Individual project

Affective Human-Robot Interaction

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Natural human-computer interfaces (HCI) are essential in creation of future ubiquitous computing (ubicom) systems. Social robots are expected to enter into the consumer markets within 10–15 years. Such robots could take care of many routine tasks that previously required human labor. Our research is motivated, for example, by the emerging needs of elderly care, health care, safety, and logistics.

The human-robot interaction (HRI) should be natural, like human to human communication. Humans can interact with the robot by simple gestures, emotions or speech commands. The human-robot interaction will take place locally in a "face to face" manner as well as remotely by using a mobile device and wireless communication.

Several computer vision methods are already available for supporting such affective interaction. Human faces, emotions, gestures, speech and even the walking style can be automatically recognized for example by state-of-the-art Local Binary Patterns and their spatiotemporal extensions, developed at the Machine Vision Group (MVG), Computer Science and Engineering (CSE) Laboratory, Department of Electrical and Information Engineering, University of Oulu.

The robot can utilize adaptive learning and mapping methods in its behavior and navigation. Intelligent Systems Group (ISG), also from the above mentioned CSE Laboratory, has a long experience in building intelligent indoor and outdoor robot systems.

The project is expected to produce leading-edge solutions for affective human-robot interaction in smart ubicom environments. An intelligent robot will detect and identify the user and personalize and customize its services according to this information. It will recognize the emotions of the user.

Another important aspect is how the robots can learn their behavior and the tasks they are supposed to carry out in dynamic environments. The robots should have online learning capabilities for adapting to new circumstances. The adaptation must be successful with different persons but also with the same person at different times. Short-term learning is needed to customize the interaction based on the user's personality and the current context. On the other hand, long-term learning is required in order to allow the interaction to continue to be engaging over long time periods.

Our objective is also to develop and study methods for utilizing the motion and embodiment of the robot, combined with learning, in order to create a socially appealing HRI system.

Key publications to date:

- *Kellokumpu V, Zhao G & Pietikäinen M (2010) Recognition of human actions using texture descriptors. Machine Vision and Applications, accepted.*
- *Hadid A & Pietikäinen M (2009) Combining appearance and motion for face and gender recognition from videos. Pattern Recognition 42(11):2818-2827.*
- *Haverinen J & Kemppainen A (2009) Global indoor self-localization based on the ambient magnetic field. Robotics and Autonomous Systems, 57(10):1028-1035.*
- *Röning J, Haverinen J, Kemppainen A, Mörsäri H & Vallivaara I (2008) Smart systems for distributed sensing. Proceedings of 11th Biennial Baltic Electronics Conference (BEC2008), Tallinn, Estonia, 21-30.*
- *Zhao G, Barnard M & Pietikäinen M (2009) Lipreading with local spatiotemporal descriptors. IEEE Transactions on Multimedia 11(7):1254-1265.*

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国家自然科学基金委员会
National Natural Science Foundation of China

Academy of Finland
Research funding and expertise