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1) Telerobotic Manipulation for Healthcare Applications

Teleoperation has shown to be a successful technology for enabling people to interact with robots. Through teleoperation, even complex humanoid robots have performed a variety of challenging manipulation tasks, such as retrieving common household objects for their human companions. In addition, the application of teleoperated manipulators to health applications has recently become commercially viable, as witnessed through such systems as the daVinci surgical system from InTouch Health Inc. The majority of *deployed* telerobotic manipulators in the healthcare domain though is focused on surgical applications. Yet, there are still open areas of need that these telerobotic systems can address in the home environment. Through teleoperation, quality of life for older adults and/or people who experience disabling circumstances could be improved, by, for example, executing grasping, pick-and-place, and fetch-and-carry tasks. It could similarly aid clinicians and healthcare professionals providing treatment. There are numerous challenges though that must be addressed - determining the roles and responsibilities of both human and robot in order to ensure that the cognitive load of the user is not increased, developing technology (intuitive interfaces, haptic devices, etc.) that does not require extensive training before effective use of the telerobotic system, and developing methods to allow an increase in the number of telerobotic systems that can be controlled by one user. Aspects of these concepts have been addressed, in some way or another, in other domains such as for multi-agent networks and gaming systems. It therefore seems a natural evolution to bridge concepts in other application areas to address relevant issues for telerobotic manipulation in the healthcare domain.

2) Assistive Therapy through Therapist/Patient Observation

Machine learning techniques have currently been deployed in a number of real-world application areas – from casino surveillance to fingerprint matching. That fact, coupled with advances in computer vision and human-computer interfaces, positions systems that can learn from human observation at the point where they can realistically and reliably be deployed as functional components in autonomous control systems. Healthcare applications though pose a unique challenge in that, although autonomous capability might be available, it might not be desired. And yet, based on recent studies focused on assessment of the changing demographics of the word, there is a need for technology that can deal with the shortcomings envisioned in the workforce. A challenge is therefore to find healthcare applications that can both benefit from integration of autonomous systems, as well as be accepted by the healthcare professionals and patients. Traditional roles for robotics have focused on repetitive, hazardous or dull tasks. If we take the same stance on healthcare applications, we find that some therapeutic activities fall under this traditional classification due to the long-repetitive nature of the therapist-patient interaction. There are numerous challenges though that need to be addressed – primarily

focused on how to effectively transition knowledge of the therapist from human to robot while maintaining the expertise and presence (when available or needed) of the therapist, and determining the various activities an autonomous robot should assist with in the therapy cycle. Of special concern it to develop mechanisms that can provide feedback from robot to therapist so that the therapist can successfully monitor progress and activities accordingly.