sheldon

smart habitat
for the elderly

First sheld-on conference meeting
Proceedings Book

Riga 10th October 2018

cost
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme
of the European Union

sheldon
smart habitat
for the elderly

Cost action CA16226
Indoor living space improvement: Smart Habitat for the Elderly

Sheldon
Furniture, Habitat, Active and Healthy Ageing, ICT, Healthcare

Proceedings of the first COST Action CA16226 conference
meeting Riga, Latvia 10th October 2018

Edited by Jake Kaner, Petre Lameski, Signe Tomsone,
Michael Burnard, and Francisco Melero.
Graphic design: beardman.design
Organized by Riga Stradiņš University
All Proceedings have been reviewed

The Organizers would like to acknowledge the scientific committee of
the first COST action CA16226 Sheldon Conference meeting:

Signe Tomsone – Latvia
Petra Maresova - Czech Republic
Jake Kaner – United Kingdom
Rafael Maestre – Spain
Petre Lameski - fYR Macedonia
Michal Issacson – Israel
Kuldar Taveter – Estonia
Levente Dénes – Hungary
Nuno Garcia – Portugal
Ciprian Dobre – Romania
Georgios Ntalos – Greece
Carlos Valderrama – Belgium
Michael Burnard – Slovenia
Francisco Melero – Spain

RĪGA STRADIŅŠ
UNIVERSITY

CentroTecnológico
del Mueble y la Madera
de la Región de Murcia

CETEM

Preface

We are pleased to welcome you to the first international conference of COST Action CA16226: "Indoor living space improvement: Smart habitat for the elderly" (SHELDON). This conference, held in Riga, Latvia on October 10th, 2018, follows a year of joint work, short term scientific missions, and networking. It is the first SHELDON organised event where participants will share their work over the past with each other. Researchers and practitioners working in habitats and furniture, ICT tools, services, and devices, and health care for older adults will come together to discuss, to share, and to learn from one another. We hope the conference provides an opportunity to build new collaborations between the working groups, to extend both the fundamental and applied research work through multidisciplinary cooperation that ensures stakeholder needs are addressed. Through these activities, SHELDON will contribute to healthy, active, safe, and sustainable environments for older adults that allow them to live independently and with dignity.

The needs of an ageing population extend beyond the border of any country or region and are truly a global concern. Together, SHELDON participants will advance the state of the art to refine, innovate, and create new solutions that drive global change that increase the wellbeing of older adults, that support their caretakers, and that ease the socioeconomic concerns related to ageing.

The first conference of the SHELDON COST Action will allow us to strengthen our network, find joint interests, and further define the activities we will cooperate on over the coming years. We hope that all attendees take advantage of the degree of expertise present, engage, and challenge each other.

We are convinced our first conference will be a successful event that broadens our network, results in new collaborations, and builds lasting friendships within the SHELDON network.

On behalf of the core group,

Mike Burnard, Vice-Chair
Francisco Melero, Chair

sheldon
smart habitat
for the elderly

Index

Working Group 1 Proceedings

Furniture & Habitat Industries

Leader: Prof. Jake Kaner (UK)
Vice-Leader: PhD. Rafael Maestre (ES)

First sheld-on conference meeting
Proceedings Book

Bringing nature indoors: Design and development of indoor living spaces in harmony with nature for active and healthy ageing in urban environments

Vladan Djokić[1], Jelena Ristić Trajković[2], Ana Nikezić[3], Milena Kordić [4]

[1-4] University of Belgrade Faculty of Architecture,
Bulevar kralja Aleksandra 73/II, Serbia,

[1] vdjokic@arh.bg.ac.rs;

[2] jelena.ristic@arh.bg.ac.rs;

[3] ana.nikezic@arh.bg.ac.rs;

[4] milena.kordic@gmail.com

Keywords:
dwelling of elderly, well-being, architecture design, interior design, urban areas

cost
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme
of the European Union

The focus of this research is improving well-being and happiness of the elderly in terms of design and development of their indoor living spaces in harmony with nature. Multiple scientific studies have pointed out on the benefits and importance of nature for people, and especially for children and older populations. These benefits (increased participation in physical activities, improved mental health and cognitive function and an increase in social interaction) found through access to nature are key ingredients to well-being during ageing. As our population ages rapidly, and at the same time, the majority of people live in cities since urbanization is continuing worldwide, it is important to provide and foster re-connection with nature for the senior members of our communities. Today's cities suffer from many health and environmental problems. In recent years the growing awareness of sustainability and climate change issues make it even more apparent that bringing nature into our homes is essential.

Bringing nature indoors causes people to feel happier, healthier, calmer, and at the same time more energetic and optimistic about their lives. Natural environments also help to improve sleeping patterns, reduce pain, speed up recovery and even increase longevity. Nature, with all its elements, has a great power on a human body. It can make that we feel in harmony with the surrounding environment, and above all welcomed into a space. The biophilia hypothesis suggests that there is an innate connection between humans and nature and that people tend to show a positive response when they experience a connection with nature. It states that since humans originated from savannah-like environments they have "the urge to affiliate with other forms of life". When connected with nature and natural systems, humans can feel more emotionally content, and this has the potential to increase their life span.

How can we design an extension of nature in indoor living spaces for elderly? There are many inspiring ways to bring nature into homes: nature-based solutions, using of natural materials; plants– live walls, vertical walls etc.; natural elements; outdoor colours; views & light; etc. Design of spatial relations between outdoor and indoor spaces is also very important for the quality of indoor space. Even visual perception of nature, looking out a window into a garden or forest or viewing pictures of nature, can contribute to mental benefits that are especially significant for older inhabitants. All the above mentioned, called Biophilic design, is the design of spaces in a manner that promotes and encourages the interaction of humans with nature and natural systems.

This research deals with different design strategies, principles, scales, concepts and patterns of biophilic design for elderly people, as well as their different benefits for health and well-being, with the aim of improving the design of dwelling environments in urban areas. The research also stimulates further discussions about the question of how bringing nature indoor

through design (of interior/ architectural spaces, furniture) can improve the well-being of elderly, and how these can enable them to undertake activities that contribute to their we-ll-being. It means creating a sensitive and responsive design that highlights a) visual connection to nature, b) pulpability and soundness of the nature and c) nurturing a sense of place, a community in which the role of aesthetics is crucial for behavioural change.

References

- *Berto, R. 2007. Assessing the Restorative Value of the Environment: A Study on the Elderly in Comparison with Young Adults and Adolescents. International Journal of Psychology, 42 (5), 331-341.*
- *Browning, W., Ryan, C. and Clancy, J. 2014. 14 Patterns of biophilic design. Improving health & well-being in the built environment. New York: Terrapin Bright Green*
- *Frumkin, H. 2008. Nature Contact and Human Health: Building the Evidence Base. In: S.F. Kellert, J.H. Heerwagen, & M.L. Mador (Eds.). Biophilic Design (115-116). Hoboken, NJ: John Wiley & Sons.*
- *Hartig, T. 1993. Nature Experience in Transactional Perspective. Landscape and Urban Planning, 25, 17-36.*
- *Heerwagen, J.H. & Hase B. 2001. Building Biophilia: Connecting People to Nature in Building Design. US Green Building Council. Posted March 8, 2001. Web. 19 July 2018.*
- *Heerwagen, J.H. 2006. Investing In People: The Social Benefits of Sustainable Design. Rethinking Sustainable Construction. Sarasota, FL. September 19-22, 2006.*
- *Hosey, L. 2012. The Shape of Green: Aesthetics, Ecology, and Design. Washington, DC: Island Press.*
- *Joye, Y. (2007). Architectural Lessons From Environmental Psychology: The Case of Biophilic Architecture. Review of General Psychology, 11 (4), 305-328.*
- *Kellert, S. R, Wilson, E. O. 2013. The biophilia hypothesis. Washington, DC: Island Press.*
- *Ryan, C.O., W.D. Browning, J.O. Clancy, S.L. Andrews, & N.B. Kallianpurkar. 2014. Biophilic Design Patterns: Emerging Nature-Based Parameters for Health and Well-Being in the Built Environment. Archnet International Journal of Architectural Research, 8 (2), 62-76.*
- *Skedung, L., Rawadi, C. El., Arvidsson. M., Farcet, C., Luengo, G. S., Breton, L. & Rutland, M. W. 2018. Mechanisms of tactile sensory deterioration amongst the elderly. Scientific Reports Volume 8, Article number: 5303*
- *Sternberg, E.M. 2009. Healing Spaces. Cambridge: Bleknap Harvard University Press*
- *Van den Berg, A.E., Hartig, T. & Staats, H. 2007. Preference for Nature in Urbanized Societies: Stress, Restoration, and the Pursuit of Sustainability. Journal of Social Issues, 63 (1), 79-96.*

Acknowledgments

This paper was written as a part of the projects "Research and systematization of housing development in Serbia in the context of globalization and European integrations for the purpose of improving housing quality and standards" (TR36034), "Studying climate change and its influence on the environment: impacts, adaptation and mitigation" (43007), financed by the Ministry of Education and Science of the Republic of Serbia and COST Action CA16226 Indoor living space improvement: Smart Habitat for the Elderly.

Measurement of elderly people preference and acceptance of natural materials with wearable sensors

Agnieszka Landowska[1], Anna Sandak[2,3,4], Jakub Sandak[2,3,4]

1 Gdansk University of Technology, ETI Faculty, Narutowicza 11/12, Gdansk, Poland, nailie@pg.gda.pl

2 InnoRenew CoE, Livade 6, 6310 Izola, Slovenia, anna.sandak@innorenew.eu, jakub.sandak@innorenew.eu

3 CNR-IVALSA, via Biasi 75, 30010 San Michele all'Adige, Italy, anna.sandak@ivalsa.cnr.it

4 University of Primorska, Faculty of Mathematics, Natural Sciences and Information Technology, Glagoljaska 8, 6000 Koper, Slovenia

Keywords:
wood, sensory experience, physiology, human experience observation

First sheld-on conference meeting. Riga, October, 10th 2018. **Proceedings Book**

Funded by the Horizon 2020 Framework Programme of the European Union

This abstract reports selected results of a semi-experiment on human sensory experience of wood and wood-like materials. The goal was to determine, whether it is possible to spot a difference in user experience with diverse materials and whether observation channels capture process interferes with the measured user experience.

The experimental design of the study could be summarized with the following assumptions:

- participant is requested to recognize wood in wooden and non-wooden sample set, using senses of sight and touch separately and in a combination;
- 12 samples: 4 samples for touch, 4 samples for sight, 4 samples for touch-sight combination;
- samples selection based on questionnaire-based wood detection test (including obvious and tricky choices);
- recording of the following input channels: camera for facial expressions analysis, physiological signals set: skin conductance, blood-volume pulse, respiration, peripheral temperature, electromyography of trapesius muscle, EEG;
- independent variable: type of material;
- dependent variable: physiological reaction signals, facial expression;
- confounding variables: knowledge on material type.

The experiment was held at CNR-IVALSA, Italy under STSM of the COST Action CA16226 SHELD-ON. Participants were recruited among IVALSA employees and their families. Participant characteristics: 9 people, age: average 45 (±13), 2 of them above 60 y.o., sex: 3 female, 6 male, expertise: 7 wood experts, 2 non-experts; dominant hand: right (9/9).

The input channels were evaluated on the following criteria: is intrusive - the degree of the input channel capture is influencing the experience values measured (based on subjective participant opinion); is robust - the level of the user experience procedure interfering with input channels capture; is informative - whether the channel differentiated modes and sample types.

Analysis of the results obtained in the study allowed to reveal some preliminary observations on using the input channels for observation of human experience with materials, which are reported in Table 1.

Input channel	Intrusive	Robust	Informative	Remarks
Face expressions (video)	No	No	No	Camera location is crucial, as face angle changes while looking at samples.
Skin conductance (fingers)	No	Yes	Yes	-
Peripheral temperature	No	Yes	No	Features were not differentiating materials
BVP				
Heart Rate	No	Yes	No	Time-domain parameters
BVP Heart rate variability	No	Yes	Yes	Frequency domain parameters
Electromyography (trapesius)	No	No	Yes	Moving/touching samples significantly disturbed the channel
Respiration (thorax and abd.)	No	Yes	Yes	Both locations are advisable.
EEG	Yes	No	?	Only recorded for 3 participants. The equipment used was hard to adjust and highly intrusive.

Table 1: Summative evaluation of observation channels in monitoring user experience with materials

The study could be concluded with the following statements:

- Camera-based observation was not intrusive for participants. Physiological sensors, that were placed on non-dominant hand, thorax and abdomen and on trapesius muscles were also considered as almost non-intrusive. EEG helmet was intrusive.
- Facial expressions channel was problematic due to location of the camera. Automatic emotion recognition is very sensitive to illumination, camera angle and face occlusions (glasses, beard, moustache etc.).
- EMG signal measured on trapesius was disturbed by moving and touching samples, perhaps it would be more advisable to consider an alternative location on facial muscles.
- Some physiological signals were able to differentiate user experience with different samples.

The procedure indicates, that there is a significant effort should be put into finding non-intrusive ways of monitoring human experience, including non-invasive sensor locations. EEG-based solutions were not exhaustively explored and require further studies. The proposed procedure, with minor simplifications and modifications, might be used in further studies on human experience with diverse materials.

Acknowledgments

Study was supported by EU COST Action SHELD-ON Smart habitat for the Elderly, DS Funds of ETI Faculty, Gdansk University of Technology and BIO4ever project RBSI14Y7Y4 funded by MIUR.

Modified wood and psychological well-being

Dean Lipovac[1], Michael D. Burnard[2], Andreja Kutnar[3]

1 InnoRenew CoE, 6310 Izola, Slovenia; dean.lipovac@innorenew.eu

2 InnoRenew CoE, 6310 Izola, Slovenia; University of Primorska, Andrej Marušič Institute, Muzejski trg 2, 6000 Koper, Slovenia; mike.burnard@innorenew.eu

3 InnoRenew CoE, 6310 Izola, Slovenia; University of Primorska, Andrej Marušič Institute, Muzejski trg 2, 6000 Koper, Slovenia; andreja.kutnar@innorenew.eu

Keywords:
wood modification, evaluation, perception, well-being, health

First sheld-on conference meeting. Riga, October, 10th 2018. **Proceedings Book**

Funded by the Horizon 2020 Framework Programme of the European Union

Visually and tactilely pleasant materials help create healthy indoor environments which have a positive influence on psychological well-being. When people are in contact with materials they prefer, their emotional and physiological functioning tends to improve (Demattè et al. 2018, Ikei et al. 2017). Beneficial effects of healthy materials could be especially valuable to older adults who spend a considerable amount of time indoors. Wood is generally one of the preferred materials that can lead to improvement in human well-being (Burnard and Kutnar 2015). In recent years, wood modification processes became increasingly popular, since they improve many mechanical (and other) properties of wood (e.g., dimensional stability) (Sandberg et al. 2017). However, modification processes also change visual and tactile characteristics of wood (Bakar et al. 2013) which play an important role in the general evaluation of materials by laypeople (Bhatta et al. 2017). Since the use of modified wood is likely to increase over time, it is important to know how this material is perceived and evaluated by the end-users. To gain insight into this matter, we prepared six cylindrical handrail samples created from unmodified spruce, unmodified pine, acetylated radiata pine, thermally modified spruce, thermally modified pine, and stainless steel (Fig. 1).

Figure 1: The handrail samples used in the study.

50 persons over the age of 65 were presented with all six samples in random order twice, first to assess by touch only, and again to evaluate by touch and vision combined. In both conditions, the participants rated the samples on a semantic differential scale which consisted of sensory (e.g., rough-smooth) and evaluative (e.g., like-dislike) pairs of descriptors. After these two tasks, the participants were presented with all six samples at once to simultaneously see and touch and ranked them from most to least preferred.

The results suggest that modified wood is perceived and evaluated similarly to untreated wood in both conditions (tactile and tactile-visual), while stainless steel is seen as considerably different than all types of wood. In both tasks, all samples of wood were generally perceived as warm, natural, and liked, while the steel was rated as cold, artificial, and less liked. The same handrail samples were rated similarly between the tactile and tactile-visual task, which

suggests that touch plays an important role in the perception and evaluation of materials. Handrails created from modified wood were generally given higher preference rankings than those manufactured from untreated wood (Table 1).

	Spruce	Pine	A.Pine	T.M.Pine	T.M.Spruce	Steel
Ranka	6	3	2	4	1	5

aThe final rank was calculated by summing all responses and reranking based on the totals

The results indicate that the tactile and visual properties of modified wood are evaluated favourably among older adults. These findings encourage the use of modified wood in creating healthy indoor environments.

References

- *Bakar B. F. A., Hiziroglu S., Tahir P. M. 2013. Properties of some thermally modified wood species. Materials & Design, 43: 348–355*
- *Bhatta S. R., Tiippana K., Vahtikari K., Hughes M., Kyttä, M. 2017. Sensory and emotional perception of wooden surfaces through fingertip touch. Frontiers in Psychology, 8: 367*
- *Burnard M. D., Kutnar A. 2015. Wood and human stress in the built indoor environment: a review. Wood Science and Technology, 49, 5: 969–986*
- *Dematte M. L., Zucco G. M., Roncato S., Gatto P., Paulon E., Cavalli R., Zanetti, M. 2018. New insights into the psychological dimension of wood–human interaction. European Journal of Wood and Wood Products, 76, 4: 1093–1100*
- *Ikei H., Song C., Miyazaki Y. 2017. Physiological effects of wood on humans: a review. Journal of Wood Science, 63, 1: 1–23*
- *Sandberg D., Kutnar A., Mantanis G. 2017. Wood modification technologies - a review. iForest, 10: 895–908*

Acknowledgments

The authors gratefully acknowledge the European Commission for funding the InnoRenew CoE project (Grant Agreement #739574) under the H2020 Widespread-Teaming programme and Lulea University of Technology for providing the wood samples.

Positive role of Technical solutions in Social inclusion of the elderly

Karel Schmeidler

Vysoka škola technicka a ekonomicka, Českе Budějovice, Czech Republic, Ka1@seznam.cz

First sheld-on conference meeting. Riga, October, 10th 2018. **Proceedings Book**

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

Demographic trends indicate a marked rise in the number of elderly people in the urban population and there is a high correlation between their age and disability. The share of elderly people in the total population is expected to rise from 21% in 2000 to around 31% by the year 2020 and to around 34% by the year 2050.

Due to demographic changes older and disabled people represent a significant and permanent growing part of the Czech population. Disabled people represent around 13% of the nation. Problems of social exclusion in connection to ageism arise.

There has been a progressive increase over the past decade in the social awareness of the requirements for older and disabled people throughout the Czech Republic and other parts of Central Europe. This progression has moved from making provision for older and disabled people on a welfare-oriented basis, towards increasingly equal access to all facilities as a matter of human rights. Improving access to any form of travel will provide additional social, as well as economic benefits at personal, governmental and commercial levels.

Czech policy regarding the elderly aims at maintaining their active life and mobility. This is a central element of their integration in society. Senior citizens want to enjoy a good life with many activities like travel, tourism and mobility and want to stay autonomous and independent as far as possible. Without the possibility to maintain mobility, senior citizens cannot lead an independent life, with many other problems, such as isolation and health problems as a consequence. Various initiatives recognize the needs of elderly people. With changing attitudes and conditions the desire to travel for social activities, medical care and leisure represents a potential major new source of ideas for travel providers, urban planners, car, IVIS and ADAS designers and producers. We have used a procedure to recommend that helps understand existing problems of senior citizens.

Many needs only become transparent if appropriate methods of research are used. In the case of our projects, a combination of qualitative, quantitative and heuristic methods was chosen.

Relevant questions were discussed and elaborated together with the target groups. The results of the project work were critically reviewed by scientists, representatives of senior citizens' organizations, as well as by decision makers and practitioners of various disciplines at workshops, conferences and mobility planning in the Czech Republic and other European countries.

The unit layout as a system and its effect on the QOL and behavior of the residents in long term care nursing homes creating a new tool for measuring, evaluating and comparing different building layouts

Yifat Rom

Institute of Technology, Haifa and Department of Gerontology, University of Haifa, Israel

Keywords:
environmental gerontology, long-term care facilities, layout typology, Quality of Life, Architecture

cost
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

The importance of the physical environment is increasingly recognized as a key component in influencing the quality of life and the behavior of residents living in nursing homes (Chaudhury, Cooke, Cowie, & Razaghi, 2017)(Garre-Olmo et al., 2012)(Parker et al., 2004). There is a large body of literature on the impact of the physical environment of dementia care settings. Researchers have been focusing on understanding the effect of the environmental components in the long term nursing homes ((Elf, Nordin, Wijk, & Mckee, 2017) (Parker et al., 2004)) on different aspects of quality of life (Lawton, 1991)(Verdugo, Gómez, Arias, Navas, & Schalock, 2014)(Wang, Schalock, Verdugo, & Jenaro, 2010). Design guides typically offer "hypotheses" for how the spatial organization and appointment of the physical environment may promote well-being for people with dementia (K., D., & C., 2000). Recent comprehensive literature review (Chaudhury et al., 2017) highlighted the influence of unit size, spatial layout, homelike character, sensory stimulation, and specific spaces (i.e., dining, bathing, and outdoor spaces) on residents' behaviors and well-being in care facilities and stresses the importance of the physical environment to be appropriate and responsive to the cognitive abilities and functioning of people living in nursing homes.

Addressing the unit configuration as a whole and as a system can play a key role in residents' quality of life and behavior as well. Literature approaching the Unit configuration relate mainly to orientation and to the ability navigate independently in the given environment. Unfortunately, these researches are contradictory and confusing. (Marquardt & Schmieg, 2009) (K. et al., 2000)(Schmieg 2009). There is no literature on the aspect of the unit layout as a system and its effect on the QOL and behavior of the residents. Addressing the layout as a system claims that every component might affect or be affected by other physical components, and at the same time, when we address the unit as a system we need to acknowledge that a good physical environment alone cannot create the seeked milieu. The potential of an appropriate physical setting is meaningfully utilized only when there is a corresponding recognition of all systems components that include people who are involved: the residents, the staff (especially caregivers) and the family. Furthermore, the perceptions of residents, staff, aides, and families differ when it comes to defining quality of life. Residents' perceptions of quality of life primarily focused on their morale or attitude. On the other hand, staff members, aides, and family members defined quality of life primarily in terms of care. It is therefore possible that the staff opinions reflect what is best for residents as a group rather than for the specific individual (Birren et al., 1991). For example: it has been found that family visitation is correlated with residents morale and on the other hand it can be very stressful for the staff or it can help the staff by downloading some of the staffs workload. Therefore Creating an environment which will enhance family visitation (components like appropriate

meeting areas, the right location of entrance as well as other physical components), might improve the residents quality of life ad change staffs satisfaction and performance.

The absence of knowledge about the physical layout highlight the need for an appropriate tool that will help measure, evaluate, compare or differ different building layouts. The goal of this paper is to create a new methodology that will define layouts of nursing homes and divide them into different typologies. In order to create these typologies, all the units of the nursing homes need to have the same guidelines with the same building components (with the minimum area required). In Israel, all nursing homes are controlled and authorized by the Israeli Ministry of Health; therefore, all nursing homes follow the same guidelines. Most components are obliged to be located in the same unit, and all the units' components must be located in the same floor. There are a few components that can be shared by three nursing home units, therefor external to the specific unit, and can be located anywhere in the building (mostly administrative and para-medical facilities) To create the typologies we aim to analyze the nursing home unit layouts in four main dimensions: the existence/or shared components, the area of each component (especially compared to the minimum size required, walking distances, and the floor layout-proximities taking into account the previous findings (size and distances).

In this COST meeting, we intend to share our new knowledge and display the results based on a preliminary search that was conducted in eight different nursing home units.

References

- *Birren, J. E., Lubben, J. E., Rowe, J. C., Deutchman, D. E., University of California, L. A. M. D. of G. M. and G., Jewish Homes for the Aging of Greater Los Angeles., & Anna and Harry Borun Center for Gerontological Research. (1991). The concept and measurement of quality of life in the frail elderly. Academic Press.*
- *Chaudhury, H., Cooke, H. A., Cowie, H., & Razaghi, L. (2017). The Influence of the Physical Environment on Residents With Dementia in Long-Term Care Settings: A Review of the Empirical Literature. The Gerontologist, 00(00), 1–13.*
- *Elf, M., Nordin, S., Wijk, H., & Mckee, K. J. (2017). A systematic review of the psychometric properties of instruments for assessing the quality of the physical environment in healthcare. Journal of Advanced Nursing, 73(12), 2796–2816.*
- *Garre-Olmo, J., López-Pousa, S., Turon-Estrada, A., Juvinyà, D., Ballester, D., & Vilalta-Franch, J. (2012). Environmental determinants of quality of life in nursing home residents with severe dementia. Journal of the American Geriatrics Society, 60(7), 1230–1236.*

- *K., D., D., C., & C., S. (2000). The therapeutic design of environments for people with dementia: A review of the empirical research. Gerontologist, 40(4), 397–416.*
- *LAWTON, M. P. (1991). A Multidimensional View of Quality of Life in Frail Elders. In The Concept and Measurement of Quality of Life in the Frail Elderly (pp. 3–27). Elsevier.*
- *Marquardt, G., & Schmieg, P. (2009). Dementia-Friendly Architecture: Environments That Facilitate Wayfinding in Nursing Homes. American Journal of Alzheimer's Disease & Other Dementiasr, 24(4), 333–340.*
- *Parker, C., Barnes, S., McKee, K., Morgan, K., Torrington, J., & Tregenza, P. (2004). Quality of life and building design in residential and nursing homes for older people. Aging and Society, 24(6), 941–962.*
- *Verdugo, M. A., Gómez, L. E., Arias, B., Navas, P., & Schalock, R. L. (2014). Measuring quality of life in people with intellectual and multiple disabilities: Validation of the San Martín scale. Research in Developmental Disabilities, 35(1), 75–86.*
- *Wang, M., Schalock, R. L., Verdugo, M. A., & Jenaro, C. (2010). Examining the Factor Structure and Hierarchical Nature of the Quality of Life Construct. American Journal on Intellectual and Developmental Disabilities, 115(3), 218–233.*

Working Group 2 Proceedings
ICT developments

Leader: Petre Lameski (MK)
Vice-Leader: Kuldar Taveter(EE), Michal Isaacson (IL)

First sheld-on conference meeting
Proceedings Book

Ageing in digital environment

Lilia Raycheva

The St. Kliment Ochridsky Sofia University, Bulgaria,

lraycheva@yahoo.com

Keywords:
ageing, digitization, communication, media and information literacy

First sheld-on conference meeting. Riga, October, 10th 2018. **Proceedings Book**

cost
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme
of the European Union

Contemporary societies are undergoing significant social, economic, cultural, and political changes, which correlate with the dynamic developments of the digital communications. No matter how positive the impact of ICT applications and media developments on progress in all areas of life might be, it is no less true that they pose challenges to the social stratification of society. The different speed, extent, and level of utilizing the digital competence by the different layers of the population determine the need to update the mechanisms for accessing, using and perceiving information disseminated online. Therefore, media and information literacy programs acquire additional importance in today's habitat.

Population ageing and the development of modern communication environment are two interlinked processes. The trends of demographic crisis determine the need for urgent prevention of digital generation divide, i.e. of the vulnerability and the social exclusion of older people from the ICT world. In order to deal with the challenges to population ageing, it is important to analyze how these issues are presented in the media ecosystem, and to seek information on the current good practices and deficits regarding digital communication and older adults.

The demographic trends display the growing percentage of the aged population. Although it is expected that the overall population of the European Union will grow to 532 millions by 2060, the population in nearly half of the member states (Bulgaria, Croatia, Germany, Greece, Estonia, Hungary, Latvia, Poland, Portugal, Rumania, Slovakia, Slovenia, and Spain) will decrease. The prognoses show also that the ratio of people above 65 years to those between 15 and 64 will increase from 27.8% to 50.1% (European 2015).

Despite these forecasts, the amount of attention devoted to older people is still not proportionate to the challenges they face in the modern world. The active efforts to promote the adoption of a special Convention on the Rights of Older Persons by the UN have not been successful so far. Although many UN and EU institutional documents related to technology, business models and the editorial responsibility of the media have been adopted, the multi-faceted attitude at older people as objects of coverage and as subjects of the communication process have still not been treated effectively.

The Active Ageing Index (AAI), jointly developed in 2012 by the United Nations Economic Commissionn for Europe and the European Commission is a key monitoring tool for policy makers to enable them to devise evidence-informed strategies in dealing with the challenges of population ageing and its impacts on society. The Index is built on four domains: employment;

participation in society; independent healthy and secure living; capacity and enabling environment for active ageing. Among the six factors of the fourth domain are use of ICT, social contacts and educational attainment. Two Nordic countries, namely Sweden and Denmark, come at the top of the overall ranking across EU Member States. In contrast, the majority of the Central and Eastern European countries, as well as Greece, is at the bottom of the ranking and need further improvements (Active 2012).

The demographic shifts may have a dramatic impact on consumers' expectations from media and communication industries, as well for their ICT literacy and skills while navigating the digital world. Thus, the habits of the millennials (the generation born between 1981 and 1997) differ from those of the older adults (55+). The demand for technology services that offer convenience, memorable experiences and instant access to content anywhere and anytime by the younger population is often juxtaposed to the preferences of the older people for health and wellness, entertainment and education services designed especially for them. Contemporary media ecosystem requires not only e-reading and e-writing practices but also e-producing talents and e-disseminating skills.

Regarding the well-being of older people in the contemporary digital media and communication environment some significant tendencies can be outlined:

- legally: there is a general insufficiency of legal instruments to provide reliable regulatory mechanisms for a more adequate media coverage of older people's life;
- technologically: the dynamic progress of ICTs poses significant challenges to media consumption and digital usage by the older population;
- economically: decreased economic interest in topics related to older people is a serious challenge to the process of their social integration and quality of life;
- socially: the contemporary ICT based environment has an ambivalent impact on media consumption. Older people can be both consumers and creators of content, and moreover, they can mutually socialize with one another.

Prejudices and negative stereotypes are among the major current challenges relative to the life of the ageing population in the modern information and communication environment. Identifying the ways in which these prejudices may be effectively overcome will help to prevent vulnerability and to neutralize the rise of barriers to the full participation of older people in socio-cultural processes.

References

- *European Commission. 2015. The 2015 Ageing Report. Economic and budgetary projections for the 28 EU Member States (2013-2060).*
- *Active Ageing Index (AAI). 2012.*

AmICare: a low-cost AAL solution and its deployment

Rafael Maestre-Ferriz[1], Andres L. Bleda-Tomas[2], Miguel Ángel Beteta-Medina[3], Jose Arturo Vidal-Poveda[4]

[1-4] Electronics and Home Automation Department Technologic Centre of Furniture and Wood (CETEM) Yecla (Murcia), Spain

[1] r.maestre@cetem.es

[2] al.bleda@cetem.es

[3] ma.beteta@cetem.es

[4] a.vidal@cetem.es

Keywords:
AAL, WSNs, Ubiquitous Computing, Non-intrusive monitoring, Caregiving

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

Introduction

In recent years, nodes of WSNs including sensing, wireless communications and modest computation capabilities have become an affordable commodity with low power and size requirements making it possible to perform non-intrusive (or transparent) monitoring by the integration into everyday objects. WSNs can be connected to cloud services contributing to the expansion and progression of ambient intelligence systems, not only in static elements, but anywhere and everywhere.

The Ambient Intelligence for Supporting Caregivers system (AmICare) has been developed by CETEM and is based on the pervasive or ubiquitous computing paradigm, where sensor nodes can be integrated into common home items (like furniture pieces) hidden from users and ubiquitously distributed in the home. Its main goal is to provide caregivers with valuable information about the elderly (or disabled people) behaviour, monitoring their resting time and detecting any unexpected user behaviour (e.g. getting out of bed at unexpected times).

Compared to other solutions, one of its key advantages lays on its simplicity along with its ease of deployment and maintenance, all of which translates into a low total cost of ownership. No wearable device is required and it can be integrated not only in private homes, but it scales up very well to bigger environments such as nursing homes, residences, hospitals or any kind of caregiving facility. Any user with an internet-capable device within the same Wi-Fi network can access the server, configure alert generation rules for each resident and quickly receive notifications if these alerts are triggered.

In this paper, the system and its deployment in an intellectual disabled residence are described.

System Description

Our system has been designed around a local server (HTTP Apache) and database (MySQL) implemented in a Raspberry pi 3 (model B+) which acts as a central node of the WSN. The complete system works under the same local network, which prevents unwanted accesses from outside the network.

The database stores information about the system users or caregivers (user/password, user ID), as well as the residents or client (name, idClient, room and bed). It also stores sensor data with the time-date information and its corresponding resident. Finally, it stores the alerts that have been triggered (idClient, time-date, sensor type and value).

The node is made up of an electronic PCB that includes a processing unit and some sensors. The processing unit integrates all necessary devices for a full functional Wi-Fi node including an on-board antenna. The main processor is the CC3200 wireless microcontroller from Texas Instruments.

Even though the node could include a wide range of sensors, for the deployment in the disabled residence only three different sensors were chosen: a textile presence sensor for beds, accelerometer for detecting impacts and an ambient temperature sensor.

Caregiver Interface and Functionalities

Considering the input from caregivers, the interface had to satisfy some main requirements: attractive and user-friendly; run in the background; independent alert configuration and triggering for each resident; alerts noticeable but not too loud; alerts can be turned off by caregivers; access and visualisation of acquired data and historical data; access to the interface must be secure with a login process; system should be accessible from different kind of platforms. Finally, it was implemented as a web interface using PHP, which is very flexible and can meet all requirements.

The interface always starts with a "login or registration", after which a "main page" with six navigation tabs is reached. The "Home" tab presents a brief description of the system. The "Data" tab, the user can see the sensor data in a table and filter it per resident name, type of sensor, or time-date ranges. The "Users" tab allows the residence staff to enter the information of each resident name and her corresponding bedroom and bed. The "Alert" tab allows the residence staff to configure new alerts, as well as delete and check the status of triggered alerts. The "monitor" tab shows notifications of the entire facilities at a glance on top of its floorplan.

The system provides the following functionalities: absence or presence detection in bed; impacts or shocks detection; temperature room monitor; resting time monitor; configuration of personal alerts for each resident; tracking of attended/non-attended alerts; sound and visual alerts.

Real Deployment and Tests

A gradual deployment and testing procedure were carried out in three stages in order to minimise the impact on the everyday activities of the residence. Fist, three sensors were installed in three beds of a room, and tested for a complete month. This tested the system robustness

at a small scale, was used to identify bugs and interface improvements from users feedback. The second stage had an intermediate size (4 triple rooms or 12 nodes) and lasted for a month and a half. The final stage included all beds and rooms in the residence and has been working correctly for 3 months.

The caregivers' feedback has been quite positive: registration of residents is easy and can be double checked; absence/occupancy information is very useful during certain time periods; impact detection provides few alerts but no false one; temperature information can be useful in extreme weather conditions; resting time graphs are useful to detect sleep changes; individual alerts are necessary; tracking of alert status (attended or not) is very useful.

Acknowledgments

We thank all staff of the AMPY residence (Asociación de Minusválidos Psiquicos de Yecla) for their role in the collaborative development of requirements and the testing procedure of AmICare. The AmiCare system was an initiative supported by the "Obra Social La Caixa".

Design of software for active ageing

Nuno Pombo

Assisted Living Computing and Telecommunications Laboratory, Department of Informatics, Universidade da Beira Interior, Covilhã, Portugal

ngpombo@ubi.pt

Keywords:
software engineering, sensors, AAL, active ageing

First sheld-on conference meeting. Riga, October, 10th 2018. **Proceedings Book**

Funded by the Horizon 2020 Framework Programme of the European Union

Novel information and communication technologies create possibilities to change the future of care models towards a personalized healthcare. In line with this, Ambient Assisted Living (AAL) concepts may to provide ambient intelligence technologies to enable for example elderly people and chronic patients to continue to live in their preferred environments.

However, applying trained models from health data is challenging because the personalized environments could differ significantly than the ones which provided training data.

The present study focuses on dealing with modelling, and evaluation of an adaptable system; for heterogeneous scenarios emerged from the personalized healthcare, capable to select the most relevant information from multiple either data sources or sensors with the prediction accuracy in mind. In addition, the proposed system may offer a suitable and proficient user interaction independent of it experiences and technology literacy.

Facial expression recognition towards smart living environment for people with physical disabilities

Aleksandar Stojmenski[1], Boban Joksimoski[2], Ivan Chorbev[3], Petre Lameski[4], Eftim Zdraveski[5]

[1,5] University of Sts. Cyril and Methodius in Skopje, Macedonia, Faculty of Computer Science and Engineering

[1] aleksandar.stojmenski@finki.ukim.mk

[2] boban.joksimoski@finki.ukim.mk

[3] ivan.chorbev@finki.ukim.mk

[4] petre.lameski@finki.ukim.mk

[5] eftim.zdravevski@finki.ukim.mk

Keywords:
assistive technologies, smart home environment, 3D imaging, motor disabilities

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

In this paper, the possibilities and methods for using assistive technologies with focus on the people that cannot regularly control different aspects of their home environments are analyzed. A smart home environment platform for assisting people with physical disabilities to control devices in their home environment is presented. There are various types of disabilities which can affect people in different ways. Some of the types include intellectual, sensory, mental or physical disabilities. In this paper we focus on individuals with physical disabilities, because those people have difficulties in meeting their everyday needs at home without caregivers. Advances in technology [1, 2] have opened new ways to help support people with devices that can be used and configured by physically disabled individuals. Current smart home systems are implemented under a centralized architecture in which the electrical home devices are controlled by the home gateway which is the platform for service providing to the users of the system. Smart homes include electrical devices that control features of the home. Originally, smart home technology was used to control environmental systems such as lighting and heating, but recently almost every device in the home can be controlled by such systems. Smart home gateways does not simply turn devices on/off, they can monitor and react based on the environmental activities. Inputs to the gateways are usually mobile phones or smart home remote controls. We are providing an extension to the traditional smart home architecture to bring the smart living environment closer to people that have physical disabilities. The extended smart home environment control is set up with the usage of different gestures and facial expressions, which are customized for every user. Autonomous user control of essential devices using facial expressions or small hand movements is provided. The user can control doors, lights, heating, air conditioning, tv, radio and various other electronic devices. The electronic devices can be easily connected to the recognition system and controlled with wireless transmitters and receivers specifically designed for smart home environment control. Different triggers on the smart home devices can be configured with individually set up facial expressions. The facial expressions can be scanned individually or as a combination of more facial expressions to represent particular action on the smart home devices. For example, a user can configure the system to turn off the lights if he blinks three times in a row.

Four modules are included in the platform that enable end users of the system to complete everyday activities without additional assistance. 3D cameras [3] are used to capture facial landmarks and expressions to map the user intent into a specific action in the smart home environment. Actuators [4] are triggered to complete actions based on the detected and mapped facial expressions. The mapped expressions are autonomously configured by the user with the module for settings configurations and data entry, which uses specialized input de-

vices[5]. Qualitative and quantitative experiments were performed by individuals with disabilities for usability and acceptance evaluation of the extended smart living environment. In the experiments, mesurements for correctly recognized facial expressions and accuracy test of the mapping between different combinations of expressions were performed. As part of the qualitative analasys, interviews and surveys were conducted for evaluation of the usability and acceptance of the data entry and settings module. Those experiments contributed to provide guidelines for overall system enhancement, which are presented in this master thesis. In the future, the extended smart home environement will enable authonomius control of the home environement for individuals with other types of disabilities also.

Fine tuning is needed in the movement and expression recognition. The IRS (3D camera) module along with the RealSense and the Kinect 3D cameras is evaluated in series of facial expressions, not only one facial expression at a time. With this kind of evaluation, we tested the probability of mistake in the activation of the home device action when using multiple facial expressions at a row, for example, first blink one eye then open mouth and afterwards kiss in order to activate the turn on heating control

References

- *D. J. Cook, M. Youngblood, E. O. Heierman, K. Gopalratnam, S. Rao, A. Litvin, and F. Khawaja, "MavHome: an agent-based smart home," 2003, pp. 521–524.*
- *G. Demiris, M. J. Rantz, M. A. Aud, K. D. Marek, H. W. Tyrer, M. Skubic, and A. A. Hussam, "Older adults' attitudes towards and perceptions of 'smart home'technologies: a pilot study," Medical informatics and the Internet in medicine, vol. 29, no. 2, pp. 87–94, 2004..*
- *"Intel® RealSense™ Technology," Intel. [Online]. . [Accessed: 15-September-2018]*
- *"Home Easy Wireless Automation." [Accessed: 15-September-2018]*
- *G. Nussbaum, C. Veigl, J. Acedo, Z. Barton, U. Diaz, T. Drajsajtl, A. Garcia, K. Kakousis, K. Miesenberger, G. A. Papadopoulos, and others, "AsTeRICS-Towards a rapid integration construction set for assistive technologies," in AAATE Conference, 2011.*

Facial expression recognition: pair matching approach

Deniz Engin[1], Hazım Kemal Ekenel[2]

[1,2] Istanbul Technical University Istanbul, Turkey

[1] enginde@itu.edu.tr

[2] ekenel@itu.edu.tr

Keywords:
facial expression recognition, pair matching, local binary pattern, support vector machine

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

Abstract—In this study, we present a pair matching formulation for facial expression recognition. Our main purpose of this approach to be able to decide the facial expressions of two unlabeled facial images are the same or different. Match and mismatch facial expression pairs are created from two wellknown datasets: The Extended Cohn-Kanade dataset and the Japanese Female Facial Expression Database. To demonstrate our approach, the local binary pattern is applied for feature extraction from facial images and match/mismatch facial expressions are classified via support vector machines as a binary classifier. Results of binary classification are utilized to recognize the facial expression for each image by using controlled facial images with knowing facial expressions. Experimental results show that this approach improves facial expression results, especially when the limited data is available.

I. Introduction

Facial expressions play an essential role to understand human feelings and to be able to communicate and help them. Therefore, researchers have been concentrate on facial expression recognition by using mainly machine learning and computer vision algorithms. To be analyses of facial expression recognition, datasets can be mainly categorized into two types in terms of collecting environments: controlled and uncontrolled (wild) datasets. The controlled dataset consists of images which are collecting in basically lab environment with the same background and light conditions, whereas images of uncontrolled dataset belong to in everyday life in variations such as pose, illumination, occlusion and camera quality [1]. In addition, creating a controlled dataset is challenging to collect and label facial images of a specific person for different facial expressions, therefore this kind of datasets have fewer images. On the other hand, images can be easily collecting from the web for the uncontrolled dataset which contains lots of images, conversely, however annotation of these images requires so much effort [2]. In this study, we present a new pair matching problem for facial expression recognition to address these problems: (i) augmentation for small datasets, (ii) annotation for large datasets. To be able to assess this problems, we propose a baseline approach by utilizing local binary pattern as a feature extraction and support vector machines for classification on The Extended Cohn-Kanade Dataset (CK+) [3] and The Japanese Female Facial Expression (JAFFE) Dataset [4] which are commonly used for facial expression recognition in terms of controlled environment.

II. Methods

Facial expression analysis generally employs three steps: face alignment, feature extraction, and classification. Face alignment can be required to obtain frontal faces when there are different viewpoints in the dataset. Feature extraction methods are based on hand-crafted and

learned from data by using a neural network. Traditional machine learning algorithms such as support vector machine which is widely used and deep neural networks can employ for classification problems. In this study, the CK+ and the JAFFE datasets are used to evaluate the proposed method since both of them are controlled dataset and contain fewer facial images. Firstly, the facial images are aligned and cropped, and matched/mismatched pairs are generated. Local binary pattern (LBP) are used to extract features from each image, and differences of features for each pair are obtained via subtraction. The label of the differences of features is one for the matched pairs and zero for the mismatched pairs. Support vector machine (SVM) is applied as a binary classifier. Also, the principal competent analysis (PCA) is used to dimension reduction before the fed into features to SVM. Facial expression are recognized by utilizing pair matching results of each image pair.

III. Experimental results

Evaluation methods of FER system generally can be divided into two groups: cross-dataset approach and subjectindependent manner which has k-fold cross-validation and leave-one-subject-out (LOSO) approach to split dataset as a train and test sets. In this study, we utilized the leaveone- subject-out (LOSO) for only classification the facial expression without using pair matching and proposed pair matching approaches. Table I and Table II demonstrated that our proposed method increased the facial expression recognition. Performance comparison with our method and state-of-the-art methods can be shown in Table III and Table IV.

Methods	Accuracy (%)
Ours (Only Classification)	64.32
Ours (Pair Matching)	96.24

Table I: Our results on the JAFFE dataset.

Methods	Accuracy (%)
Ours (Only Classification)	90.21
Ours (Pair Matching)	92.35

Table II: Our results on the CK+ dataset.

Methods	Accuracy (%)
2D Inception-ResNet (5-fold) [5]	85.77
3D Inception-ResNet (5-fold) [5]	89.50
3D Inception-ResNet+landmarks (5-fold [5]	93.21
Inception-ResNet without CRF (5-fold) [6]	85.77
Inception-ResNet with CRF (5-fold) [6]	93.04
DTAN (10-fold) [7]	91.44
DTGN (10-fold) [7]	92.35
DTAGN (10-fold) [7]	97.25
DTGAN (8-fold) [7]	91.44
AUDN (10-fold) [8]	92.05
Going Deeper [9]	93.20
STM-ExpLet (10-fold) [10]	94.19
IACNN (8-fold) [11]	95.37
Ours (LOSO)	**92.35**

Table III: Performance comparison on the CK+ dataset in terms of seven expressions.

Methods	Accuracy (%)
Dahmane et al. [12]	85.65, 86.69
Buciu et al. [13]	90.34
Liu et al. [14]	91.80

Methods	Accuracy (%)
Ours (LOSO)	**96.24**

Table IV: Performance comparison on the JAFFE in terms of seven expressions.

IV. Conclusion

We introduced a pair matching formulation for facial expression recognition to be able to define whether the facial expression is the same or different for two facial expressions which belong to different persons. The advantages of this formulation, the amount of data for the controlled dataset can be increased and a large uncontrolled dataset can be labeled. Experimental results demonstrated that that pair matching formulation improves the accuracy of facial expression recognition.

References

1. *G. B. Huang, M. Ramesh, T. Berg, and E. Learned-Miller, "Labeled faces in the wild: A database for studying face recognition in unconstrained environments," University of Massachusetts, Amherst, Tech. Rep. 07-49, October 2007.*
2. *C. Fabian Benitez-Quiroz, R. Srinivasan, and A. M. Martinez, "EmotioNet: An accurate, real-time algorithm for the automatic annotation of a million facial expressions in the wild," in In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2016, pp. 5562–5570.*
3. *P. Lucey, J. F. Cohn, T. Kanade, J. Saragih, Z. Ambadar, and I. Matthews, "The extended cohn-kanade dataset (ck+): A complete dataset for action unit and emotion-specified expression," in In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition Workshops. IEEE, 2010, pp. 94–101.*
4. *[4] M. Lyons, S. Akamatsu, M. Kamachi, and J. Gyoba, "Coding facial expressions with gabor wavelets," in Automatic Face and Gesture Recognition, 1998. Proceedings. Third IEEE International Conference on. IEEE, 1998, pp. 200–205.*
5. *B. Hasani and M. H. Mahoor, "Facial expression recognition using enhanced deep 3d convolutional neural networks," arXiv preprint arXiv:1705.07871, 2017.*
6. *B. Hasani and M. Mahoor, "Spatio-temporal facial expression recognition using convolutional neural networks and conditional random fields," in IEEE International Conference on Automatic Face & Gesture Recognition, 2017.*
7. *H. Jung, S. Lee, J. Yim, S. Park, and J. Kim, "Joint fine-tuning in deep neural networks for facial expression recognition," in Proceedings of the IEEE International Conference on Computer Vision, 2015, pp. 2983–2991.*
8. *M. Liu, S. Li, S. Shan, and X. Chen, "Au-aware deep networks for facial expression*

recognition," in In Automatic Face and Gesture Recognition (FG), 2013 10th IEEE International Conference and Workshops on. IEEE, 2013, pp. 1–6.

9. *A. Mollahosseini, D. Chan, and M. H. Mahoor, "Going deeper in facial expression recognition using deep neural networks," in In Proceedings of the IEEE Winter Conference on Applications of Computer Vision (WACV). IEEE, 2016, pp. 1–10.*
10. *M. Liu, S. Shan, R. Wang, and X. Chen, "Learning expressionlets on spatio-temporal manifold for dynamic facial expression recognition," in In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2014, pp. 1749–1756.*
11. *Z. Meng, P. Liu, J. Cai, S. Han, and Y. Tong, "Identity-aware convolutional neural network for facial expression recognition," in In Automatic Face & Gesture Recognition (FG 2017), 2017 12th IEEE International Conference on. IEEE, 2017, pp. 558–565.*
12. *M. Dahmane and J. Meunier, "Prototype-based modeling for facial expression analysis," IEEE Transactions on Multimedia, vol. 16, no. 6, pp. 1574–1584, 2014.*
13. *I. Buciu, I. Pitas et al., "Ica and gabor representation for facial expression recognition," in Image Processing, 2003. ICIP 2003. Proceedings. 2003 International Conference on, vol. 2. IEEE, 2003, pp. II–855.*
14. *P. Liu, S. Han, Z. Meng, and Y. Tong, "Facial expression recognition via a boosted deep belief network," in In Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition, 2014, pp. 1805–1812.*

Feature and sensor selection for AAL

Eftim Zdravevski[1], Petre Lameski[1], Ivan Chorbev[1], Nuno Pombo[2], Nuno Garcia[3], Vladimir Trajkovik[1]

[1] University of Sts. Cyril and Methodius in Skopje, Macedonia, Faculty of Computer Science and Engineering

[4,5] Universidade da Beira Interior, Covilhã, Portugal

[1] eftim.zdravevski@finki.ukim.mk

[2] ngpombo@ubi.pt

[3] ngarcia@di.ubi.pt

Keywords:
Sensor selection, Feature selection, Ambient assisted living, Machine learning

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

Feature and sensor selection for AAL applications is a very important task, especially when trying to detect activities in daily living. The importance of the selection is elevated by the fact that not all sensors are always needed for every activity. Furthermore selecting the right features from the time series recorded by the sensors could lead to a better classification model when classifying the activities.

Another objective to have in mind is the quality of recognition when the system is deployed in a real-life environment. It is important to note that the sensors not always record and sometimes malfunction. In these scenarios we need to be able to have robust classification models especially when we want to detect life endangering activities and situations. Building fault tolerant models is another issue that needs to be addressed and for which the sensor selection has a major role.

In this paper we present some of the methods used for feature selection in order to build a better and more robust activity classification models and also will present methods for sensor selection and how to build fault tolerant models.

Higher education programme on building information modelling towards the development of smart environments for Seniors

Francisco José Melero[1], Michael Burnard[2], Petre Lameski[3], Ivan Chorbev[4], Lucía Gonzalez[5], Mar Olmo[6], Volker Koch[7], Gunther Woelfle[8], Karolina Plewniak[9].

1 Technical Research Centre of Furniture and Wood of the Region of Murcia, C/Perales S/N, 30510, Yecla, Spain, fj.melero@cetem.es.

2 University of Primorska, Titov TRG 4, 6000 Koper, Slovenia, michael.burnard@iam.upr.si.

3,4 Faculty of Computer Science and Engineering, University of Ss Cyril and Methodius in Skopje, Blvd Goce Delcev 9, 1000 Skopje, fYR Macedonia, [3]lameski@finki.ukim.mk, [4]ivan.chorbev@finki.ukim.mk

5,6 Fundación Ageing Social Lab, Avenida Andalucía, 3, 23005, Jaén, Spain, [5]lucia.gonzalez@ageinglab.org, [6]mar.olmo@ageinglab.org.

7 Department of Building Lifecycle Management, Karlsruhe Institute of Technology, Kaiserstrasse 12, 76131, Karlsruhe, Germany, volker.koch@kit.edu

8 buildingSMART e. V., Wiener Platz 6, 01069, Dresden Germany, gunther.woelfle@buildingsmart.de.

9 alfatraining Bildungszentrum e.K., Kriegsstrasse 100, Karlsruhe, Germany. karolina.plewniak@alfatraining.de.

Keywords:
BIM, AAL, Higher Education

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

The building and construction industry is an important part of the EU economy and society. It contributes to about 9% of the EU´s GDP and provides around 18 million direct jobs. It also creates high-skill jobs and investment in other industries that leads to further social and economic benefits (European Commission 2018). There are two important challenges to address in the sector. One is related to the increasing implementation of ICT tools, while the other is associated with a greater requirement of managerial and collective skills brought by the changing profile of the sector (Skills panorama 2014).

Building Information Modelling (BIM) is disrupting the sector. This tool provides all stakeholders with a digital representation of a building's characteristics throughout its entire life-cycle and thereby holds out the promise of large efficiency gains. BIM is being rapidly adopted, so it is critical for public bodies and industries that the sector maximises its value to deliver improved efficiencies and increased innovation in the management, design, construct and operation phases of a built asset (Poljanšek 2018). Training the current and incoming workforce is necessary to ensure effective adoption of BIM.

The demand of public and private environments adapted to the needs of older adults is expected to grow in the coming years. Despite living longer, EU citizens will spend too many years in old age in environments conceived for younger and healthier people, creating dependency, isolation and mental health problems (Tram et al. 2016). Being physical and social environments key determinants for people to remain healthy and autonomous into their old age (WHO 2002, WHO 2005).

The use of BIM in the design, construction and management of multifunctional indoor environments will greatly contribute to meet the requirements of Europe's ageing population while promoting healthy and safe ageing.

The main aim of ESSENSE (Education Supporting Smart Environments for Seniors) is to develop and implement a common curriculum and learning approach on BIM towards the design, construction and management of public and private environments for older adults that will meet the learning needs of Higher Education students. These will be relevant to the labour market and societal needs of an ageing society.

ESSENSE is a Strategic Partnership in the field of Higher Education comprised of Higher Education and Vocational Education and Training institutions, business associations and representatives of social enterprises, bringing varied expertise on teaching, BIM, project management, ICT, Smart Housing and AAL, where collaboration will be directed at significant societal challenges

ESSENSE will comprise the following activities and results:

- An analysis of the current situation and evolution of AAL within the BIM Method.
- An educational philosophy and joint curriculum having as a basis both the skills and competences required for the use of BIM tools for the design, construction and adaptation of environments for an active and healthy ageing.
- Didactic materials, tools and assessment methods.
- A Blueprint and the deployment of its respective action plan.

ESSENSE will offer innovative tools to HE students and experts from building-related fields that are aligned with the future needs of society and with the opportunities that the implementation of Smart Housing and AAL principles that BIM processes can bring. Furthermore, it will also raise awareness among authorities about the importance of aligning the educational programmes to societal needs and implementing these principles in educational and labour policies.

References

- *European Commision, Construction (accessed September 2018)*
- *Skills Panorama, Analytical Highlights, Focus on Construction. March 2014.*
- *Martin Poljanšek, BIM standardization. 2017.*
- *N. Tram & J. Wadoux, Working and Living: Age-friendly environments in EU. 2016*
- *WHO (2002), Active Ageing: A Policy Framework*
- *WHO (2005), Global Age-friendly Cities: A Guide*

Acknowledgments

ESSENSE (Ref 2018-1-DE01-KA203-004292) has been funded with support from the European Commission. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Erasmus+

Privacy and data security concerns toward home sensor technologies among the oldest old

Michal Isaacson

Department of Gerontology, Faculty of Social Welfare & Health Sciences, University of Haifa, Israel

misaacson@univ.haifa.ac.il

Keywords:
Privacy, Oldest old, Gerontechnology, Sensor technologies, smart home

First sheld-on conference meeting. Riga, October, 10th 2018. **Proceedings Book**

cost
EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

A multitude of different sensor technologies are available for assisting and keeping track of activities in the home environment. This study explores how these technologies can be used to improve the lives of older adults living independently in the community. Focusing on older adults' perceptions of privacy and data security in the context of a home monitoring system. In this study, non-invasive sensors readily available in the market were integrated into a simple user interface that was then introduced into study participants' homes. Following introduction of the system, study participants were interviewed by a team of researchers. The interview addressed questions as to how participants think that they can benefit from integrating sensor technologies into their home and which activities of daily living they perceive as beneficial if tracked. As well as focusing on privacy concerns and who they would like to share the information obtained by these sensors with and how the devices may affect their communication with other family members.

Privacy-aware and acceptable lifelogging services for older and frail people: the PAAL project

Francisco Florez-Revuelta[1], Susanna Spinsante[2], Martina Ziefle[3], Alex Mihailidis[4], Liane Colonna[5]

1 Dept. of Computer Technology, University of Alicante, Alicante, Spain, francisco.florez@ua.es

2 Dept. of Information Engineering, Marche Polytechnic University, Ancona, Italy, s.spinsante@staff.univpm.it

3 Human-Computer Interaction Center, RTWH Aachen University, Aachen, Germany, ziefle@comm.rwth-aachen.de

4 Dept. of Occupational Science & Occupational Therapy, University of Toronto, Toronto, Canada, alex.mihailidis@utoronto.ca

5 Swedish Law and Informatics Research Institute, Stockholm University, Stockholm, Sweden, liane.colonna@juridicum.su.se

Keywords:
Lifelogging, user acceptance, ethics, data protection, older and frail people

First sheld-on conference meeting. Riga, October, 10th 2018. **Proceedings Book**

Lifelogging (also known as quantified self or self-tracking) technologies may enable and motivate individuals to pervasively capture data about them, their environment, and the people with whom they interact (Gurrin et al., 2014). Acquisition and processing of physiological signals (e.g. heart rate, respiratory rate, body temperature, skin conductance), motion and location data, performed activities, images seen, and sounds heard, are the basis for the provision of a variety of services to increase people health, wellbeing, and independence (Flórez-Revuelta and Chaaraoui, 2016).

The lack of understanding of the human factor has significantly reduced the transfer of developments of lifelogging technologies to innovations having a social and economic impact (Lidynia et al., 2017). Sensitive and detailed information regarding health status, physical conditions, and behavioural patterns might be available everywhere, anytime, and to different stakeholders (Ziefle et al., 2016). This may implicate both positive (e.g. productivity, mobility and growth) but also negative and threatening effects (e.g. violations of privacy, security concerns, infrastructure constraints and distrust in smart healthcare applications).

The detailed study of humans' technology acceptance, willingness to accept self-tracking technology as well as individual usage motivations and barriers are mostly disregarded or even underestimated so far. Any successful rollout of such sensitive technologies requires first and foremost the acceptance by users, and consider the way these technologies meet users' needs with respect to privacy, dignity, and their requirements for lifelogging to be perceived as useful.

The European Commission recently adopted the General Data Protection Regulation (GDPR). Lifelogging technologies must consider privacy-by-design in order to protect the fundamental rights not only of the users but also of other people interacting with them or by-standers, particularly if video or audio data are captured, which are easily understandable by anyone (Colonna, 2014).

The aim of the PAAL project is manifold: to increase the awareness about the ethical, legal, social, and privacy issues associated to lifelogging technologies; to propose privacy-aware lifelogging services for older people, evaluating their acceptability issues and barriers to familiarity with technology, in order to elaborate on possible strategies for overcoming them; and finally to develop specific applications referred to relevant use cases for older and frail people.

The expected impact of PAAL aims at developing practical outcomes that include new lifelogging systems, products and devices to improve the wellness and quality of life of the aging population. The emphasis on practical outcomes will be realised through the inclusion of key factors, such as the ethical, cultural and social implications of this type of technology.

References

- *Colonna L. 2014. Data Mining and Its Paradoxical Relationship to the Purpose Limitation Principle. In Reloading Data Protection, Springer, Dordrecht. 299-321*
- *Gurrin C., Smeaton A. F., Doherty A. R. 2014. Lifelogging: Personal big data. Foundations and Trends in Information Retrieval, 8, 1: 1-125.*
- *Flórez-Revuelta F., Chaaraoui A. A. 2016. Active and Assisted Living: Technologies and Applications. 8, 1: 1-125. IET Healthcare Technologies Series 6, The Institution of Engineering and Technology*
- *Lidynia C., Brauner P., Ziefle M. 2017. A step in the right direction–understanding privacy concerns and perceived sensitivity of fitness trackers. In International Conference on Applied Human Factors and Ergonomics, Springer, Cham. 42-53*
- *Ziefle M., Halbey J., Kowalewski S. 2016. Users willingness to share data on the internet: Perceived benefits and caveats. In Proceedings of the International Conference on Internet of Things and Big Data (IoTBD 2016), INSTICC. SciTePress. 255-265*
- *Ziefle M., Halbey J., Kowalewski S. 2016. Users willingness to share data on the internet: Perceived benefits and caveats. In Proceedings of the International Conference on Internet of Things and Big Data (IoTBD 2016), INSTICC. SciTePress. 255-265*

Acknowledgments

The support of the JPI MYBL (award no: PAAL_JTC2017) and the Canadian Institutes of Health Research, the German Bundesministeriums für Bildung und Forschung (grant no: 16SV7955), the Italian Ministero dell'Istruzione dell'Università e della Ricerca, the Spanish Agencia Estatal de Investigación (grant no: PCIN-2017-114) and the Swedish Research Council for Health, Working Life, and Welfare (grant no: 2017-02302) is gratefully acknowledged.

Does Smart Ageing Improve Quality of Life of Elderly?

Jasmina Barakovic Husić[1], Sabina Barakovic[2], Enida Cero[3]

1 University of Sarajevo, Faculty of Electrical Engineering
jbarakovic@etf.unsa.ba

2 Little Mama Labs, Sarajevo

3 American University in Bosnia and Herzegovina

Keywords:
Smart systems, Quality of Life, Smart ageing solutions

First sheld-on conference meeting. Riga, October, 10th 2018. **Proceedings Book**

Funded by the Horizon 2020 Framework Programme of the European Union

The final goal of smart things and systems should be to improve the Quality of Life (QoL), specially of elderly given that this population is characterized by exponential growth.

A number of smart ageing solutions are developed without QoL of elderly being noticeably improved.

This paper aims to investigate whether smart ageing solutions succeed in direct improvement of QoL of elederly.

After intoduction of QoL indicators for elederly population, a survey study is performed.

The results of the conducted survey in lead to a conclusion that the existing smart ageing solutions does not necessarily directly contribute to QoL of elderly due to several reasons.

This conclusion opens a wide area of research issues to be addressed and corrections to be applied in the future.

Smart your home. How to make seniors' homes smarter

Coroain Elena[1], Held Paul[2], Lipphardt Anne-Marie[2]

[1,2] Innovation in Learning Institute, University Erlangen-Nuremberg, Germany.

[1] elena.coroian@ili.fau.de

Keywords:
Smart home technologies, ICT based learning, problem based learning, senior learners, empowerment

cost
EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme
of the European Union

Introduction: A new, innovative project in the field of ambient assisted living will be presented. The project "SmartyourHome" wants to empower older adults to understand and use the possibilities of smart home technology to support them in their daily live at home. Seniors shall be initiated to configure and program such devices and to control them, also via voice recognition services.

Aim: SmartyourHome has two strong motivations, related to senior's needs: Smart home technologies and services can be of special benefit for seniors if deployed in a target group oriented way. Second: Seniors are mostly excluded from live long learning since specific, seniors' adapted training is only provided, if ever, in agglomerations. But seniors live everywhere. An inclusive online learning approach is needed, which is applied in this project, as everyone who has access to the internet can benefit. This project links both motivations: Reliable smart home competences and skills are brought to the seniors' reach. Seniors shall be empowered to benefit from smart home technologies for more comfortable, safer and healthier independent living which allows them to stay longer at home, as most seniors wish. They should be enabled to understand basic smart home principles and to start first installations.

Results: 120 seniors with basic ICT skills will be directly involved in the project, as learners and as tele-tutors. Despite the number being limited due to the very innovative and early adopters' approach, this will not hinder large numbers of seniors to be inspired from the project and to go forward in the same direction. Targeted communication channels and strategies are therefore essential for SmartyourHome. Since publications are scarce in the field, a pre-study will be elaborated and published which make existing knowledge, competences and preferences of seniors more transparent. Based on it, three online and blended learning modules will be developed on basic smart home principles and hands-on which will be embedded in context of 360°, synchronous and asynchronous support, mentored by peers as tele-tutors. Since no equivalent experiences exist so far, the project has a very strong research component. All developments will be evaluated by seniors. As a result, a tested, evaluated and adapted introduction into the extremely beneficial field of smart home for seniors will be available for free, as open resource, for all seniors at the end of the project. This will contribute to higher awareness of options and benefits related to affordable and accessible smart homes amongst seniors in general.

References

- *ScienseDirect 2015 (Pavel Vacek /Klára Rybenská: The most frequent difficulties encountered by senior citizens while using information and communication technology using information and communication technology)*
- *DIVSI Internet Milieus 2016: The Digitized Society on the Move (Study 2016)*
- *Gerhards, Maria / Mende, Annette: Offliner. Women aged 60 and over form the core group. Results of the ARD/ZDF offline study 2009*
- *Gerhards, Maria / Annette Mende: Ein Drittel der Deutschen bleibt weiter offline*
- *Schweiger, Wolfgang/Rupprecht, Anna Katharina: Internet use in old age (2009)*

Survey of IoT tools and deployments for Healthcare and AAL scenario

J.L. Romero-Gázquez[1], V. Koch[2], F.J. Melero-Muñoz[3], M.V. Bueno-Delgado[4]

[1,4] Universidad Politécnica de Cartagena, Plaza del Hospital 1, 30202 Cartagena (Spain). [1]josel.romero@upct.es, [4]mvictoria.bueno@upct.es

[2] Karlsruhe Institute of Technology, Englerstr. 7 - 76131 Karlsruhe (Germany). volker.koch@kit.edu

[3] Centro Tecnológico del Mueble y la Madera, C/ Perales s/n, 30510 Yecla (Spain). fjmelero@cetem.es

Keywords:
AAL, healthcare, IoT, SDN, ODL

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

The Information and Communication Technologies (ICTs) have been the lead actors in the past and recent applications for healthcare and Ambient Assistant Living (AAL) scenarios (Dohr et al. 2010). Many works on this topic can be found in the scientific literature, with proposals focused on patient monitoring systems, remote medical services or patient data security. They have been designed not only to keep patients safe and healthy, but also to improve how physicians deliver care as well, and boost patient engagement and satisfaction by allowing them to spend more time interacting with healthcare staff. All of them make use of the well-known driver technologies for healthcare applications such as NFC (Prinz et al 2012, Alzahrani et al. 2013), RFID (Alsinglawi et al. 2017, Amendola et al. 2014, Aslam et al. 2017) or BLE (Kropf et al. 2016); now most of them are under the umbrella of the Internet of Things (IoT) paradigm, where thousands of smart devices will be connected each other or to a higher entity through an Internet connection (Fernandez and Pallis 2014, Catarinucci et al. 1015, Laplante and Laplante 2016).

The massive adoption of IoT in healthcare entails to face with some challenges about interconnection or interoperability, security and privacy, management, data structure, layered architecture and programmability, among others. For instance, the use of IoT healthcare applications in a hospital comprises to manage thousands of Electronic Health Record (EHR) systems, sensors, tools and applications from different vendors, with vendor-lock problems and lack of interoperability. Moreover, all of them need to be connected through the hospital local network or directly through the Internet, transmitting and receiving data at real time. This means GB of data per second to store and manage with low latency and data security and privacy constraints (Alzahrani et al. 2013, Somasundaram and Thirugnanam 2017).

This work explores the current challenges and solutions found in the recent scientific literature about the massive adoption of IoT in healthcare. This study has been addressed by three steps: (i) to know the main applications of the IoT in AAL and healthcare, (ii) to identify the problems and challenges of these implementations and (iii) to show the methodologies and tools used to alleviate these problems. The results are presented as an updated survey about IoT applications for healthcare and AAL scenarios with a huge number of IoT devices. Most of the recent scientific literature focuses their software architecture proposals on Software Defined Networking (SDN) (Hu et al. 2015) or similar solutions (Li et al. 2016, Salahuddin et al. 2017). SDN enables the management of healthcare data in a safe and efficient manner, providing interoperability among devices and EHR systems, scalability, and high efficiency. SDN is not only used for the operation, configuration and management of IoT devices, but also the entire IT network. Finally, in this work we suggest the use of OpenDaylight (ODL) as a great SDN controller for the IoT orchestration in healthcare applications. ODL is a modular and open-source tool that allows the addition of own modules developed by the client for their special deployments in the field of healthcare, smart homes, smart cities, Industry 4.0. ODL provides a specific module for IoT, IoT Data Management (IoTDM), which provides the flexibility, security, structuring and interoperability required for healthcare scenarios in a single software system.

References

- *Alsinglawi, B., Nguyen, Q. V., Gunawardana, U., Maeder, A., Simoff, S. J. 2017. RFID systems in healthcare settings and activity of daily living in smart homes: a review. E-Health Telecommunication Systems and Networks, 6, 1-17.*
- *Alzahrani A., Alqhtani A., Elmiligi H., Gebali F. , Yasein M. S. 2013. NFC security analysis and vulnerabilities in healthcare applications. IEEE Pacific Rim Conference on Communications, Computers and Signal Processing (PACRIM), Victoria: 302-305.*
- *Amendola S., Lodato R., Manzari S., Occhiuzzi C. , Marrocco G. 2014. RFID Technology for IoT-Based Personal Healthcare in Smart Spaces. IEEE Internet of Things Journal, 1, 2:144-152.*
- *Aslam, B., Khan, U. H., Azam, M. A., Amin, Y., Loo, J. and Tenhunen, H. 2017. Miniaturized decoupled slotted patch RFID tag antennas for wearable health care. International Journal on RF and Microwave Computer Aided Engineering, 27:21048.*
- *Catarinucci L., Donno D., Mainetti L., Palano L., Patrono L., Stefanizzi M. L. , Tarricone L. 2015. An IoT-Aware Architecture for Smart Healthcare Systems. IEEE Internet of Things Journal, 2, 6: 515-526.*
- *Dohr A., Modre-Opsrian R., Drobics M., Hayn D., Schreier G. 2010. The Internet of Things for Ambient Assisted Living. 2010 Seventh International Conference on Information Technology: New Generations, Las Vegas: 804-809.*
- *Fernandez F., G. C. Pallis G.C. 2014. Opportunities and challenges of the Internet of Things for healthcare: Systems engineering perspective, 4th MOBIHEALTH International Conference, Athens: 263-266.*
- *Hu L., Qiu M., Song J., Hossain M. S., Ghoneim A. 2015, Software defined healthcare networks, IEEE Wireless Communications, 22, 6: 67-75.*
- *Kropf J., Kadyrov S., Roedl L. 2016. Modular IoT Platform for AAL and Home Care Using Bluetooth Low Energy. MobiHealth: 132-137.*
- *Laplante P.A., Laplante N. 2016. The Internet of Things in Healthcare: Potential Applications and Challenges. IT Professional, 18, 32-4.*
- *Li Y., Su X., Riekki J., Kanter T., Rahmani R. 2016. A SDN-based architecture for horizontal Internet of Things services. IEEE International Conference on Communications (ICC), Kuala Lumpur: 1-7.*
- *OpenDayLight- SDN platform. Available online at* 🔗
- *Prinz A., Menschner P, Leimeister J. M. 2012. Electronic Data Capture in healthcare-NFC as easy way for self-reported health status information, 1, 3:137-144.*
- *Salahuddin M. A., Al-Fuqaha A., Guizani M., Shuaib K., Sallabi F. 2017. Softwarization of Internet of Things Infrastructure for Secure and Smart Healthcare. Computer 50, 7: 74-79.*
- *Somasundaram R., Thirugnanam, M. 2017. IoT in Healthcare: Breaching Security Issues. In N. Jeyanthi, & R. Thandeeswaran (Eds.), Security Breaches and Threat Prevention in the Internet of Things: 174-188.*

Acknowledgments

This work has been partially financed by COST Action CA16226.

Unconstrained face recognition under mismatched conditions

Omid Abdollahi Aghdam[1], Hazım Kemal Ekenel[2]

[1,2] Istanbul Technical University Istanbul, Turkey

[1] abdollahi15@itu.edu.tr.

[2] ekenel@itu.edu.tr

Keywords:
Face Recognition, Deep Learning

First sheld-on conference meeting. Riga, October, 10th 2018. **Proceedings Book**

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

Abstract—In this work we proposed a deep learning based method for face recognition uder mismatched conditions. We extracted face embedding using very deep convolutional neural network models trained on VGGFace2 and MS-Celeb-1M databases. For evaluation of the methodd we tested our approach on International Challenge on Biometric Recognition in the Wild, ICB-RW 2016, and SCFace databases. In these databases, there is a frontal Mugshot image per subject as gallery set, and images acquired from surveillance cameras as probe set. We used the nearest neighbor classifier with correlation as the distance metric for face identification. Experimental results on the ICB-RW 2016 database show that the features learned with deep learning models are discriminative which can be fed to simple classifier like nearest neighbor for face identification. We reported the results for features extracted from single models and ensemble model. Our best single model Rank-1 identification rate has around 15% improvement over the ICB-RW 2016 winner system. The ensemble of four models achieved 91.8% Rank-1, 98.0% Rank-5 identification rate, and 0.997 Area Under the Curve of Cumulative Match Score on the probe set. Furthermore, we evaluated the discriminative power of learned features on SCFace database. The ensemble of four models achieved state-of-the-art Rank-1 identification rate on distance 3, and distance 2 probe faces, 94.35 ±1.01, 99.37 ±0.32 respectively.

I. Introduction

The face recognition problem under constrained conditions can be considered as solved. FaceNet [9] took advantage of Inception model [12] followed by L2 normalization and Triplet Loss and trained on around 260M images which led to the record accuracy of 99.63% on LFW [7] and 95.12% on YouTube faces database [?]. In DeepID3 [13] two VGG [?] architectures including Inception modules [12] are used to extract features from 25 different crops of face per network. The extracted features were merged and Principal Component Analysis was used to reduce dimension to 300. Finally, a joint Bayesian model is learned for face recognition. The accuracy on LFW is 99.54%. The Angular-Softmax loss was introduced in SphereFace [14] to increase the inter-class distance and decrease the intra-class distance simultaneously. The learned face embeddings were used to identify the faces by nearest neighbor classifier with cosine similarity . This method achieved 99.42% accuracy on LFW and 95.0% on YTF.

Although, the performance for face recognition under constrained scenarios have reached almost 100%, there is still a big performance gap for surveillance scenarios. In surveillance face recognition, there are variation in pose, illumination, expressions, occlusion, blur, which make face recognition very challenging as usually there is a single high resolution frontal face image in the gallery to match. In this work, we evaluated the robustness of features learned by deep networks on ICBRW 2016 [3], and SCFace [15] databases. In ICB-RW 2016

database, there are 90 subjects, with 1 frontal face as gallery and 5 probe faces as probe set. SCFace databse consist of 130 subjects, with 1 mugshot, and 15 probe faces captured with surveillance cameras which we used in the experiments.

II. Method

In the experiments four models are used for extracting face features. Resnet-50 [6], SENet-50 [5] models trained from scratch on VGGFace2 database, VF2-ResNet and VF2-SENet respectively. Resnet-50 [6], SENet-50 [5] models trained from scratch on MS-Celeb-1M and fine-tuned on VGGFace2, shortly VF2-ft-ResNet and VF2-ft-SENet.

The faces in ICB-RW database are cropped using groundtruth bounding boxes and MTCNN [10] model is used for detecting the faces in SCFace database. The detected faces are cropped and resized to 224x244 before feeding to models. The 2048 dimensional face embeddings are extracted from the last layer of these networks, and for evaluating ensemble model, the extracted features from four models are concatenated. We used nearest neighbor classifier with correlation distance as metric to identify the faces.

III. Experimental results

In the ICB-RW 2016 database, the performance of the models are reported with Rank-1, Rank-5 identification rate, and Area Under Cumulative Match score in Table I, the results achieved by the best previously reported method are in the last row. The experimental results for SCFace database are shown in Table II. We used randomly selected 80 subjects for reporting the test results as in [11]. We run 20 experiments and report the average and standard deviation of identification rate for 20 runs.

Model	Rank-1 (%)	Rank-5(%)	CMC
Ensemble Model	91.78	98.00	0.997
VF2-ft-SENet	85.33	98.22	0.995
VF2-SENet	85.11	97.11	0.994
VF2-ResNet	87.11	96.00	0.993
VF2-ft-ResNet	87.11	96.89	0.991
Ekenel et al. [4]	72.00	86.22	0.962

Table I: Identification rates and CMC of models on ICB-RW 2016 database.

Distance	d1 (4.20 m)	d2 (2.60 m)	d3 (1.00 m)
Ensemble Model	54.03 ±1.72	94.35 ±1.01	99.37 ±0.32
VF2-ResNet	47.41 ±1.93	92.69 ±1.03	98.53 ±0.47
VF2-SENet	47.84 ±2.23	91.91 ±1.04	98.47 ±0.54
VF2-ft-SENet	42.95 ±1.88	88.54 ±0.98	98.38 ±0.50
VF2-ft-ResNet	38.70 ±2.12	89.30 ±1.64	97.65 ±0.74
Coupled-ResNet [11]	73.3	93.5	98.00

Table II: Rank-1 identification rates of models on SCFace database.

References

1. *He, Kaiming, et al. "Deep residual learning for image recognition." Proceedings of the IEEE conference on computer vision and pattern recognition. 2016.*
2. *Cao, Qiong, et al. "Vggface2: A dataset for recognising faces across pose and age." Automatic Face Gesture Recognition (FG 2018), 2018 13th IEEE International Conference on. IEEE, 2018.*
3. *J. Neves, and H.& Proença, "ICB-RW 2016: International Challenge on Biometric Recognition in theWild", Biometrics (ICB), 2016 International Conference on (pp. 1-6). IEEE.*
4. *E. Ghaleb, G. Özbulak, H. Gao, H.K. Ekenel, "Deep Representation and Score Normalization for Face Recognition Under Mismatched Conditions", IEEE Intelligent Systems, Vol. 33, No. 3, p. 43-46, May/June 2018.*
5. *H. Jie, L. Shen, and G. Sun, "Squeeze-and-excitation networks", arXiv:1709.01507 2017.*
6. *K. He, X. Zhang, S. Ren, and J. Sun, "Deep residual learning for image recognition", CVPR, 2016.*
7. *G.B. Huang, M. Ramesh, T. Berg, and E. Learned-Miller, "Labeled faces in the wild: A database for studying face recognition in unconstrained environments", Technical Report, 2007.*
8. *L. Wolf, T. Hassner, and I. Maoz, "Face recognition in unconstrained videos with matched background similarity", CVPR, 2011.*
9. *F. Schroff, D. Kalenichenko, and J. Philbin. "Facenet: A unified embedding for face recognition and clustering", CVPR, 2015.*
10. *Zhang, Kaipeng, et al. "Joint face detection and alignment using multitask cascaded convolutional networks." IEEE Signal Processing Letters 23.10 (2016): 1499-1503.*
11. *Lu, Ze, Xudong Jiang, and Alex ChiChung Kot. "Deep Coupled ResNet for Low-Resolution Face Recognition." IEEE Signal Processing Letters (2018).*
12. *C. Szegedy,W. Liu, Y. Jia, P. Sermanet, S. Reed, D. Anguelov, D. Erhan, V. Vanhoucke, and A. Rabinovich, "Going deeper with convolutions", CVPR, 2015.*
13. *Y. Sun, D. Liang, X. Wang, and X. Tang, "DeepID3: Face recognition*

with very deep neural networks", arXiv:1502.00873 (2015).

14. *W. Liu, Y. Wen, Z. Yu, M. Li, B. Raj, and L. Song, "Sphereface: Deep hypersphere embedding for face recognition", CVPR, 2017.*
15. *M. Grgic, D. Kresimir, and S. Grgic, "SCface–surveillance cameras face database", Multimedia Tools and Applications 51.3 (2011): 863-879.*
16. *Y. Guo, L. Zhang, Y. Hu, X. He, and J. Gao, "Ms-celeb-1m: A dataset and benchmark for large-scale face recognition", ECCV, Springer, Cham, 2016.*

Use of sensors for the monitoring of the physical training of elderly people

Ivan Miguel Pires

Instituto de Telecomunicações, Universidade da Beira Interior, Covilhã, Portugal

Altranportugal, Lisbon, Portugal

ALLab - Assisted Living Computing and Telecommunications Laboratory, Computer Science Department, Universidade da Beira Interior, Covilhã, Portugal

impires@it.ubi.pt

Keywords:
Activities of Daily Living (ADL), elderly people, physical training, mobile devices, sensors

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

The Short-Term Scientific Mission (STSM) consists in the development of methods for the monitoring and assisting of the physical training of elderly people. The new methods developed help in the particular assistance of each subject and it may help to measure the health state of the subjects, identifying possible diseases and risks with machine learning techniques.

During the research visit, I plan to analyse the previously acquired data related to the mobile sensors (e.g., accelerometer, gyroscope, magnetometer, GPS receiver, and microphone), external sensors (e.g., Electroencephalography, Electromyography and Electrocardiography sensors) and furniture sensors (e.g., pressure sensors, contact sensors, light sensors, RFID sensors and temperature sensors) during the physical training and tests performed by institutionalized ageing people.

The research method for this research visit was done with the following steps:

- Development of a mobile application in order to capture data of the accelerometer, gyroscope and magnetometer sensors, the microphone and the GPS receiver from the off-the-shelf mobile devices, the Electroencephalography, Electromyography and Electrocardiography sensors from the Bitalino device, and the pressure, contact, light, RFID and temperature sensors from another Bitalino device;
- 2Development of a method to identify the ADL related to elderly people and to measure the results of the different tests;
- Propose an architecture of a new solution that help the elderly people for the independent living.

The new architecture is based in the results obtained in the previous works already published (Pires 2018a, Pires 2018b, Pires 2018c).

References

- *Pires I., Teixeira M., Pombo N., Garcia N., Flórez-Revuelta F., Spinsante S., Goleva R., Zdravevski E., "Android library for recognition of activities of daily living: implementationconsiderations, challenges, and solutions", Open Bioinformatics Journal, Bentham Science Publishers B.V., 11, pp. 61-88; doi:10.2174/1875036201811010061, May 2018*
- *Pires I., Garcia N., Pombo N., Flórez-Revuelta F., Spinsante S., Teixeira M., "Identification of Activities of Daily Living through Data Fusion on Motion andMagnetic Sensors embedded on Mobile Devices", published in Pervasive and Mobile Computing,Elsevier, 47, pp. 78-93; doi: 10.1016/j.pmcj.2018.05.005, July 2018*
- *Pires I., Garcia N., Pombo N., Flórez-Revuelta F., Spinsante S.,, "Approach for the Development of a Framework for the Identification of Activities of Daily Living Using Sensors in Mobile Devices", published inSensors, MDPI, Sensors 2018, 18(2), 640; doi:10.3390/s18020640, February 2018*

Acknowledgments

This work was supported by FCT project UID/EEA/50008/2013 (Este trabalho foi suportado pelo projecto FCT UID/EEA/50008/2013).

The authors would also like to acknowledge the contribution of the COST Action IC1303 – AAPELE – Architectures, Algorithms and Protocols for Enhanced Living Environments.

The authors would also like to acknowledge the contribution of the COST Action CA16226 – Indoor living space improvement: Smart Habitat for the Elderly.

Working Group 3 Proceedings
Healthcare

Leader: Signe Tomsone (LV)
Vice-Leader: Petra Marešova (CZ)

First sheld-on conference meeting
Proceedings Book

11 principles of spatial design for well-being of older adults

Veronika Kotradyová

Faculty of Architecture, Slovak University of Technology in Bratislava
veronika.kotradyova@stuba.sk

Keywords:
spatial design, architecture, ageing, well-being, guidelines

First sheld-on conference meeting. Riga, October, 10th 2018. **Proceedings Book**

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

Our behaviour, outlook, general wellbeing and everyday social interactions are directly tied to the natural and built environment. How spaces and their structures control our everyday use have far reaching consequences – potentially impacting our long-term mental and physical health.

The paper is a summary of recent multidisciplinary research of human centred design on platform of BCDlab. It is summarized into 11 features of supportive environments for contemporary humans – "cultural animals".

The needs of human beings are changing with time and for senior citizens the formulated 11 principles of spatial design for well-being are intensified.

Lack of a supportive environments contributes to diseases relevant for public health.

Feeling of safety; prospect and refuge (1+2)

First of all, it is a feeling of safety, combined with the competence to manage risks and attractions. This is connected to the second important features – the possibility to combine prospect with refuge, often related to protecting one's back with a simultaneous overview about the situation in the space. It is clearly reflected in space occupation, especially in public spaces. This need is also about seeing and being seen, as humans need to control this status and this need is strongly culturally dependent.

Contact with the outdoors (3)

A third important feature of spatial design for well-being is contact with the outdoors, at least visually, during the day and the possibility to control it. This remains strongly undervalued in many working environments.

personal space and intimacy vs socialisation (4+5)

Another important issue is the need for personal and intimate space – one's own territory – and competence to occupy and control it. In later life, this need to control one's own space is extremely important.

This is strongly related to the need to switch between privacy and social interaction according to the current situation. The success of these systems depends on the arrangement of space that either supports or postpones communication, and is a topic grounded in proxemics and anthropology. By older life appreciation of living in mixed heterogeneous communities that consider age and social status increases. This state provides feeling of inclusiveness.

Appropriate scale (6)

The sixth feature is providing an appropriate scale and harmonised proportions of buildings and their indoor living and working environment - spaces for long-term occupation by humans.

Attachement (7)

Another important characteristic is the possibility (or competence) for an individual to be attached to a place or products, to have the competence to adapt them, personalize, to mirror and extend the Self/ego into the occupied space and gain a state of self-identification. This feature is important for the human as a cultural creature, but also as an animal that needs its own marked habitat. This is strongly connected with the 8th feature - maintaining cultural sustainability through providing local identity to the built environment and to life style.

local identity (8)

Securing identity in private and public spaces and preventing loss of local identity thanks to globalization and especially in the environment for older adults.

Body consciousness (9)

A critical characteristic prevention of pain and body deformation due to the use of inappropriate products and environmental settings; freedom in choice of body position and use of body conscious products are needed to achieve this.

Aprropriate environmental stimulation (10)

The tenth feature is the selection of adequate sensual stimuli – without over stimulation – in long-term stay environments. In older life this includes, providing the right ratio of stimulating and relaxing arrangements.

More natural materials (11)

The last characteristic is the choice of appropriate materials, where natural materials are prioritised and can also influence measurable parameters of well-being.

Addressing use and technology in dignified and positive aging; Its Applicability in Living Lab Social at real environment

Lucía Gonzalez López, María del Mar OLmo Vidal, Alfonso Cruz Lendinez

Ageing Social Lab Foundation, Parque Tecnológico de Geolit

ageinglab@ageinglab.org

Keywords:
Dignified and positive aging (EDP, Ageing Lab), Technology, Living Lab

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

Dignified and Positive Aging (EDP) is an intervention model that starts from the premise of aging as an opportunity for life development for older adults. It poses a new challenge for actors that must give close, flexible and creative solutions to positive aging that in turn respects and maintains fundamental rights (dignified aging). In terms of methodology, EDP starts from praxis and is enriched by professional expert knowledge, considering both the person and their environment, from the perspective of a free and balanced practice. The (EDP) model includes five basic principles: bioethics, active participation, collaborative intelligence, welfare, and co-responsibility.

The application of these principles and criteria is ensured and assessed through two key interconnected factors: monitoring and evaluation. The first is insured by a monitoring committee and the second through evaluations of evidence and analysis of the results of the intervention. This includes analysis (of documented and undocumented practices) results in equilibrium indexes in application, systematization, implementation, and connectivity as well as the degree of implementation and identification of improvement proposals (progressivity).

In this section we focus on the principle of EDP "wellness", which includes criteria such universal accessibility and technology. Practical application in services for dependent people include good EDP practices in Home Help Service and good EDP practices in Gerontological Centers.

"The DPA model considers that technological activity must be inherent to each service. A socially committed entity will include in its intervention model a criterion based on technology, and among its objectives include influencing the social and economic progress, guiding the results of the service to meet the users' needs, from the evolution of the service. This criterion is applied in the model in a clearly cross-sectional way, which contributes to providing the model with its own distinctive and easily identifiable particularities."

Results: The DPA model has been deployed by the Ageing Lab Foundation for care of the elderly in Spain. Experience has been obtained from over 3000 home care users, and 16 centres for the elderly (6 retirement homes and 10 day-care centres, involving nearly 1000 users and 300 staff).

Applicability in European Projects: as a framework, the DPA model will help extend ethical deployment of EDP beyond the scope of the REMIND, FRAIL, and SHELDON projects. All of them have been approved by European Commission.

The Ageing Lab Living Lab is a concept to support the ICT systems oriented to the user, with the prior condition that Living Labs are located in real world contexts, not in laboratory environments, this being a response to current trends.

In 2006, the European Living Labs Network (ENoLL) was established. In 2012, there were 320 Living Labs members of ENoLL and the network is continuously growing. ENoLL members are operating all over the world, but primarily in Europe. Ageing Lab, is part of this network as an entity with the capacity to operate in real environments: livinglabsocial.com openlivinglabs.eu

Living Lab Social of Ageing Lab in real Environments provides tailored solutions, to research projects and in the development and innovation of products or services that respond to the challenge of aging.

It is an instrument that allows active participation of the end user, from their own experience, in the process of design or redesign of projects, products and services, as well as in the pilot phases.

References

1. *Ageing Lab Foundation*
2. *European Network of Living Lab*

Acknowledgments

SHELD-ON (Ref OC-2016-2-21644) has been funded with support from COST, by the EU framework Programme of Horizon 2020. This publication reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

Are emissions in residential environments still a toxicological issue?

Martin Weigl[1], Christina Fürhapper[2], Elisabeth Habla[3], Daniel Stratev[4]

Franz-Grill-Straße 7, 1030 Vienna, Austria, Holzforschung Austria

[1] m.weigl@holzforschung.at

[2] c.fuerhapper@holzforschung.at

[3] e.habla@holzforschung.at

[4] d.stratev@holzforschung.at

Keywords:
VOC, formaldehyde, sleeping room, human wellbeing, toxicology

First sheld-on conference meeting. Riga, October, 10th 2018. **Proceedings Book**

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

Emissions from products are widely discussed, but focusses on isolated products under controlled conditions. These measures help with material selection and product development, especially if designed for low emitting products. However, when forming consumer products such as furniture or even residential buildings, a variety of different products are combined, leading to a more laminar composition than a uniform one. Consequently, the overall emission of the combined products is mostly unknown as sorption and diffusion of emissions alter the overall emission profile. Furthermore, emissions are evaluated most commonly after 28 days of exposure. Following the assumption that after such a time an emission steady state is reached and these values could be used as an estimate of the long-term emission profile of the consumer product. However, even this doesn´t reflect the real emission kinetics as a steady state is often not reached, especially if natural materials such as wood are used. Hence, due to the fact that the indoor environment contains many different products with often unknown surface-dimensions exposed to the indoor air, the real loading within a room is usually unknown. Additionally, variable air exchange rates are a further source of uncertainty. Ultimately, the indoor air quality can´t be calculated based on commonly available information related to consumer products.

To better understand the long-term emission kinetics under real life conditions, measurements for volatile organic compounds (VOC) and formaldehyde were carried out during the building phase of residential houses as well as through approximately six months after move in. Thirteen houses were selected, one made of concrete, and each six of either timber frame or solid wood. All objects were completely furnished, and sampling was conducted within the sleeping room, as these are the rooms people commonly spend the longest time per day in, especially without any further activities that might influence the emission kinetics. A mechanical ventilation system was installed in nine houses, wooden floorings were used in eleven of which the majority was surface treated via natural oil. Additionally, health state related parameters were collected periodically from surveys and measures of blood pressure, eye lid blink rate, and pulmonary function.

A comparison of the long-term emission profile for TVOC (i.e., the sum of all VOCs) and formaldehyde in case of controlled ventilation or manual ventilation is given in Fig. 1 (Cronhjort et al. 2017, Fürhapper et al. 2017). Indoor air quality has a dynamic behaviour over time, and that especially controlled ventilation systems help reduce contamination. In all cases, indoor air quality was good according to different grading systems. From other studies (not shown here) it is known, that furniture is an additional emission source, but for both furniture and building, declining emissions can be assumed. When generating living environments for persons with special needs such as older adults or chronically ill people, toxicological and epidemiological assessments of the indoor air status are favourable. Inhabitants in this study showed throughout the whole investigation, even within times of elevated emissions, good overall health states and the well-being self-assessment was generally at a very high level.

From a toxicological point of view, each single substance must be evaluated. It turned out, that all measured objects at almost all measured times showed no toxicological peculiarity. Exceptions in one case came from one building material leading to slightly increased formaldehyde concentrations, and in another one from the application of air fresheners and smoking. Although this study shows a limited sample size, it is clear, that good indoor air quality can be gained when applying modern building standards and building products, and if occupants show adequate behaviour. On the other hand, the occurrence of irritating, toxic or CMR-substances must be prevented. In this respect, evaluation of indoor air quality status coupled with toxicological assessment is recommended, preferably not immediately after finishing the building project, and especially if occupant's special needs must be assumed.

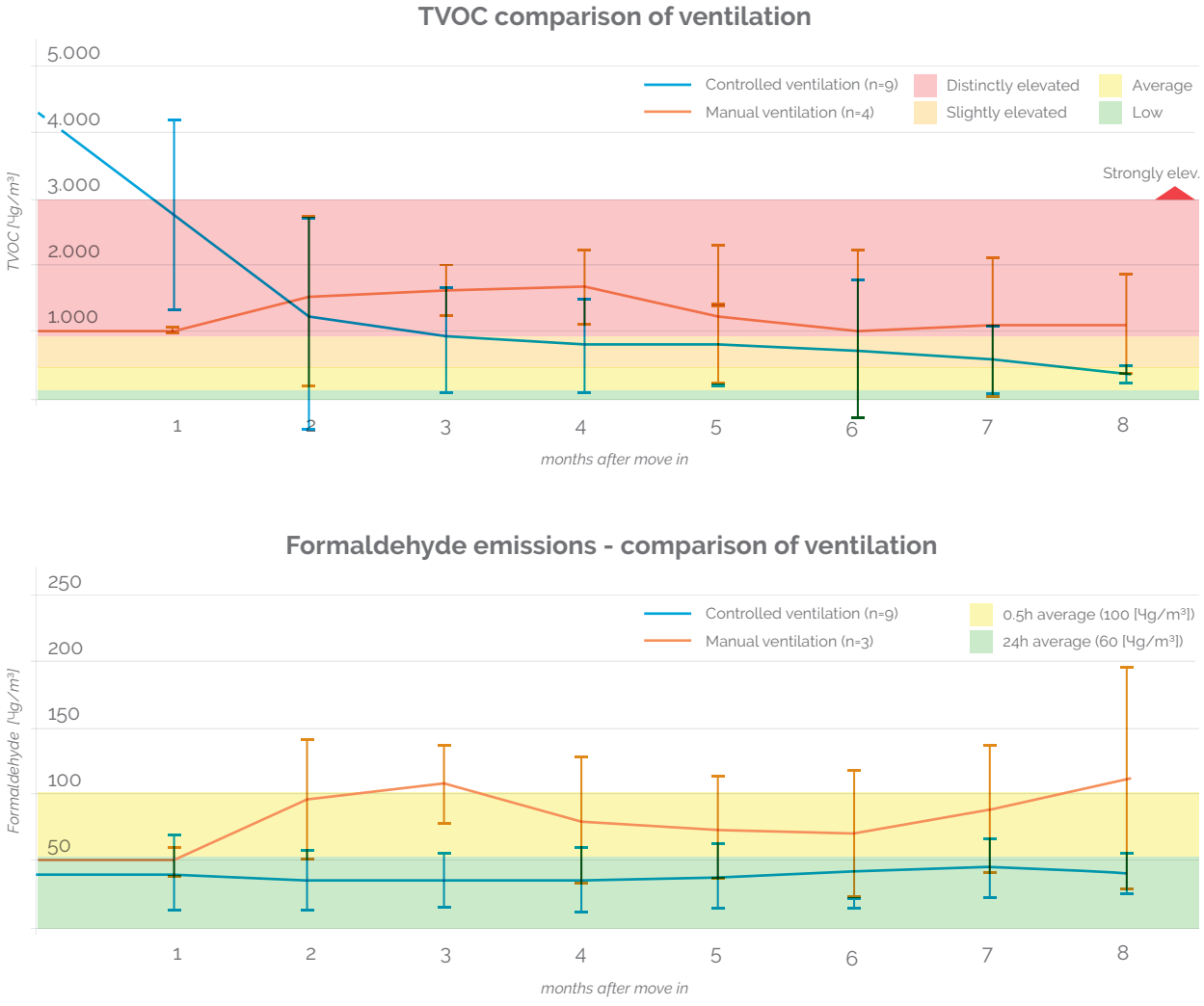

Figure 1: Comparison of the long-term emission profile for TVOC (left) and formaldehyde (right) in case of controlled ventilation (blue) or manual ventilation (orange)

References

- *Cronhjort Y., Heikkinen P., le Roux S., Tulamo T., Verma I., Zubillaga l., Hughes M., Vahtikari K., Johnson K., Livesey K., Macé E., Suttie E., Romppainen S., Helle T., Uhler B., Fürhapper C., Grüll G., Truskaller M., Weigl M., Habla E., Carlborg P., Nord T., Waldhör T., Sundbye R., Axelsson M., Bysheim K., Nore K., Nyrud A.Q., Tycho J., Elomaa J., Dobianer K., Cook S. 2017. Competitive wood-based interior materials and systems for modern wood construction.*
- *Fürhapper C. 2017. Wood2New - Konkurrenzfähige Materialien aus Holz für den Innenbereich und Systeme für moderne Holzkonstruktionen, Endbericht AP3 – Innenraum.*

Acknowledgments

We kindly acknowledge funding from WoodWisom-Net+ and our industrial partners.

Development of an advanced air quality assessment system in residential and office environments for people with respiratory diseases

Krejcar, O, Frischer, R, Maresova, P

Faculty of Informatics and Management, University of Hradec Kralove, Czech Republic

ondrej.krejcar@uhk.cz

Keywords:
air quality; pollution measurement; respiratory diseases; assessment system; elderly

First sheld-on conference meeting. Riga, October, 10th 2018. **Proceedings Book**

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

The aim of this project is the realization of a low-cost analytical system capable of detecting the current air quality in residential and office premises for the elderly or, in general, for persons suffering from respiratory difficulties in poor air quality conditions. The project addresses both the applied and the technical aspects of the solution, including data collection, storage, visualization, and data centralization.

To analyze data about the quality of air indoors, a set of sensors (intelligent autonomous technical devices) are under development. It is only through the connection of data collection and analytics that the project is different from existing solutions, such as weather stations or systems evaluating the air quality in buildings equipped with a ventilation system.

The aim of the hardware aspect of the project is development and implementation of prototype sensors that are capable of detecting the presence of CO2, CO, different types of hydrocarbons, dust particles, temperature, humidity, illumination, atmospheric pressure, etc.

The result of the project are therefore not only diagnostic hardware but also security hardware that allow detection of various extreme and dangerous situations, and prevention of further complications. The results are primarily targeted at the elderly, which is a group where not only health risks but also safety risks must be eliminated.

The developed solution is comprised of a unique sensor platform based on a type STM32Fxx single-chip micro-controller with high performance and multiple peripherals. To communicate with the environment, most current sensors use a serial bus connection of type IIC, SPI, UART, etc. Several cheap sensors were developed to allow concentration at a single measuring point and to enhance the information about air quality with additional information. Correlations between the individual quantities is therefore easier to examine and test because the data are centralized at one place and there is no need to link different types of databases (such as National Hydrometeorological Institutes).

Conclusion

The advantage of the sensor – application – action / visualization elements is obvious. In this way, it is possible to implement external information (such as the occurrence of inversion via a web service), and control circulation fans or electromagnetic window locks, or to visualize the need to air the room directly at the window with a notification or a color light. This system, however, asks for more than a group of enthusiasts with innovative hardware, it requires coordination with industry partners and extensive facilities. This is the only way to bring to life a widespread system that can appeal to a large part of the population and provide better living conditions.

Influence of lifestyle and environmental risk factors on elderly frailty

Armanda Teixeira-Gomes[1], Bruna Lage[2], Vanessa Valdiglesias[3], Solange Costa[4], Blanca Laffon[5], João Paulo Teixeira[6]

[1] Rua Alexandre Herculano, 321, 4000-055 Porto, Portugal; EPIUnit – Instituto de Saúde Pública da Universidade do Porto, Porto, Portugal; National Institute of Health, Environmental Health Department, Porto, Portugal; armandatgomes@gmail.com

[2] EPIUnit – Instituto de Saúde Pública da Universidade do Porto, Porto, Portugal; National Institute of Health, Environmental Health Department, Porto, Portugal; brunafilipalage@gmail.com

[3] EPIUnit – Instituto de Saúde Pública da Universidade do Porto, Porto, Portugal; DICOMOSA Group, Area of Psychobiology, Department of Psychology, University of A Coruña, A Coruña, Spain; vvaldiglesias@udc.es

[4] EPIUnit – Instituto de Saúde Pública da Universidade do Porto, Porto, Portugal; National Institute of Health, Environmental Health Department, Porto, Portugal; solange.costa2@gmail.com

[5] DICOMOSA Group, Area of Psychobiology, Department of Psychology, University of A Coruña, A Coruña, Spain; blaffon@udc.es

[6] EPIUnit – Instituto de Saúde Pública da Universidade do Porto, Porto, Portugal; National Institute of Health, Environmental Health Department, Porto, Portugal; jpft12@gmail.com

Keywords:
Ageing, Frailty, Exposome, Lifestyle factors, Biomarkers

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

The world's population is ageing rapidly. Nowadays, already a quarter of the European population is 60 years old or over. Portugal is not an exception; by 2030 Portuguese will rank 3rd among the world's oldest population. The major public health goal for older individuals is to prevent disability and to enhance active life expectancy. Recent evidence advocates that healthy ageing may be possible with morbidity compressed to the later years of life. One area of concern is the burden of environmentally induced disease in susceptible populations. The potential to reduce the prevalence of some major diseases is driving research to understand the totality of exposures over the course of our lifetime. The European Commission has recognised (Healthy) Ageing as a principal societal Challenge in Europe. Prevention of Frailty in old age was one of the key actions identified. Frailty is a multidimensional syndrome characterised by increased vulnerability and functional decline that may be reversed, but if it is not addressed frailty may lead to long-term disability and hospitalisation. On the basis of the scientific evidence that prevention is a better intervention the main aim of the present study is a) to identify new cellular and molecular biomarkers associated with frailty that might be detected before clinical manifestations become evident, b) to evaluate the potential influence of physical exercise on the biomarkers studied and if it may prevent or even reverse frailty, and c) to investigate the impact of environmental and lifestyle factors on older adult's health, particularly its influence on frailty incidence and development d) identify risk factors related to frailty syndrome aetiology.

The data presented are preliminary results of the BioFrail project. A group of older adults (≥ 65 years old) from Porto was engaged in this study. Frailty status was assessed via Fried's frailty model. DNA damage and oxidative stress endpoints were measured through comet assay in whole blood samples. Lifestyle factors such as farming activity, home ventilation, household proximity to traffic, etc., were assessed via questionnaire. A job-exposure matrix was also applied to assess the occupational risk to known hazard compounds. The study population was classified as 47.5% robust, 49.2% pre-frail and 3.3% frail. A significantly higher prevalence of second-hand smokers was found in the pre-frail group compared to the robust group. No significant differences were found in primary DNA damage and oxidative damage between groups. Regarding the exposure-related parameters, a significant effect was obtained for consuming home-produced vegetables (within the robust group), living near farming operations (within the robust group) and living near industrial areas (within the pre-frail group). This general vision will help to further understand the frailty state and eventually will help to face it when it has already manifested or to anticipate it when it has not appeared yet. The ultimate goal of this project has clear and important benefits for the societies as the early

identification of people at risk of frailty will allow implementing preventive actions and specialising care, improving the quality of life in old age and reducing healthcare costs. Results and conclusions of this study are routed to obtain realistic and enduring applications that may help Europe and more particularly Portugal to deal with this new reality.

References

- *Fried, L.P., et al., 2001. Frailty in older adults: evidence for a phenotype. The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 56(3): p. M146-M157.*

Acknowledgments

The work developed by Armanda Teixeira-Gomes and Solange Costa is supported by the Portuguese Foundation for Science and Technology (FCT) under the grants SFRH/BD/121802/2016 and SFRH/BPD/100948/2014, respectively. Vanessa Valdiglesias was supported by Xunta de Galicia postdoctoral fellowship (reference ED481B 2016/190-0).

Key points from scoping review: technological solutions for older People

Maresova P[1], Tomsone S[2], Lameski P[3], Madureira J[4], Mendes A[4], Zdravevski E[3], Chorbev I[3], Trajkovik V[3], Ellen M[5], Rodile K[6]

1 University of Hradec Kralove, Czech Republic.,

2 Faculty of Rehabilitation, Riga Stradins University, Latvia.

3 Faculty of Computer Science and Engineering, University of Sts. Cyirl and Methodius in Skopje, Macedonia, the Former Yugoslav Republic of.

4 National Institute of Health, Environmental Health Department, & EPIUnit Instituto de Saude Publica, Universidade do Porto, Porto, Portugal.

5 Department of Health Systems Management, Guilford Glazer Faculty of Business and Management and Faculty of Health Sciences, Ben-Gurion University of the Negev, Israel.

6 Department of Architecture, Design and Media Technology, Aalborg University, Aalborg, Denmark.

Keywords:
older people, technological solution, AALs

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

Introduction: Developing countries are experiencing demographic changes, including an increasing number of seniors and people with neurodegenerative diseases such as Alzheimer's disease.

The aim of the paper is to present an up-to-date overview of technological solutions available for assisting elderly patients suffering from Alzheimer's.

Results: Works were obtained from Web of Science, PubMed, Springer, ACM and IEEE Xplore. Four independent reviewers screened the identified records and selected relevant articles which were published between 2007 and 2018. A total of 6,705 publications were selected and 128 full papers were screened. Results obtained from the relevant studies were furthermore divided into the following categories according to the type and use of technologies: devices, processing, and activity recognition. The leading technological solution in the category of devices are wearables and ambient noninvasive sensors. The introduction and utilization of these technologies, however, bring about challenges in acceptability, durability, ease of use, communication, and power requirements. Details are described in Figure 1.

	Sensor/device types			Processing type		Activity detection and recognition			Use-case		
Authors, title of study	Werables / phones / tablets	Ambient Monitorsensors (invasive)	Ambient Monitorsensors (non-invasive)	Processing on local computer or ad hoe	Cloud based processing online service	Uses machine learning algorithms for activity classification	Uses role ontology bases aproach or separate subsystem for each activity	Not related to activity detection	Monitoring	Rehabilitation	Experimental study
Jekel et al. 2016		X	X	X			X		X		X
Radziszewski et al., 2017			X		X			X	X		X
Lazarou et al., 2016	X	X	X	X		X			X		X
Hussain et al., 2014	X	X	X		X	X			X		
Nuñez Naveira et al., 2016			X					X		X	X
Stavropoulos et al.	X	X	X	X			X		X		X
Cavallo et al., 2015	X		X	X			X		X		
Westerbeg et al., 2010	X							X			X
Wang et al., 2017	X							X	X	X	X
Realdon et al., 2016	X			X				X		X	X
Olsson et al., 2013	X							X	X		

Figure 1: Characteristics of findings according to sensor types, data processing type, the usage of activity recognition and use-case (Maresova et al, 2018).

References

- *Maresova P, Tomsone S, Lameski P, Madureira J, Mendes A, Zdravevski E, Chorbev I, Trajkovik V, Ellen M, Rodile K. 2018. Technological Solutions for Older People with Izheimer's Disease: Review. Current Alzheimer Research, 15, pp. 1-9.*

Acknowledgments

The authors would like to acknowledge networking support from COST Action CA16226: Indoor living space improvement: Smart Habitat for the Elderly. COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation. www.cost.eu.

Mental health monitoring of elderly people during daily life activities

Daniel Bautista-Salinas[1] , Aurora Szentagotai-Tatar[2], Silviu Andrei Matu[3], Oscar Martinez Mozos[4]

1 Technical University of Cartagena, Cartagena, Spain, daniel.bautista@edu.upct.es

2 Babes-Bolyai University, Cluj-Napoca, Romania, auraszentagotai@psychology.ro

3 Babes-Bolyai University, Cluj-Napoca, Romania, silviu.matu@ubbcluj.ro

4 echnical University of Cartagena, Cartagena, Spain, oscar.mozos@upct.es

Keywords:
mental health monitoring, ambient assisted living, wearable sensors, emotion recognition

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

Older citizens in Europe wish to stay in their homes for as long as possible and enjoy active and healthy ageing. However, the number of older people living alone has increased to 13.14% in EU [EUR15]. Therefore, there is an urgent need for new and innovative forms of mental health care.

This work discusses technologies for mental health monitoring during daily life activities. These technologies are selected following a current scientific literature review together with interviews with psychologists.

A first prototype includes wearables for physiological measurements; home sensors to identify daily activities and patterns, like sleeping; and smartphones for ecological momentary assessment (EMA). Examples are shown in Figure 1.

Following this prototype we carried out an initial experiment for mental health monitoring of elderly people during their daily life using a subset of the proposed methods. During approx. 14 days, four participants (55-60 years old) wore an E-4 wristband, recorded activeness and happiness using an EMA smartphone app, and answered STAI questionnaires every night. This data was analysed and an intelligent classifier (Chang and Lin 2013) was trained to automatically recognize emotional states (Russell 1980).

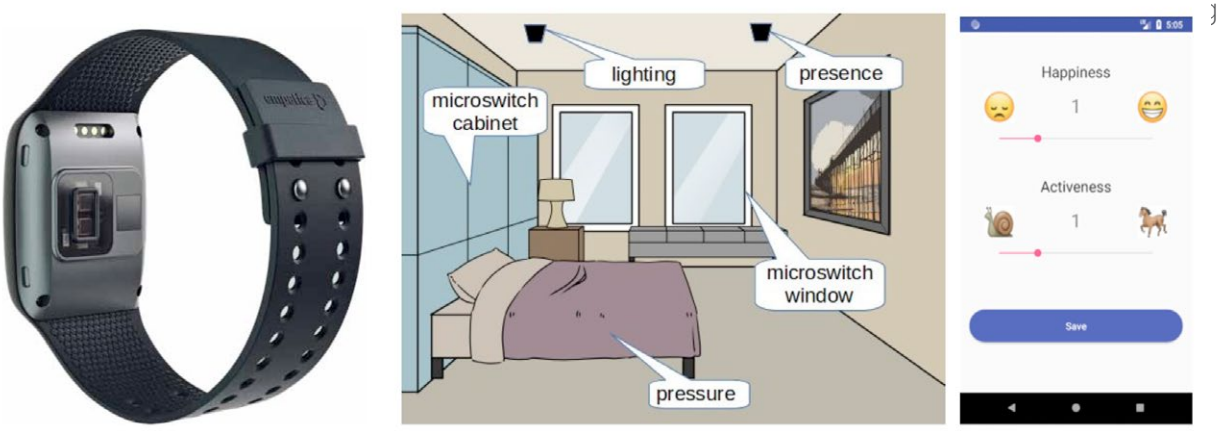

Figure 1. Left: E-4 wristband for physiological measurements. Centre: home sensors. Right: Smartphone with EMA software.

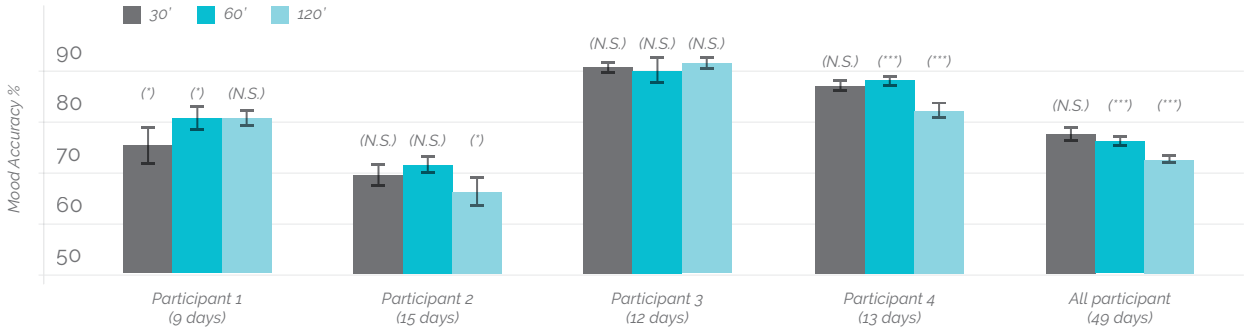

Figure 2. Left: 75%-25% data split. Right: leave one out..

Future work includes increasing the number of patients and the duration of the experiment, using of home sensors to detect activities and behaviours, and designing new ways of using EMA to improve the frequency and quality of emotional self-assessment.

References

- *EU, "EUROSTAT statistics explained,"*
- *World Health Organisation, "Mental health and older adults," Fact sheet,*
- *J. A. Russell, "A Circumplex Model of Affect," J. Pers. Soc. Psychol., vol. 39, no. 6, pp.1161–1178, 1980.*
- *C. Chang and C. Lin, "LIBSVM : A Library for Support Vector Machines," pp. 1–39, 2013.*

Acknowledgments

This work was partially funded by the EU under COST action Sheld-On (CA 16226) and by the Spanish government under RYC-2014-15029.

Sustainable environments for elderly people

Lina Šeduikytė[1], Indrė Gražulevičiūtė-Vileniškė[2]

1 Kaunas University of Technology, Faculty of Civil Engineering and Architecture, Studentu str. 48, 51367 Kaunas, Lithuania, lina.seduikyte@ktu.lt

2 Kaunas University of Technology, Faculty of Civil Engineering and Architecture, Studentu str. 48, 51367 Kaunas, Lithuania, indre.grazuleviciute@ktu.lt

Keywords:
sustainable development, thermal comfort, LCA, elderly

First sheld-on conference meeting. Riga, October, 10th 2018. **Proceedings Book**

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Funded by the Horizon 2020 Framework Programme of the European Union

Adjusting environments for elderly to create conditions which are comfortable for dignified aging at home, with the possibility to work and be a valuable part of the community is a top concern of the European Union (EU). Based on "The 2018 Ageing Report", the EU population will increase from 511 million in 2016 to 528.5 million in 2040 and then will decline to 520 million by 2070 (EC, 2018). The aging process will change significantly because of the demographic situation and migration. The ratio of people aged 65 or above to the ones aged 15-64 is going to increase in the EU in coming decades. This ratio in 2010 was 25%, in 2016 has risen to 29.6 %, and it is expected that in 2070 it will be 51.2% (EC, 2018). It is expected that the employment rate for older workers will increase because of pension reforms in most of EU countries by raising the retirement age (from 55.3% in 2016 to 67.9% in 2070 (EC, 2018)).

Analysing aging through sustainability aspects, "Transforming our world: the 2030 Agenda for sustainable development" could be considered (UN, 2015). Three development goals of seventeen could be discussed:

- Ensure healthy lives and promote well-being for all at all ages (Goal 3).
- Make cities and human settlements inclusive, safe, resilient and sustainable (Goal 11).
- Ensure sustainable consumption and production patterns (Goal 12).

Sustainable well-being of elderly could be assured through good indoor environment quality (IEQ) conditions indoors and sustainable design and production of products for older adults (for example, furniture).

Life cycle assessment (LCA) is quite a young methodology, which was developed from the collaboration between industry and universities. The term "life cycle assessment" was introduced in 1990, until that time the methodology was recognized by two different names: "Resource and Environmental Profile Analysis" (REPA) in the USA, and "Ecobalance" in Europe (Hauschild et al. 2018). LCA addresses several environmental issues. This tool is used while creating new products or during the redesign stage. LCA can show the level of sustainability and environmental performance while comparing different products (Kylili et al. 2015). Companies can identify opportunities to improve environmental aspects of their products in different life cycle stages. So, in the process of creation or redesign of different products dedicated for older adults, one can consider not only functionality and economic aspects but could create products which are sustainable and friendly to the environment.

IEQ and energy-related projects were carried out to test indoor environmental conditions in offices, residential houses and heritage buildings (Seduikyte et al. 2016, Grazuleviciute-Vileniske et al. 2017). The main research indicators in IEQ projects are thermal comfort, ventilation effectiveness, particular matter, voltaic organic compounds, and the energy efficiency of analysed spaces. Usually, field measurements, questionnaires, and computational fluid dynamics methods are used.

Thermal sensation of the elderly is different from the younger adults. Higher core temperatures and heat stress, less efficient reaction to cold because of reduced metabolic response appears with age. This leads to decreasing sensitivity to environmental temperature changes and can result in failure react appropriatly to maintain core temperature (Ma et al. 2017). The thermal sensation of elderly might be influenced by physiological and psychological influence.

Very few studies have analysed the perception of IEQ by people of different ages. There is a need for new research stream which will include sustainable aging.

Conclusions

Awareness of the growing percentage of elderly is present. A sustainable approach to the environment of elderly people is needed. This includes comfortable IEQ and sustainable production of products dedicated to the elderly.

References

- *European Commission (EC) 2018. The 2018 Ageing Report (ISSN: 2443-8014).*
- *United Nations (UN) 2015. Resolution A/RES/70/1: Transforming our world: the 2030 Agenda for sustainable development https:*
- *Hauschild M.Z., Rosenbaum R.K., Olsen S.I. 2018. Life cycle Assessment. Theory and Practice. Springer International Publishing. 1216 p.*
- *Kylili A., Fokaides P.A., Vaiciunas J., Seduikyte L. 2015. Integration of Building Information Modelling (BIM) and Life Cycle Assesment (LCA) for sustainable construction. Journal of Sustainable Architecture and Civil Engineering, 13, 4: 28-38.*
- *Šeduikytė L., Prasauskas T., Martuzevičius D., Haverinen-Shaughnessy U. 2016. Assessment of thermal comfort and CO2 concentrations in multi-family apartment buildings before and after retrofit - Lithuanian case study // Indoor Air 2016 [electronical version] : the 14th international conference on indoor air quality and climate, 3-8 July, 2016, Ghent, Belgium. Ghent : ISIAQ. p. 1-8.*
- *Gražulevičiūtė-Vileniškė I., Šeduikytė L., Liutikaitė O. 2017. Re-functioning of Inter-*

War Modernism Buildings in Kaunas (Lithuania): the Aspect of Users' comfort. Journal of Sustainable Architecture and Civil Engineering, 20, 3: 48-57.

- *Ma T., Xiong J., Lian Z. 2017. A human thermoregulation model for the Chinese elderly. Journal of Thermal Biology, 70, 2-14.*

This article/publication is based upon work from COST Action CA-16226 Sheld-on supported by COST (European Cooperation in Science and Technology).

COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation.

www.cost.eu

Funded by the Horizon 2020 Framework Programme of the European Union

sheldon

smart habitat
for the elderly

First Sheldon conference meeting
Proceedings Book,
Riga 10th October 2018
Cost action CA16226