

Supporting Older People at Home with a Mobile Robot for Independent Living

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Abstract— There is expected to be a shortage of health care resources in the future as the proportion of elderly people worldwide increases. To handle this challenge, it becomes important that people live as long as possible in their own homes which is also what most older people want themselves. Thus, a rising issue is how to incorporate technology to find efficient solutions for health monitoring and care for older people staying at home. Our multimodal elderly care systems (MECS) project funded by The Research Council of Norway aims to create and evaluate a multimodal mobile human supportive robot that can sense, learn and predict future abnormal events of a person. In this presentation, three important aspects of the project will be introduced including the *control architecture* of the robotic system, the *sensing* process and devices, and finally *design and privacy* issues, respectively. The designed control system handles the navigation of the robot in an indoor environment in the presence of static and dynamic known and unknown obstacles. The sensing part of the project deals with using various types of sensing devices for health monitoring and care purposes. Finally, the design part of the project focuses on the design issues of the robotic companion as well as privacy-related matters concerning having a mobile robot moving in a residential environment with a set of sensing and recording devices. The presentation will cover our main findings and experiences in the project building on a number of papers we have published, see list below:

- Diana Saplakan & Jo Herstad (2018). Fear, Feedback, Familiarity... How are These Connected? – Can familiarity as a design concept applied to digital feedback reduce fear?, In *ThinkMind, Digital World 2018, ACHI 2018, The Eleventh Int. Conf. on Advances in Computer-Human Interactions*.
- Jim Torresen (2018). A Review of Future and Ethical Perspectives of Robotics and AI. *Frontiers in Robotics and AI*.
- Md Zia Uddin; Weria Khaksar & Jim Torresen (2018). Activity Recognition Using Deep Recurrent Neural Network on Translation and Scale-Invariant Features, In *2018 25th IEEE Int. Conference on Image Processing (ICIP)*.
- Md Zia Uddin; Weria Khaksar & Jim Torresen (2017). Human activity recognition using robust spatiotemporal features and convolutional neural network, In Uwe D. Hanebeck (ed.), *2017 IEEE International Conference on Multisensor Fusion and Integration for Intelligent Systems (MFI)*.
- Md Zia Uddin, Weria Khaksar & Jim Torresen (2017). Facial Expression Recognition Using Salient Features and Convolutional Neural Network. *IEEE Access*.

- Rebekka Soma; Vegard Dønnem Søyseth; Magnus Søyland & Trenton Wade Schulz (2018). Facilitating Robots at Home: A Framework for Understanding Robot Facilitation, In *ACHI 2018, The Eleventh Int. Conf. on Advances in Computer-Human Interactions*.
- Trenton Schulz; Jo Herstad & Jim Torresen (2019). Animation Techniques in Human-Robot Interaction User Studies: a Systematic Literature Review, to be published in Volume 8 of *ACM Transactions on Human-Robot Interaction*.
- T. Schulz, P. Holthaus, F. Amirabdollahian, F., & K.L. Koay (2019, March). Humans' Perception of a Robot Moving Using a Slow in and Slow Out Velocity Profile. In 2019 14th ACM/IEEE International Conference on Human-Robot Interaction (HRI) (pp. 594–595). *2019 14th ACM/IEEE Int. Conference on Human-Robot Interaction (HRI)*
- Trenton Schulz; Jo Herstad & Jim Torresen (2018). Moving with Style: Classifying Human and Robot Movement at Home, In *ACHI 2018, The Eleventh Int. Conf. on Advances in Computer-Human Interactions*.
- Weria Khaksar; Md Zia Uddin & Jim Torresen (2018). Incremental Adaptive Probabilistic Roadmaps for Mobile Robot Navigation under Uncertain Condition, In *2018 15th Int. Conf. on Electrical Engineering, Computing Science and Automatic Control (CCE)*. IEEE.
- Weria Khaksar, Md. Zia Uddin, and Jim Torresen. "Learning from Virtual Experience - Mapless Navigation with Neuro-Fuzzy Intelligence", In *2018 IEEE Int. Conference on Intelligence Systems (IEEE-IS 2018)* September 2018.
- Weria Khaksar, Md. Zia Uddin, and Jim Torresen. "Fuzzy Motion Planning for Nonholonomic Mobile Robot Navigation in Unknown Indoor Environments", In *2018 International Conference on Mechatronics and Robotics Engineering (ICMRE 2018)*, February 2018. The paper has been selected and accepted for being published in the *International Journal of Mechanical Engineering and Robotics Research*.
- Weria Khaksar, Md. Zia Uddin, and Jim Torresen. Neuro-Fuzzy Sampling: Safe and Fast Multi-query Randomized Path Planning for Mobile Robots. In *International Conference on Robot Intelligence Technology and Applications* (pp. 13-27). Springer, Singapore.

ACKNOWLEDGMENT

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Presenter: Professor Jim Torresen, University of Oslo, Norway

Jim Torresen is a professor at University of Oslo where he leads the Robotics and Intelligent Systems research group. He received his M.Sc. and Dr.ing. (Ph.D) degrees in computer architecture and design from the Norwegian University of Science and Technology, University of Trondheim in 1991 and 1996, respectively. He has been employed as a senior hardware designer at NERA Telecommunications (1996-1998) and at Navia Aviation (1998-1999). Since 1999, he has been a professor at the Department of Informatics at the University of Oslo (associate professor 1999-2005). Jim Torresen has been a visiting researcher at Kyoto University, Japan for one year (1993-1994), four months at Electrotechnical laboratory, Tsukuba, Japan (1997 and 2000) and a visiting professor at Cornell University, USA for one year (2010-2011).



His research interests at the moment include artificial intelligence, machine learning, reconfigurable hardware, robotics and applying this to complex real-world applications. Several novel methods have been proposed. He has published approximately 150 scientific papers in international journals, books and conference proceedings. 10 tutorials and several invited talks have been given at international conferences. He is in the program committee of more than ten different international conferences, associate editor of three international scientific journals as well as a regular reviewer of a number of other international journals. He has also acted as an evaluator for proposals in EU FP7 and Horizon2020 and is currently project manager/principal investigator in five externally funded research projects/centres.

More information and a list of publications can be found here: <http://www.ifi.uio.no/~jimtoer>

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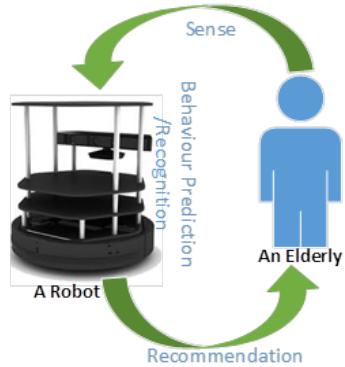
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MECS project: Multi-sensor Elderly Care Systems

Project Goal: Create and evaluate multimodal mobile **human supportive robots** that can sense, learn and predict future abnormal events of a person.



Workshop at Kampen Omsorg+



Dialogue/interviews: Design with user participation



User study: Linear acceleration is unfamiliar, but using the animation principle of *slow in and slow out* is more familiar?

MECS Research

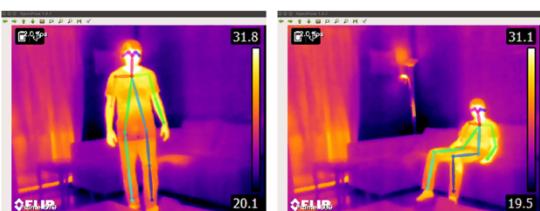


Diana Saplakan
Rebekka Soma
Trenton Schulz

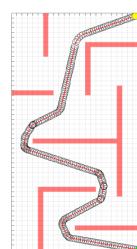
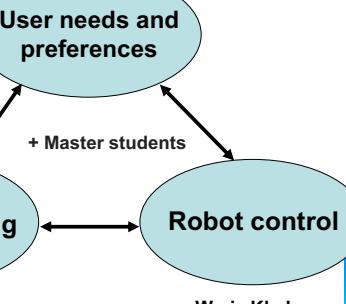


Apply sensors that provides non/less intrusive sensing/activity recognition:

- Thermal camera
- Ultra-Wide Band (UWB) radar
- 3D depth images



Ultra-Wide Band (UWB) radar



Md. Zia Uddin

Weria Khaksar

