Personalized Assistive Robots

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A fundamental goal for increasing the quality of life for an aging population is enabling people to be self-sufficient for longer periods of time. All too frequently these days, otherwise healthy people are forced to move to assisted living facilities because they lack certain basic skills – either motor or cognitive – that prevent them from living on their own. Even when the person has a spouse who is able to act as a caregiver, the physical and psychological effects on the spouse often quickly becomes extreme. Outside caregivers can fill the gap, but full-time professional caregivers are very expensive.

Robots could fill such roles. For one, they could act as both physical and cognitive assistants – helping guide the elderly when they walk (a kind of "smart walker"), helping them get up, reminding them to take pills and to eat, talking them through activities of daily living, reminding them of scheduled activities, acting as a "smart shopping cart" by helping them to find items in aisles as well as carrying the items (and loading/unloading them).

In addition, for everyday activities the robots could monitor the person and provide feedback to that person, their relatives, and physicians. Aspects to be monitored might include eating, toilet and sleeping habits, how well the person walks or climbs stairs, whether they fall or are having trouble getting out of chairs, sofas, or bed.

Thirdly, robots could be rehabilitation coaches. The treatments for many injuries involve repetitive exercises to improve certain functionality, be it physical therapy, occupational therapy, speech therapy, or cognitive exercises for people with traumatic brain injuries. The overall strategies are similar – people are taught techniques in the doctor's office or clinic, practice a bit there, and then are supposed to go home and continue practicing on a daily basis, until they are seen again. It is well known, however, that compliance is not very high in most cases and, even when people do repeat the exercises, they often do them incorrectly which, in the best case, just wastes their efforts and, in the worst case, can exacerbate the situation. The concept here is that the robot would watch the people doing their exercises at home and provide guidance for correcting mistakes, offer encouragement, and track progress. The robot would act as personal coach that augments the professional therapist.

These concepts all require certain robotic capabilities (besides the standard ones of navigation and manipulation). For one, such robots will need to be extremely perceptive of humans – they need to infer intention from watching people's actions (e.g., are they going to watch TV, are they getting ready to exercise), detect the person's state (e.g., what is their energy and pain level), and understand motions and actions in detail (e.g.,

how well are they walking, how well are they doing their knee exercises). These perceptions will need to be tailored to the individual – how does the person's gait compare to what was seen the other day, or last month; are they walking more or less than before; is the need for reminders increasing? By personalizing the perception to the individual, more accurate conclusions (and diagnoses by doctors) can be reached.

Another common theme is socialization. Many people find technology to be intrusive, and the elderly are not going to easily "take orders" from a mere machine. The robots will have to have personalities and character that people find pleasant, not annoying. The robots will have to adhere to social norms, such as when going through doors or entering elevators, so that they will be more readily accepted. Again, it will be beneficial if the social interactions are tailored to the individual. For instance, some people respond better to a nurturing personality, while others need more directed help. Recent work has shown that some people may prefer more "chipper" robots while others prefer their robots to be more sedate. Proxemics (personal space) varies amongst people, as well, and is important for making people feel comfortable around robots. These characteristics may vary not only between people but also at different times for the same person – for instance, when people are tired, they often like to be treated in a more nurturing way. By trying different strategies, the robot will have to learn what works for the individual in various situations.

Finally, there may be tremendous opportunities for personalized, social robots to act as companions – engaging people in conversation, remembering special events and holidays, helping people to keep in touch with friends and loved ones. Again, to be accepted, the robots will have to display consummate social skills and personalize their interactions in ways that are well beyond the current state of the art.

There is a huge potential for robots to be assistive caregivers for the elderly and the disabled, improving their quality of life and enabling them to be on their own for longer periods of time. There is also a great risk that the technology will be abandoned if it is perceived to be annoying and unhelpful. It is imperative, therefore, that these assistive robots be developed with good social and interpersonal skills, to enable them to personalize their interactions with individuals.