

Project Abstract

People with quadriplegia, a debilitating disability characterized by the inability to move or experience sensation in all four limbs, are unable to effectuate the physical tasks associated with many basic aspects of daily life such as grooming one's hair, brushing one's teeth, eating, drinking, navigating one's environment, opening doors, opening cabinets, reaching for a book, answering a phone call, etc. Even reflexive, insignificant physical gestures such as touching one's face are beyond the capability of people with quadriplegia. Inevitably, the execution of these basic everyday tasks, which the vast majority of people without disabilities do almost reflexively, becomes the responsibility of caregivers for people with quadriplegia, thereby impeding their ability to live independently and in the process causing a deleterious impact on their emotional and physical well-being.

This seed proposal seeks to develop *iCanDo*, a cyber-physical technology that will empower people with quadriplegia to interact with their physical environments without assistance, and accomplish the basic tasks defining daily life that until now have simply been impossible for them to do by themselves. *iCanDo* will be centered on a *robotic-arm augmented wheelchair* that is interfaced to a tablet device and a camera that are both mounted on the wheelchair. The user interacts with the robot arm through the tablet interface via the three dominant input modalities that support hands free interaction, namely, eye gaze, voice and orally-activated mouse. Aided by computer vision methods, the user's intention such as "pick up the cup of coffee" is inferred from these multi-modal inputs and gets translated into an appropriate plan for directing the robot arm precisely towards the cup and grasp it.

iCanDo stands to bridge the divide that many people with quadriplegia face in their ability to navigate their worlds. It serves as a transformative vehicle for independence, autonomy, and social equity for members of a population that have been marginalized in many technological advancements.

This project is an interdisciplinary collaboration between a roboticist from Mechanical engineering (Nilanjan Chakraborty), Health Technology and Management (Brooke Ellison who herself is a quadriplegic) and three specialties in Computer Science, namely, Computer Vision (Haibin Ling), HCI (Xiaojun Bi) and Accessible Computing (IV Ramakrishnan). A series of novel techniques will be developed involving reliable and safe robot arm motion planning, robust visual situation awareness, and synergistic integration of multi-modal inputs for inferring user's intentions. The unique amalgamation of Robotics, HCI, Computer Vision and Accessible Computing will arguably tackle a challenging problem of immense significance that has the potential to transform the lives of people with quadriplegia.