Universität Bielefeld

CITEC
Cognitive Interaction Technology
Cluster of Excellence
Bielefeld University

CITEC Newsletter 1/2014

In preparation for its use in the intelligent apartment, the emotional robot head "Flobi" (pictured) is tested in an interactive scenario. *Photo: CITEC*

Smart Apartment with a Robot Butler

Four new large-scale projects launched at CITEC

A production robot in a factory is bound by precisely demarcated limits: its work zone is a place where humans are not permitted.

For robots meant to help humans in daily life, though, this does not apply. Instead, service robots ought to adapt themselves to humans and should understand our living environment in order to be useful to us in a variety of ways. In a new large-scale research project, CITEC researchers are investigating how digital integration with a smart apartment might allow a service robot to better recognize routine tasks – from unpacking shopping items, to greeting the resident with a cup of coffee after returning home from work. By equipping the apartment with sensors and interactive surfaces that increase the robot's perception, it can connect to household appliances through interfaces, thus synergistically increasing its range of actions. As such, the entire apartment could becoming "caring" by providing for the needs of its residents.

This is one of the four new large-scale projects at CITEC. Each of the four projects investigates complementary perspectives on the overarching question of how the perception, cognition, and action of technical systems (such as robots) can functionally work together, resulting in everything from the exploratory play up to the goal-oriented activity that is observed in both humans and animals.

In this newsletter, we take a closer look at our large-scale projects (page 4). Between seven and twelve different CITEC research groups are working together on each project to realize the CITEC principle: discovering new ideas and knowledge through close cooperation of interdisciplinary experts.

Best Regards,
Helge Ritter, CITEC Coordinator

Leading Human-Robot Conference Held in Bielefeld

The most important conference worldwide on Human-Robot Interaction took place from the 3rd to 6th of March 2014 at CITEC. In previous years, the "ACM/IEEE International Conference on Human-Robot Interaction" (HRI) was held in Tokyo, Boston, and Lausanne. Emotional robots were one of the big topics during the Bielefeld conference. Over 300 scientists and researchers from more than 30 countries were in attendance.

www.humanrobotinteraction.org/2014

New Research Equipment for the Cluster of Excellence

After relocating to its new facilities, CITEC acquired several significant new pieces of research equipment, including a virtual walk-in 3-D room (Cave), which has been in use at the central laboratory since July 2014. An intelligent laboratory apartment was also added to the new CITEC facilities. From April on, the apartment is being fitted with cameras, microphones, and 3-D imaging sensors as well as visual displays, loudspeakers, and ambient lights. This smart apartment comes equipped with a service robot named "Mobile Manipulator M1". Additionally, two "Shadow" robot hands were purchased. Using a new logic analysis system, CITEC researchers can measure high frequency signals in circuits and microelectronic systems. Along with the new CITEC facilities, the new equipment (purchased at a cost of 2.5 million Euro) was financed through the research building funding initiative of the German federal government. In mid 2013, 260 researchers moved into the new CITEC facilities located on Bielefeld University's Campus North.

RESEARCH

Attention as a Linkage Process for Basic Brain Functions

International research group with CITEC participation publishes special journal issue

With articles on experimental psychology and neuroscience, a research group filled a journal: The international team was headed by Professor Dr. Werner Schneider from CITEC and Professor Dr. Wolfgang Einhäuser-Treyer from Philipps University of Marburg and funded by the Center for Interdisciplinary Research (ZiF, Zentrum für interdisziplinäre Forschung) of Bielefeld University. In the 17 articles published in the journal "Philosophical Transactions of the Royal Society B", psychologists, neuroscientists, and scientists

Professor Dr. Werner Schneider *Photo: CITEC*

from other disciplines demonstrated what an essential role attention processes play in perception, memory, and action control.

The ZiF research group worked under the name "Competition and Priority Control in Mind and Brain: New Perspectives from Task-Driven Vision."

From October 2012 through the end of July 2013, more than 40 researchers from Australia, Denmark, Germany, France, Great Britain, the Netherlands, Canada, Israel, Sweden, and the United States came to Bielefeld University to discuss the important topics in current research on attention.

"We focused on the issue of how perception, memory, and action control are related," says Professor Schneider. Until recently, these three areas of research were mostly considered separately from one another. According to the CITEC researcher, "however, they are closely linked by the current task (goal)." The task determines which information is perceived, remembered, and used when taking action.

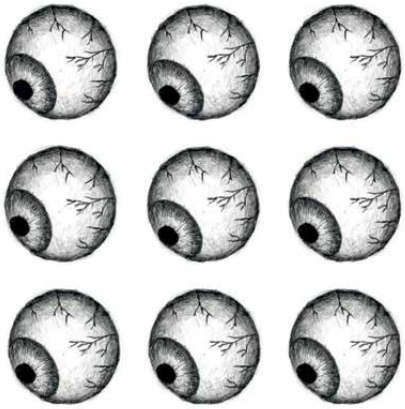
One illustrative example is reaching for one specific porcelain figurine among many. "Before I pick it up, my brain has to access information about how heavy such figurines typically are. My visual perception must tell me approximately how far the object to be picked up is located from my hand. I have to ignore sensory and memory information about other figurines in the area. Only then can I confidently reach for it," explains Schneider.

Due to competition between information from several sources – perception, memory, and action control – some win out: certain brain processes determine what will receive priority and what will not. Schneider calls this "priority control" and describes it as such: "What information takes priority depends on the particular task. When grasping an object, our brain needs other types of information than for driving or dancing."

"Our guiding assumption is that priority control, selection, and competition are key features of attention processes. They determine what information is encoded, retrieved, and used." Such information can affect all of the senses. The ZiF research group focused on the visual brain, which will serve as a departure point for future analyses of brain processes of hearing and touch.

Members of the research team brought together their latest research insights in the journal "Philosophical Transactions of the Royal Society B." The first articles published in this journal appeared in 1665. Famous contributors include Isaac Newton, James Clerk Maxwell, Michael Faraday, and Charles Darwin.

The October 2013 issue contains 17 peer-



The ZiF research group studies attention and vision. Their symbol is an eye in publications.

reviewed articles from members of the ZiF research group on a variety of different topics. Psychologist Signe Vangkilde PhD from the University of Copenhagen (Denmark) describes in her article how temporal expectations control selective vision. "In traffic, expectations play an important role in indicating when and where possible dangers might arise," describes Werner Schneider. Computer scientist and psychologist Greg Zelinsky PhD from Stony Brook University in New York, introduces a model of how eye movements are controlled when searching for every day items.

Biologist Dr. Stefan Everling from the University of Western Ontario (Canada) describes in his article how two central brain structures work together when overt attention is directed in space.

In his own article, Werner Schneider develops a new theory on how visual attention processes work together with working memory processes in order to effectively control basic actions in a task-driven way.

Publication

Werner X. Schneider, Wolfgang Einhäuser-Treyer und Gernot Horstmann (eds.). "Attentional selection in visual perception, memory and action" (Special Issue). Philosophical Transactions of the Royal Society B: Biological Sciences, published on 19 October 2013.

http://rstb.royalsocietypublishing.org/site/2013/attention.xhtml

How Babies Learn New Words

CITEC teams in profile: "Emergentist Semantics" research group

The CITEC research group headed by senior lecturer Dr. Katharina Rohlfing brings together linguistics and developmental psychology. From a linguistic approach, the researchers are looking at the issue of how small children acquire words and grammar – the very structure – of a language. The psychological approach considers another question dealing with the acquisition of concepts: how do children learn the meaning behind a word?

Since 2008, Katharina Rohlfing has led the "Emergentist Semantics" research group. "Parents are the key resource in a child's learning," explains Dr. Rohlfing, a linguist. She and her team analyse which strategies parents use to teach their children language: "These tutoring strategies can be used, on the one hand, to give suggestions to other parents on how they can support their children's learning. On the other hand, these strategies can also be applied to robotic development by teaching robots language as one would a small child," explains Dr. Rohlfing. Such learning robots were developed in cooperation with European partners from the Marie Curie Doctoral Training Network in Developmental Robotics, RobotDoc.

In their research, the team observed how parents teach their children different actions. An important point here is "acoustic packaging" – the idea that language helps small children to differentiate individual units within a sequence of events. "One example is handwashing," says Rohlfing. Handwashing is a set of many individual actions, including going into the bathroom, applying soap, washing up, and then drying off. According to Rohlfing, parents typically draw their children's attention to the fundamental aspect of the activity by saying "wash your hands" as soon as the children put their hands under the water.

Since 2008, senior lecturer Dr. Katharina Rohlfing (back, middle) has led the "Emergentist Semantics" research group.

With her research, Rohlfing demonstrates how for babies as young as three months old, the way in which parents interact with their children forges important connections between words and actions, which are critical in later language acquisition. "From as early as six months, it appears to be important that parents make their explanations dependent on their children's attention," she describes. "It is a widely held misconception that children first understand nouns above all else." To test whether an infant makes the link between an action and a word, the team used film sequences in their latest trials. Videos of different actions – laughing and drinking – were shown to a child on two different screens. The child's accompanying chaperone would say one of the phrases that goes along with the action shown in the video (e.g. "Look, the baby is drinking!"). "When the child looked at the scene and had it repeated to them, the child would most likely internalize the term."

Katharina Rohlfing and her colleagues have considered the significance of pointing gestures in language development. "When a baby looks at an object that arouses its interest, it continues the communication and encourages the other person to talk with him or her," explains Rohlfing. "It is likely that babies who do not use pointing gestures often learn to speak at a later age than other children."

The research conducted by this team is not limited to children who are learning the German language. In order to determine how parents help their children to differentiate distinct steps in a series of actions using acoustic packaging in a cross-linguistic context, Rohlfing, who was born in Poland, is working together with Professor Dr. Joanna Rączaszek-Leonardi from the University of Warsaw.

Selma Šabanović: Gender Visiting Professor at CITEC

When are robots assigned a male or female gender? Do men and women think about or interact differently with robots? How do our social notions and lived experiences of gender influence the design and use of social robots? Social informatics and human-robot interaction researcher Selma Šabanović PhD (photo) from Indiana University in Bloomington, USA, investigates questions such as these. In June and July 2014 she was Gender Visiting Professor at Bielefeld University. Šabanović gave lectures and discussed research on gender, culture, and robotics in seminars at CITEC. Selma Šabanović's field of research focuses on the interaction between humans and machines and intercultural studies of science and technology. She also applies social analysis to shed light on the use and the design of robots. She researches, for example, how laypeople experience and use robots in everyday situations, at home or in nursing facilities.

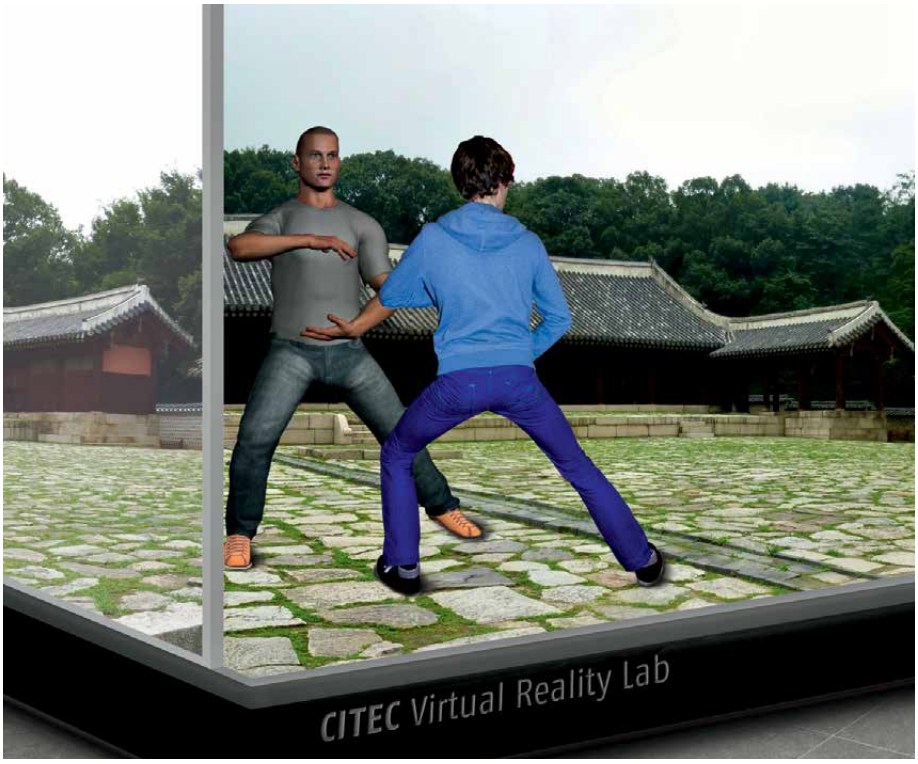
13 New PhD candidates

The CITEC graduate school has admitted 13 new PHD candidates and will fund their research for up to three years. The doctoral students began their doctoral research projects between January and May 2014. Among the new doctoral researchers is biologist José Monteagudo, who is researching how flies orient themselves in virtual environments. Natalia Reich-Stiebert, a doctoral candidate in Psychology, is studying how robots can be used to assist in foreign language learning. Until October 2014, the interdisciplinary graduate school will admit twelve additional doctoral researchers.

RESEARCH

From Virtual Trainers to Walking Robots

Four large-scale projects will run until 2017 at CITEC



The ICSPACE project is developing a virtual coach that will support, for example, tai chi exercises for patients undergoing rehabilitation. *Photomontage: CITEC/Bielefeld University*

The CITEC Cluster of Excellence is driving its strategic research goals with four major new research projects. One of these goals is to develop technical systems that are able to flexibly adapt in changing situations. CITEC has invested four million Euro in the four projects, which will be completed in 2017.

CITEC teams from a wide variety of disciplines are working together on these major projects. Researchers in computer science, linguistics, neurobiology, psychology, and sports science, for example, are cooperating on the "Intelligent Coaching Space" (ICSPACE) project. They aim to develop methods that would allow athletes as well as patients in need of rehabilitation to train in a virtual environment. For their project, researchers received a walk-in, virtual 3-D room named "Cave" – a cube with projections onto the floor, front wall, and along with the left and right walls. In the future, a virtual trainer will be there to instruct participants in tai-chi, yoga, and aerobics.

Walking robot "Hector" – pictured as a design model – should, in the future, be able to move along unfamiliar ground without the help of pre-specified navigational data.

In another one of the major research projects, CITEC teams are working to develop a self-teaching robot. It consists of a robot head, which is placed upon an upper body fitted with two arms and hands. The robot head originated with the CITEC research line "Flobi" and can depict emotions in its facial expressions. As part of the project the robot will learn to grasp objects with its Shadow Dexterous Hands, which are modelled on human hands in terms of size, shape, and manoeuvrability. The robot is supposed to be able to explore and experiment with objects on its own in order to understand their use.

What does a robot need to orient itself in a place that is not easily traversed, without the help of pre-specified navigational data? CITEC researchers are examining this question with the help of a walking robot named Hector. He is meant to learn how to precisely "perceive" his own body and his surroundings. In order to accomplish this, the robot must combine very different sensory information, including how its physical movements impact sensory data. The prototype design for the robot was based on the stick bug. The aim of the project is not only to research a conceptual design for elastic robotic systems alone. In the future, Hector should serve as an experimental platform for biologists to test assumptions about insect walking behaviour.

The fourth major research project deals with the development of a "socially competent" apartment. In the future, this intelligent apartment and its service robot may assist humans with daily chores and help make their lives more comfortable. The conception of the intelligent apartment is so remarkable because it is not limited to providing single services, like cleaning rooms or answering the phone. Instead, the apartment should learn to understand real-life situations and to react flexibly to human needs by offering appropriate services to suit the situation at hand. The intelligent apartment is part of the new CITEC facilities, which were completed in June 2013. The laboratory apartment is 60 square meters in size and has three rooms in which a kitchen, living room, fitness area, and a bathroom have been placed.

Legal Notice

Publisher
Cluster of Excellence Cognitive Interaction Technology (CITEC) at Bielefeld University.
Coordinator: Professor Dr. Helge Ritter
Inspiration 1, 33619 Bielefeld, Germany
Phone: +49 521. 106-65 64
info@cit-ec.uni-bielefeld.de
www.cit-ec.de

Editorial
Jörg Heeren (legally responsible for content according to German Press Law)
kommunikation@cit-ec.uni-bielefeld.de
CITEC is funded as part of the excellence initiative of the German federal and state governments.