SGER: Social-Emotional Intelligence Prosthetic

Summary

The proposed research will develop the first known wearable device capable of perceiving and reporting on social-emotional information in real-time human interaction. Using a small wearable camera and customized video and pattern analysis algorithms, the system will automatically read and interpret the facial expressions and head movements of the person the wearer is interacting with and will communicate its inferences to the wearer via sound or tactile feedback. The system builds on and extends the computational model of "mind-reading" in el Kaliouby (2005), which forms the basis of an automated system for the inference of mental states from head and facial displays in a video stream in real time. Bringing together and expanding upon recent advances and methodologies in three key scientific and technical areas—affective computing, wearable computing and real time machine perception, the project will significantly advance the nascent ability of machines to infer cognitive-affective states in real-time from nonverbal expressions of people engaged in a range of natural interactions.

The proposed work is for the first prototype of what is expected to become a sequence of increasingly intelligent prosthetics. The project is creative and exploratory: being the first wearable computer that implements social-emotional intelligence communications, the design and strategy are original and will open up new lines of inquiry in understanding the role of social-emotional cues in natural interaction. The proposed effort is a risky endeavor: the automated perception of nonverbal cues and inference of mental states are problems that continue to challenge researchers in the domains of machine vision and machine learning. These problems become even more complex if the system is required to execute in real-time and to generalize to novel situations and people, a necessary requirement in the case of an assistive technology. In addition, the project addresses open research questions pertaining to whether machine perception can be reliable enough and comfortable enough to augment social interactions in a way that improves human to human communication. Finally, the challenge is further complicated by the requirement of operating in a mobile environment with varied lighting conditions and limited processing and power. The P.I. is well acquainted with the enormous intellectual and technical challenges posed by this project, having over a decade of experience designing and testing wearable systems with computer vision, machine learning, pattern recognition and affective user interfaces, and also years of experience in autism research.

Intellectual merit of the proposed activity: The proposed project is the first of its kind: its design and strategy are original and potentially powerful for aiding people with Autism Spectrum Disorder (who are impaired in their ability to perceive social-emotional cues) and for improving understanding of the role of social-emotional communication in natural human interaction. The project will advance the ability of machines to infer cognitive-affective states from nonverbal expressions of people engaged in natural interaction, and will enable the context of the perceiver to begin to be exploited in improving performance of real-time perceptual inference algorithms. The proposed system will expand social-emotional perceptual and communicative capabilities of machines and will be a significant first step toward aiding people who have need of help with these capabilities now. Being the first prosthetic assistive technology that is designed to augment a person's lack of or impairment in socio-emotional intelligence skills, the project has the potential to lead to a line of new research.

Broader impacts of the proposed activity: A system with social-emotional perceptual abilities can potentially assist the growing number of ASD individuals in perceiving communication in a natural rather than a structured environment, bootstrapping their ability to learn and develop in social settings. The proposed system will also provide a new tool for researchers on collaborative systems to more carefully examine the communication of non-verbal cues in natural everyday communication. The results of this interdisciplinary work can be leveraged in human-computer interaction, wearable computing, robotics and in future technologies with social-emotional intelligence. Long term, this research is also expected to contribute to understanding the theory and treatment of Autism Spectrum Disorders. Results will be distributed in all of these communities through peer-reviewed publications and conference presentations, as well as through forums for attracting more minorities to scientific and technical fields. This work promotes the training and education of students by deeply involving them in the proposed research activities in close collaboration with the P.I. The P.I. and post-doctoral associate are underrepresented minorities and are committed to growing the participation of such individuals in cutting-edge scientific research.