electronic health record be the central repository for supporting emerging healthcare services. Thus, nursing homes will use an innovative projected environment to provide useful and effective conservative help for the virtual guidance of the elderly living in the home. Expected results is to develop and implement a new framework concerning the provision of next-generation healthcare services.

# Robotic assistance in Minimally invasive and Endoluminal surgery

Salih Abdelaziz
Université de Montpellier

Minimally Invasive Surgery (MIS) has evolved rapidly and has arrived to maturity at the end of the last century. Over the last twenty years, a huge number of robots, such as the Da Vinci, has been deployed in surgery to assist surgeons in some difficult MIS procedures that are tough to perform manually such as off-pump heart surgery or percutaneous needle insertion in interventional radiology. New approaches using robotic assistance have been therefore developed to allow such kind of interventions. To go further and to reduce postoperative pain and eliminate the trauma to the abdominal wall during MIS surgeries, new types of surgery (single port and NOTES surgery) are currently under development. To succeed these new surgeries, robotic assistance is shown to be of great interest but remains very challenging. An example of robot will be presented.


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# From personalized medicine to Health policy making support though AI and data science in eHealth

Karina Gibert
Universitat Politècnica de Catalunya

The session will show how Artificial Intelligence and Multivariate analysis techniques can be properly combined into a Data Science approach to analyze complexity in Health domains, in order to provide deep understanding of Health phenomena, suitable to support decision making at diferent levels, from individual patients, to Health policies at International level, including treatment protocols as well. Similar methodologies combining specific domain knowledge and data that have been successfully applied to real cases will be introduced. The session will provide a methodological overview as well as a perspective of the kind of impact in Health domains that can be achieved by means of these methdologies. Especial atention is required to postprocessing of data-driven models in such a way that Health experts can properly rely on discovered patterns for an effective decision support. The session will present some real applications to the development of an intelligent recommender for personalized diets (Diet4you project) from a holistic perspective, the identification of response patterns to a neurological treatment to support the design of treatment protocols (developed with Guttmann Institute in Badalona (Spain)), or the induction of a typology of Mental Health Systems in Low and Middle Income countries to support the design of development and intervention plans (developed for the World Health Organization), among others.


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