Personal Assistance Robots: Will they improve the lives of aging adults?

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Outline

- Motivation for personal assistance robots
- Challenges for physical assistance robots
- Making robots more likeable
- Making robots functional, safe and affordable
- Promising technologies for physical assistance robots
- My group's related research
- Conclusions

Motivation for personal assistance robots

- In Canada, the demand for home care is projected to grow by 3.1% per year, while home care workers are only expected to increase by 1% per year [1].
- According to [1]: "technology, including robotics and artificial intelligence that can aid senior residents, will need to play a significant role."
- Based on a U.S. study, aging adults are receptive to robots assisting with chores and manipulating objects at home [2].

- [1] Mark Gollum, *CBC News*, 2017.
- [2] C.-A. Smarr *et al.*, *Int. J. Soc. Robot.*, Apr. 2014.

Challenges for physical assistance robots

- Many "social robots" exist, and some are being used by aging adults.
- This webinar is focused on robots for physically assisting people.
- Very few physical assistance robots have been sold.
- Why?

Challenges for physical assistance robots

- Main reasons why physical assistance robots are not commonplace:
  - Negative feelings about robots
  - Safety concerns
  - Affordability
  - Shortage of R & D funding
  - Diversity of users
  - Diversity of needs (i.e., physical, mental, emotional, etc.)

Making robots more likeable

- I think robots that look like animals are more likeable than ones that look like people.
-  vs. 

- Let the user personalize their robot.
  - E.g., Choose its look, its voice, its personality and its level of intelligence.
- Give the robot a sense of humour.

Making robots functional, safe and affordable

- Conventional robots:
  - Are made from metal, hard plastic or carbon fibre.
  - Use electric motors with high-ratio transmissions to provide enough torque to drive their joints.
- The use of rigid parts and high-ratio transmissions makes these robots both expensive and unsafe.
- They can be made safe by incorporating complex sensors and software, but this further increases the price.

Making robots functional, safe and affordable

- E.g., JACO robot arm by Kinova.
- It is functional and safe, but its price of ~$50,000 makes it unaffordable for most people.
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- Is there a better way?

Making robots functional, safe and affordable

- **The answer is yes!**
- Instead of modifying existing designs, we must radically change the way robots are made and actuated.
- Employing soft pneumatic actuators and soft materials is a promising approach for personal assistance robots.
- The compliance and low inertia of the air and soft materials will make these robots inherently safe.
- The materials and fabrication methods are much less expensive than the conventional ones.

Promising technologies for physical assistance robots

- Video of soft pneumatic robot arm from the University of Science and Technology of China:

https://www.youtube.com/watch?v=pD9leGB5sAA

Promising technologies for physical assistance robots

- Knee exoskeletons using soft pneumatic actuators from Roam Robotics

- Video:
- https://youtu.be/HXbt7VotT90

Promising technologies for physical assistance robots

- "Powered clothing" by Seismic, a soft exoskeleton that can be worn under clothes.

Promising technologies for physical assistance robots

- Video of "Spot mini" robot from Boston Dynamics (now owned by Hyundai):
- https://www.dropbox.com/s/0bxfty9lfg1bphr/Boston%20Dynamics%20Spot%20Mini.mp4?dl=0

My group's related research

- Our objective:
  - To create technologies applicable to both personal and industrial robots.
- Areas:
  - Design, manufacturing and control of soft pneumatic actuated robots
  - Hybrid pneumatic-electric actuated robots
  - Quiet methods for generating compressed air
  - 3D vision for robot programming and control
- A couple of example videos…

My group's related research

- Soft pneumatic actuators.
- This prototype can lift 118 times its own weight, and costs less than $8 to make.
- Video: https://mcmasteru365-my.sharepoint.com/:v:/g/personal/gary_mcmaster_ca/EVnnZMdBbqtHp9bLJPX56doBRuRIs6Ow6SPWecCA4lijqg?e=UeHPIX

My group's related research

- Robot arm control using 3-D vision and natural hand motions
- Video: https://www.dropbox.com/s/t5rotaiekoslh41/NaturalMotionControlDemonstrations.mp4?dl=0

Conclusions

- The need for personal robots for physically assisting aging adults and/or their caregivers is not being met by current robots or current assistive devices.
- Robots and exoskeletons employing soft actuators and soft materials are the most promising approach for achieving performance, safety and affordability.

Conclusions

- These robots must be designed based on the users' needs and preferences.
- More information is needed from potential users and caregivers.
- We are very interested in collaborating with other researchers.

- Thank you for your attention!
- I welcome your comments, suggestions and questions about this topic and my group's research.
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