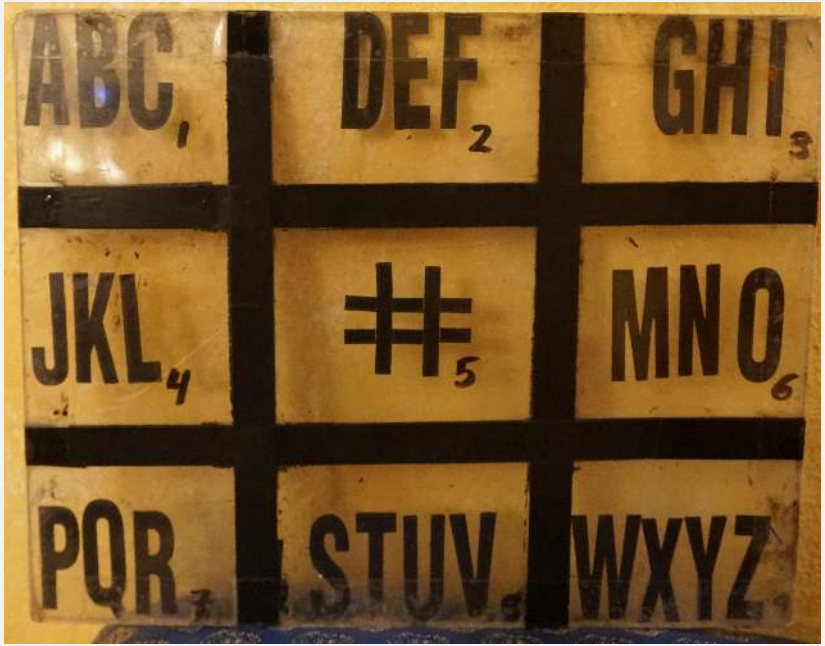
Increasing Independence with Stretch RE1

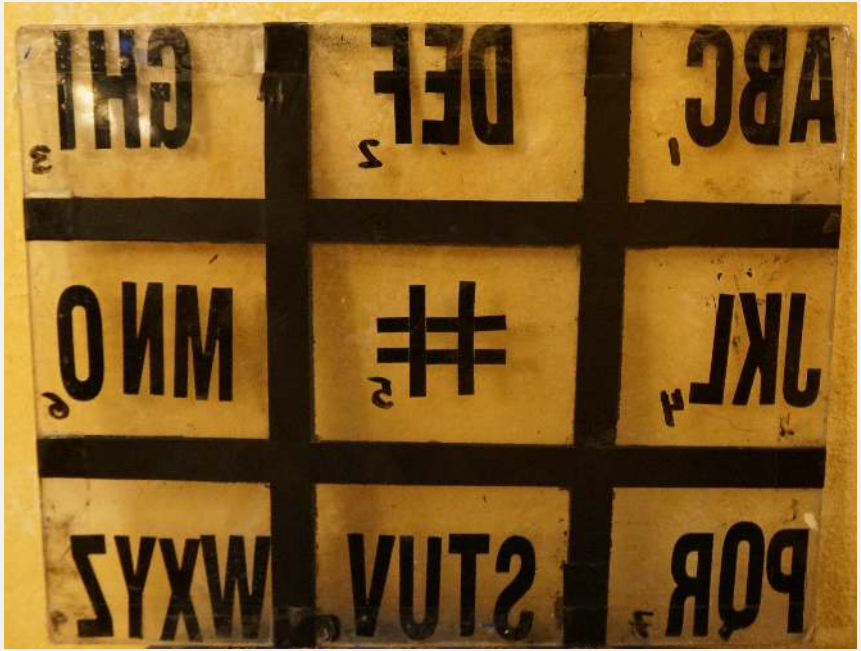
Vy Nguyen, OTD

Image courtesy of
Henry and Jane Evans

The Famous Letterboard



Henry's View



Caregiver's View

The Letterboard In Action

The Value of Occupational Therapy

The Caregiver Principle

“No matter how much assistance a device provides to a [adult] patient, it will not be used regularly unless it also takes no time to either set up or use by the caregiver, and unless it makes the caregiver’s life, a lot easier.”

~Henry Evans

A Rad Team

Pacific University Oregon

Vy Nguyen

Maya Cakmak

Kavi Dey

Tapo Bhattacharjee

R4H

Henry & Jane Evans

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

Travis Kadylak

Megan Bayles

Wendy Rogers

Harshal Mahajan

Leo Galoso

hello robot™

Aaron Edsinger

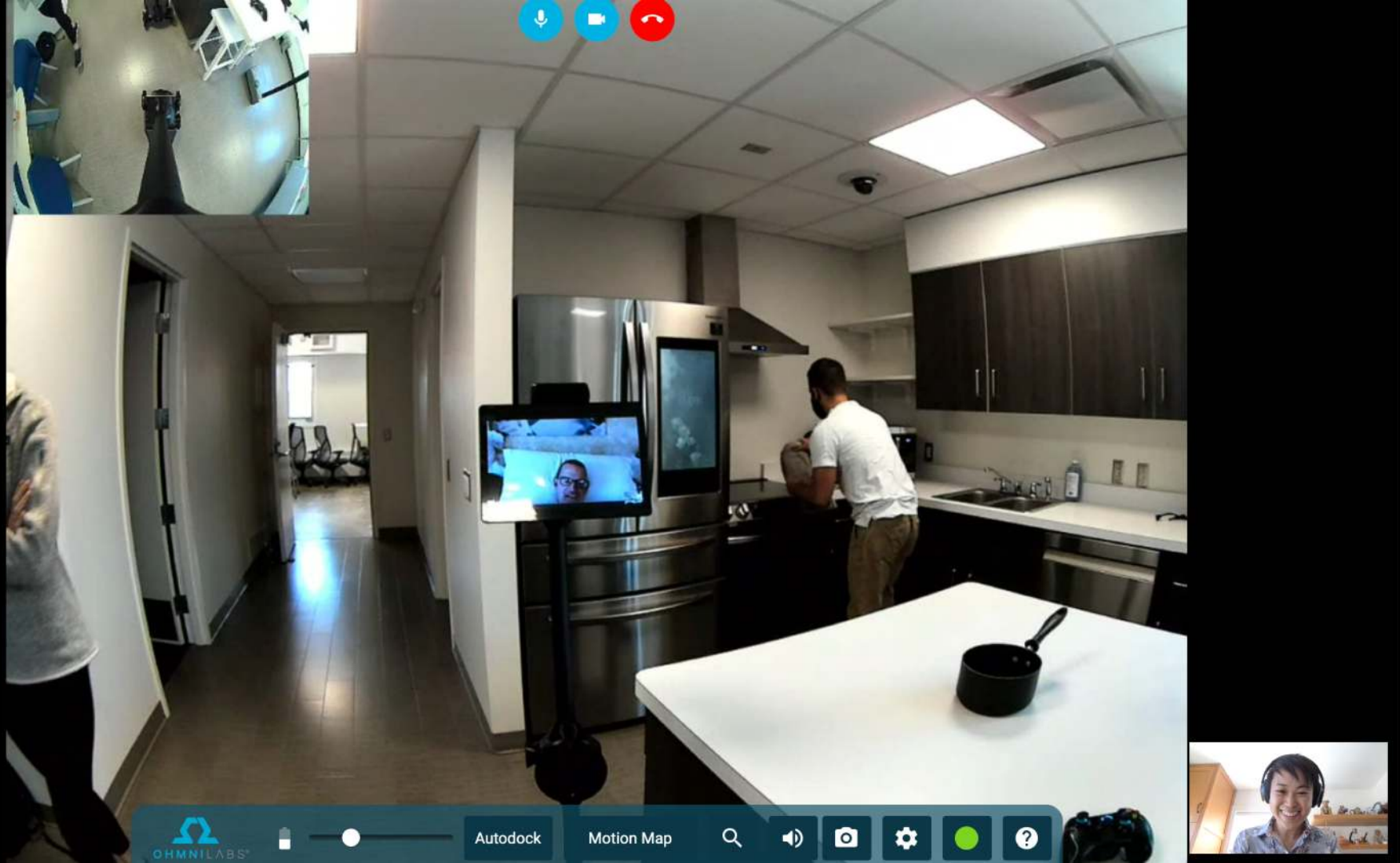
Elliston Franks

Charlie Kemp

Blaine Matulevich

Binit Shah

hello robot™


OHMNILABS
Autodock
Motion Map

Maru Cabrera
Robotics Instructor
Global Innovation Exchange (GIX)

Tapo Bhattacharjee
Assistant Professor
Cornell University

Kavi Dey
Research Intern
Seattle Academy

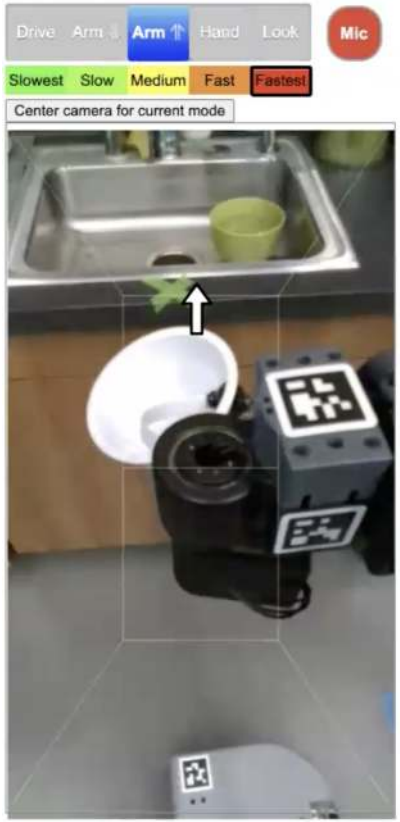
Maya Cakmak
Associate Professor
University of Washington

PAUL G. ALLEN SCHOOL
OF COMPUTER SCIENCE & ENGINEERING

Accessible Teleoperation

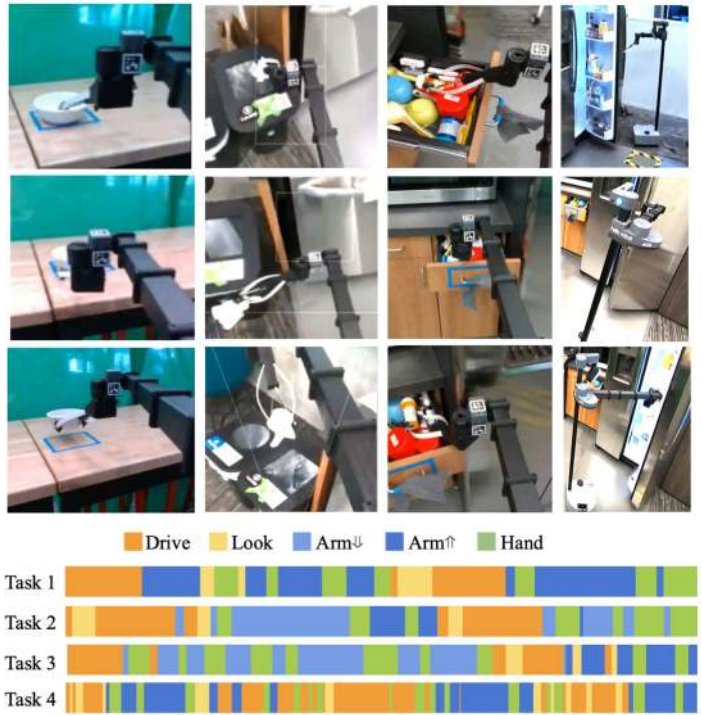
How can we enable the efficient control of the Stretch robot by diverse users?

WHAT PROF. CAKMAK AND HER TEAM ARE DOING WITH STRETCH



Asked people to control the Stretch with current interface

Perform realistic tasks in a kitchen

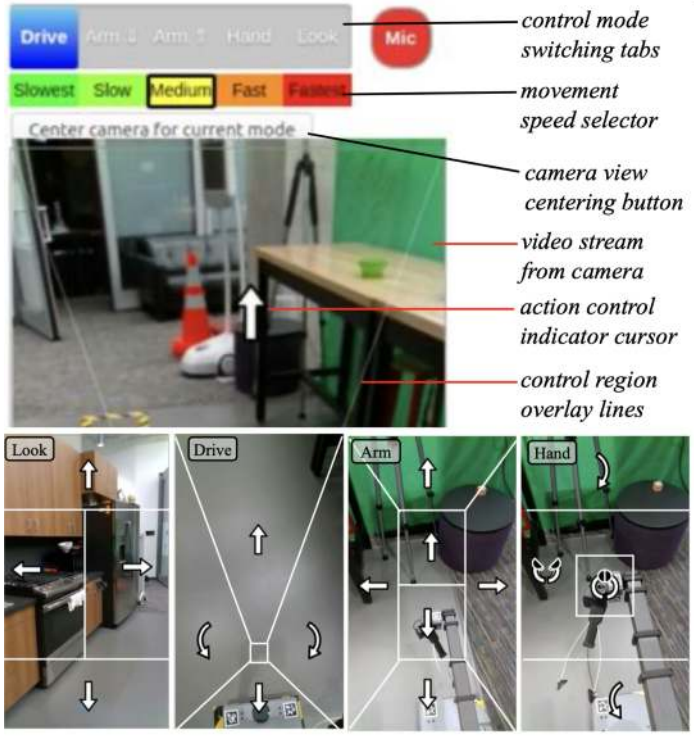


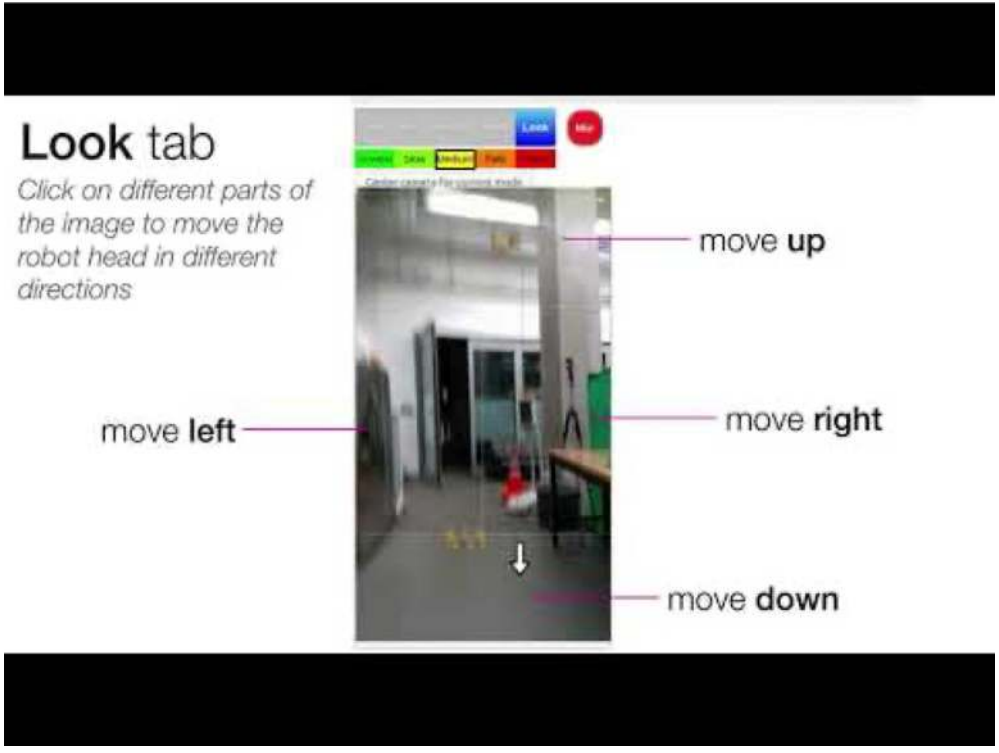
Observe usage patterns, inefficiencies, and challenges, assess accessibility, inform alternative versions

PAUL G. ALLEN SCHOOL OF COMPUTER SCIENCE & ENGINEERING

Teleoperation kit

Try our interfaces, give us feedback, share what you have





https://www.youtube.com/watch?v=ZFzt1W56_eg

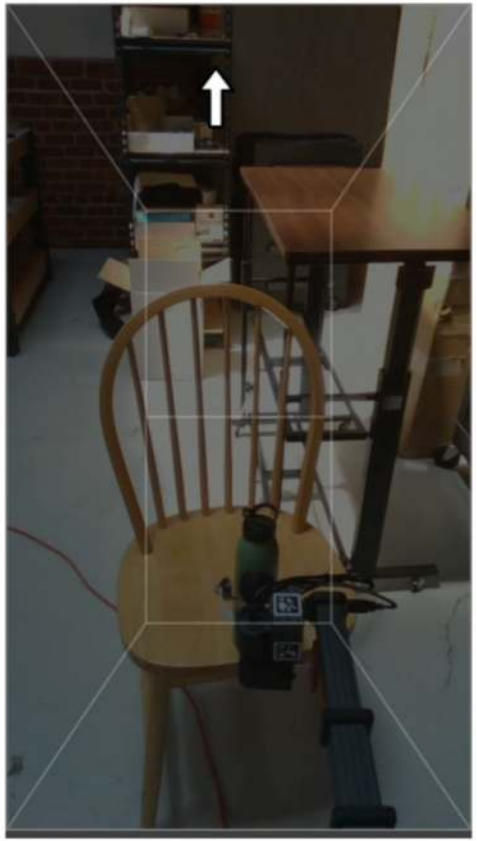
10.1.10.220

Drive | Arm ⇓ | **Arm ⇑** | Hand | Look

Mic

Slowest | **Slow** | Medium | Fast | Fastest

Center camera for current mode

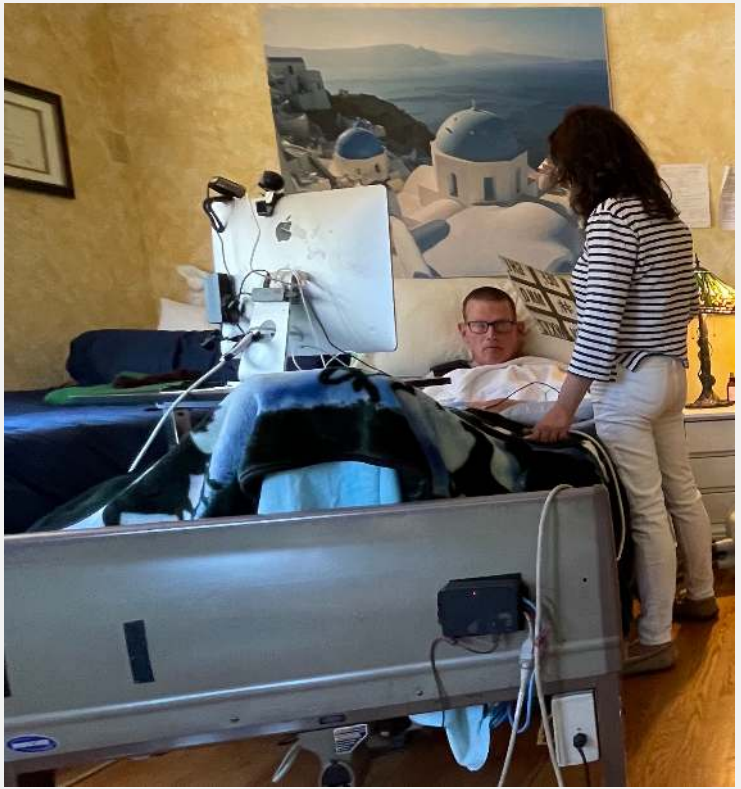


12x Teleoperated

Literature Review

Autonomy of a Person

Caregiver Burden



Persons with Severe Motor Impairments and Caregiver Dyad

A Robot's Role

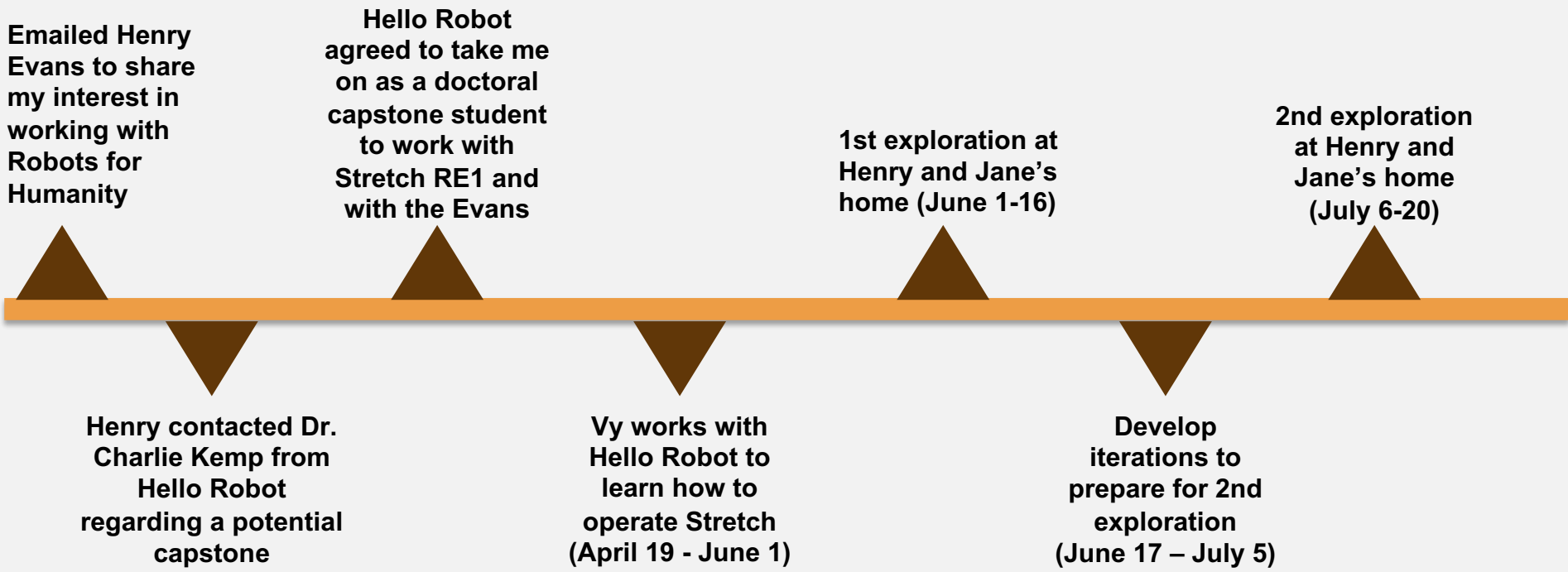
Research from the Healthcare Robotics Lab (healthcare-robotics.com) at Georgia Tech

Scholarly Question

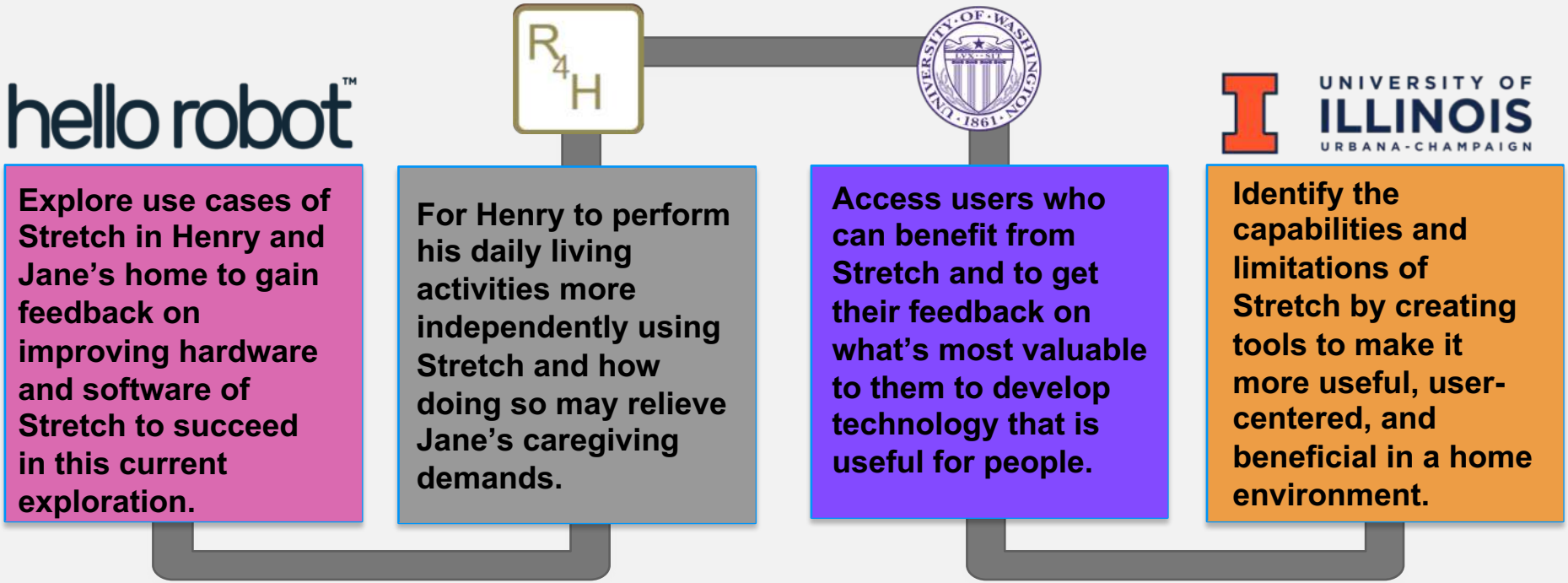
How does the functional performance of everyday activities improve for an individual with severe motor deficits using the mobile robot Stretch RE1?

Capstone Process

It all began with an email...



Needs Assessment



Occupational Therapy's Unique Role

Person-Environment-Occupation-Performance (PEOP)

Baum *et al.*, 2015

MAEVE O'REILLY
OCCUPATIONAL THERAPY

Intervention Considerations

Role of Environment

Developing New Skills

Health and Well-being

Capstone Implementation

All Tasks Performed by Henry

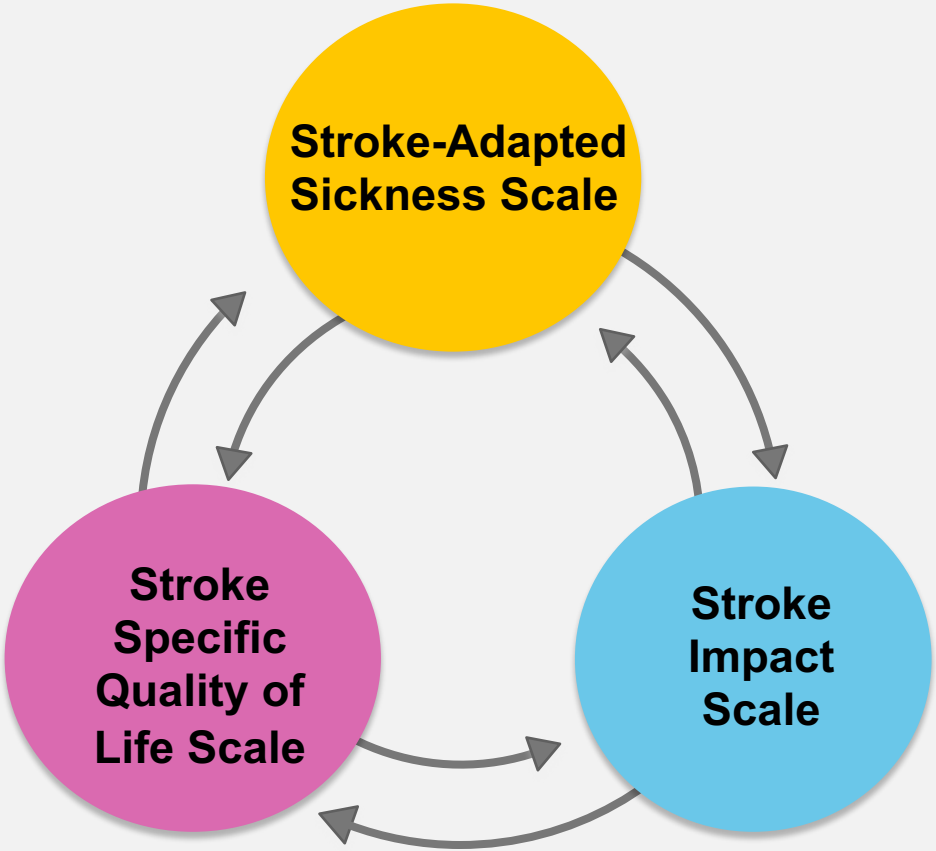
LIVING SKILLS' CATEGORY	ACTIVITY	LEVEL OF ASSISTANCE
Planning for dressing	Opening a closet door to retrieve clothes	Set-up assistance, verbal cueing
Grooming	Applying lotion and putting lotion away	Set-up and stand-by assistance, verbal cueing
Health / Safety	Unplugging percussion vest machine	Set-up assistance
House management/ Organization	Decluttering items Henry's bedroom	Set-up assistance
House management/ Organization	Decluttering items from the dining table	Set-up assistance, verbal cueing
House management/ Organization	Cleaning the dining table with a washcloth	Set-up assistance, verbal cueing
Comfort	Adjusting blinds	Set-up and standby assistance
Comfort	Turning on/off a light switch	Set-up assistance, verbal cueing

All Tasks Performed by Henry

LIVING SKILLS' CATEGORY	ACTIVITY	LEVEL OF ASSISTANCE
Meal planning	Choosing a recipe online, printing it, and giving it to Jane	Set-up assistance, verbal cueing
Personal hygiene	Wiping the face	Set-up assistance
Personal hygiene	Alleviating scratches	Set-up assistance
Self-feeding	Eating a cashew butter yogurt mix	Set-up and standby assistance
Sleep preparation	Adjusting a blanket (leg level)	Set-up assistance
Social interaction	Presenting Jane a rose	Set-up and moderate assistance
Social interaction	Playing card games with the family	Set-up and minimum assistance

Evaluation + Results

Evaluation



Informal Interview with Jane

Goal Attainment Scaling (GAS)

What is it?

It is a participative, person-centered that measures outcome data on a 5 point scale of -2 to +2.

Why use it?

Encourages patient involvement.

Self-feeding

STEMS

Goal Attainment Scaling

Goal #1 | Self-feeding	Scale	Final Score
Henry will engage in self-feeding his daily snack of thick pureed foods while operating Stretch with contextual arrangement set-up by caregiver.	-2 much lower than expected Due to the contextual limitations of the caregiver, Henry is unable to perform feeding activities. -1 lower than expected Henry eats his entire snack of thick pureed foods with dependent assistance from his caregiver. 0 expected level of achievement Henry self-feeds half of his snack of thick pureed foods using Stretch RE1 with set-up assistance in two weeks. +1 better than expected Henry self-feeds a two-thirds of his snack of thick pureed foods using Stretch RE1 with set-up assistance in two weeks.	
	+2 much better than expected Henry self-feeds his entire snack of thick pureed foods using Stretch RE1 with set-up assistance in one week.	+2

I BELIEVED

DYNASPLINT SYS MS

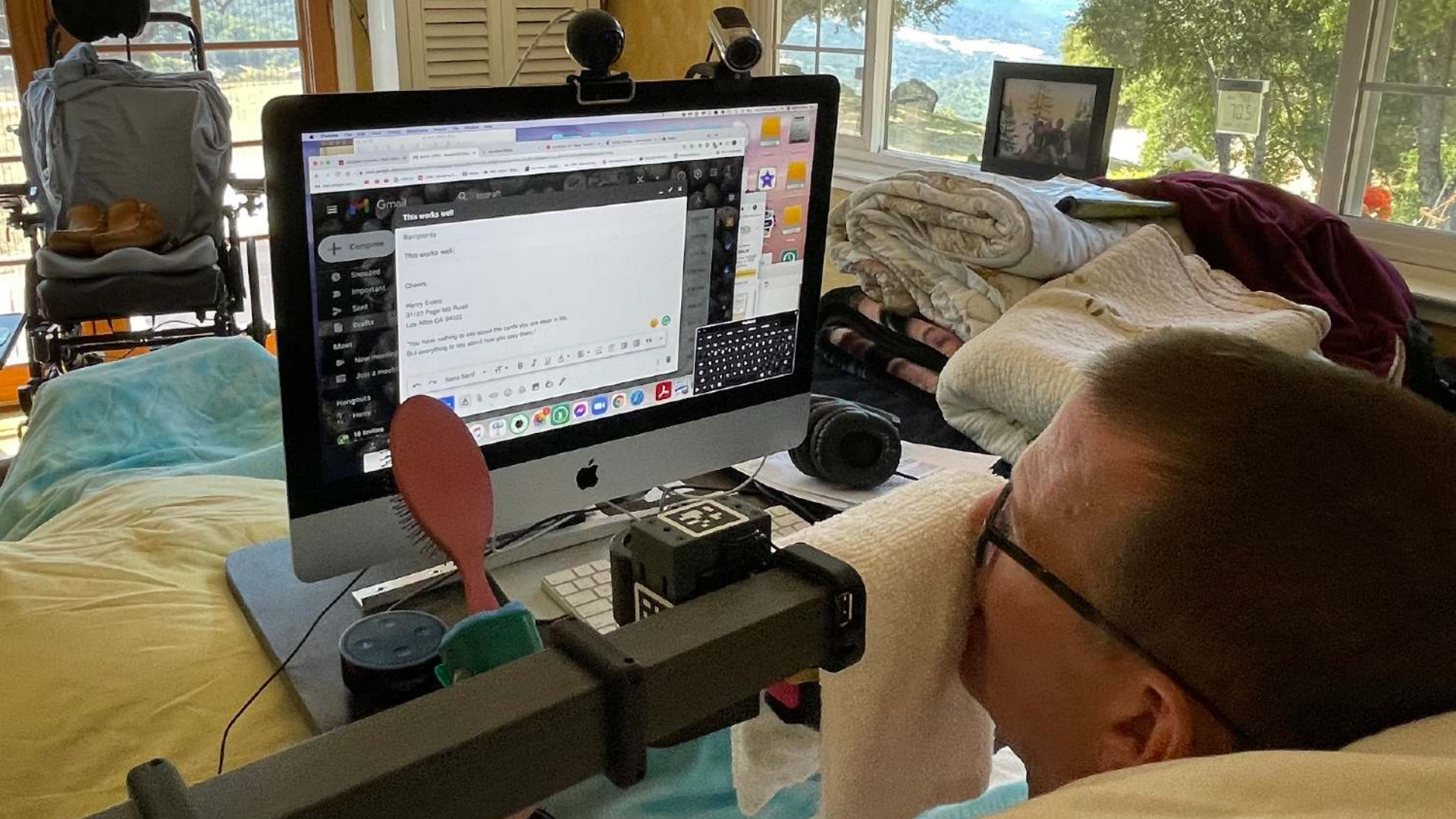
Printing

"Daisy Jane" was adapted from a
poem written by Henry Evans about
his beloved wife of over 30 years. Jane
continues to stay by her husband's side
despite a 2002 brainstem stroke which
left him unable to move or speak.
The tune was written and the vocal is
beautifully sung by Nick Hyder, and is
available on Spotify, iTunes and all
other major online stores.

Goal #2 | Meal Planning	Scale	Final Score
Henry will contribute to dinner meal planning by printing a recipe online, and with set-up assistance, he will operate Stretch RE1 to turn on the printer, retrieve the recipe from the printer tray, and give it to Jane, his wife.	-2 much lower than expected Henry and Jane discuss what they would like to eat for dinner, and Jane chooses a recipe relevant to their choice. -1 lower than expected Henry uses an Alexa kitchen monitor to project a dinner recipe found on his computer for Jane to use. Jane reported a preference to printed copies a recipe, however. 0 expected level of achievement Henry chooses a dinner recipe on his computer for Jane 1-2 nights per week with a printed copy that stays on the tray within two weeks. *Expected behavior change: Jane operates Stretch RE1 to turn on the printer, and from his computer, chooses and prints a recipe.* +1 better than expected Henry chooses a dinner recipe on his computer for Jane 1-2 nights per week to print and puts the printed recipe on the desk by operating Stretch RE1 within two weeks. *Expected behavior change: Henry operates Stretch RE1 to turn on the printer, pulls out the printer tray, and picks up the printed recipe.*	
	+2 much better than expected Henry chooses a dinner recipe for Jane 1-2 nights per week and operates Stretch RE1 to transport the printed recipe from Mrs. J's office to the kitchen within 2-weeks. *Expected behavior change: Mr. H operates Stretch RE1 to turn on the printer, pulls out the printer tray, pick up the printed recipe, and travels with Stretch to the kitchen to give the recipe to Jane.*	+2

Personal Hygiene

Goal #3 | Personal Hygiene	Scale	Final Score
Henry will actively perform personal hygiene tasks by operating Stretch RE1, such as wiping his mouth or scratching his head.	-2 much lower than expected Henry is unable to communicate with caregiver about his needs of personal hygiene due to contextual factors. -1 lower than expected Henry's caregiver wipes his mouth or Henry asks his caregiver to scratch his head. 0 expected level of achievement Henry can use Stretch RE1 to achieve these personal hygiene tasks 50% of the time in 2-weeks. +1 better than expected Henry can use Stretch RE1 to achieve these personal hygiene tasks 75% of the time in 1-week. +2 much better than expected Henry can use Stretch RE1 to achieve these personal hygiene tasks 90% of the time in 1-week.	+2


Gmail
This works well!

Down
Arm
Arm
Hand
Look
Mic
Slowest
Slow
Medium
Fast
Center camera for current mode
Robot:
Automatically change view?

Playing Cards

ATTACK
DEFUSE
EXPLODING KITTEN
SKIP
FAVOR
SHUFFLE
NOPE

Goal #4 | Social Interaction	Scale	Final Score
Henry will operate Stretch RE1 to play card games with his family while being on his own team.	-2 much lower than expected Henry is unable to play card games with his family due to contextual factors. -1 lower than expected Henry plays card games with a family member as part of a team with maximum assistance. 0 expected level of achievement Henry plays one card game with his family by operating Stretch RE1 with moderate assistance in 2-weeks. +1 better than expected Henry plays one card game with his family by operating Stretch RE1 with minimal assistance in 2-weeks. +2 much better than expected Henry plays one card game with his family by operating Stretch RE1 with stand-by assistance in 1-week.	+0

KITTENS
KITTENS
KITTENS
KITTENS
KITTENS
KITTENS

Giving A Rose

Goal #5 | Social Interaction	Scale	Final Score
With set-up assistance, Henry will operate Stretch RE1 to give his wife, Jane, a rose.	-2 much lower than expected Henry is unable to give a rose to Jane due to contextual factors. -1 lower than expected Henry instructs a caregiver to give Jane a rose on his behalf. 0 expected level of achievement Henry operates Stretch RE1 pick-up a rose from a vase and has Jane come into his room for him to give her the rose within 2-weeks. +1 better than expected Henry operates Stretch RE1 to pick up a rose from a vase and transports it to Jane in the living room within 2-weeks. +2 much better than expected Henry operates Stretch RE1 to pick up a rose from a vase, drives Stretch to different areas of in his house seeking Jane's location to gives her a rose within 2-weeks.	+1

Discussion

STRETCH CONTROLS

Slowest | Slow | Medium | Fast | Fastest

Navigate | Manipulate

Prepare Arm

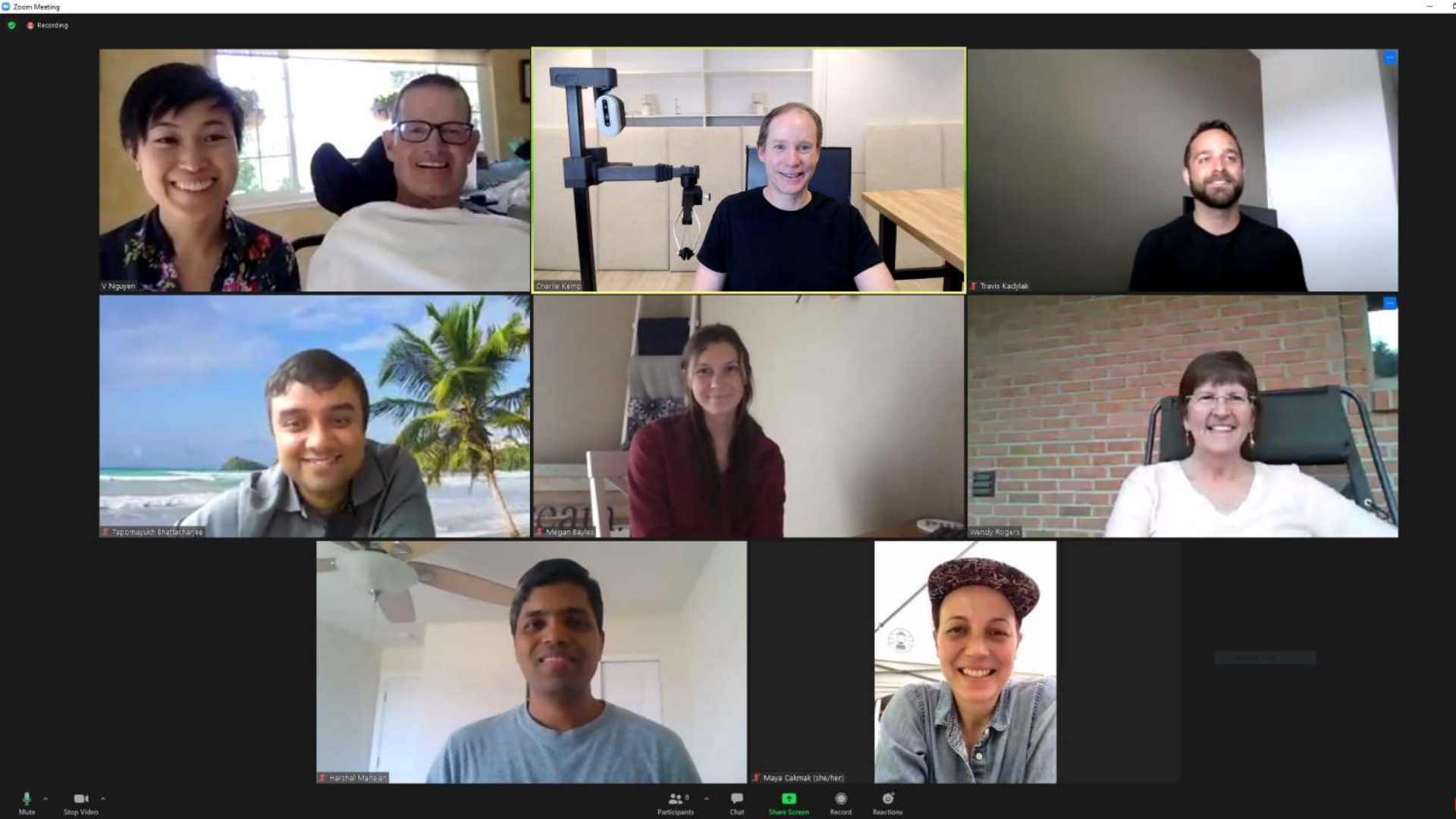
Stow Arm

Start Recording | Download Recording

Robot: r1 | hang up | Audio in: microphone 1 | Audio out: speaker 1

Occupational Therapy Implications

ABC 1
DEF 2
GHI 3
JKL 4
5
MNO 6
PQR 7
STUV 8
WXYZ 9


Zoom Meeting
Recording
V Nguyen
Charlie Kemp
Travis Kadylak
Tapomayukh Bhattacharjee
Megan Bayles
Wendy Rogers
Harshal Maheen
Maya Cakmak (she/her)
Mute
Stop Video
Participants
Chat
Share Screen
Record
Reactions

Impact

Media Opportunities

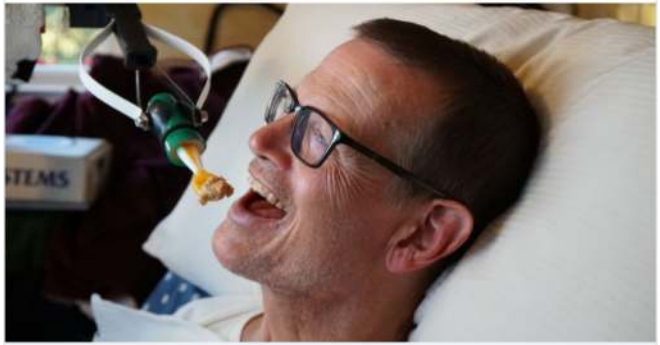
Hello Robot Inc
660 followers
1mo •

Our fantastic intern V Nguyen, an occupational therapy doctoral candidate from Pacific University, has been exploring how mobile manipulator robots can help increase independence in persons with disabilities like Robots4Humanity's Henry Evans. Check out her progress at the link below!

Huge thanks to all the people who made this research possible - especially Prof. Wendy Rogers at UIUC, Prof. Maya Cakmak at UW, Dr. Maria Eugenia Cabrera Ubaldi, Dr. Tapomayukh Bhattacharjee, and most of all Henry and Jane Evans!

https://lnkd.in/gexgciz

#robot #robots #robotics #robotsforhumans #assistivetechnology



Summer Research on In-Home Use of the Stretch robot by Henry Evans

forum.hello-robot.com • 1 min read

Community

Pacific University Oregon

IEEE SPECTRUM

hello robot™

Image courtesy of Henry and Jane Evans

Questions?

References

Anonymous. (2020). *Product*. Hello Robot. https://hello-robot.com/product.

Baum, C.M. Christiansen, C. H., & Bass, J. D. (Eds.) (2015). Occupational therapy: Performance, participation, and well-being (4th ed.). Thorofare, NJ: Slack.

Bergström, A. L., Eriksson, G., von Koch, L., & Tham, K. (2011). Combined life satisfaction of persons with stroke and their caregivers: Associations with caregiver burden and the impact of stroke. *Health and quality of life outcomes*, *9*(1). https://doi.org/10.1186/1477-7525-9-1

Bugge, C., Alexander, H., & Hagen, S. (1999). Stroke patients' informal caregivers. Patient, caregiver, and service factors that affect caregiver strain. *Stroke*, *30*(8), 1517–1523. https://doi.org/10.1161/01.str.30.8.1517

Cakmak, M. (2020, September 24. *Forky remote control instructions [Video].* Youtube. https://www.youtube.com/watch?v=ZFzt1W56_eg

Carnwath, T. C., & Johnson, D. A. (1987). Psychiatric morbidity among spouses of patients with stroke. *British medical*, *294*(6569), 409–411. https://doi.org/10.1136/bmj.294.6569.409

Chen, T. L., Bhattacharjee, T., Beer, J. M., Ting, L. H., Hackney, M. E., Rogers, W. A., & Kemp, C. C. (2017). Older adults' acceptance of a robot for partner dance-based exercise. *PloS one*, *12*(10), e0182736. https://doi.org/10.1371/journal.pone.0182736

Ciocarlie, M., Hsiao, K., Leeper, A., & Gossow, D. (2012). Mobile manipulation through an assistive home robot. *IEEE/RSJ International Conference on Intelligent Robots and Systems*, 5313-5320, https://dx.doi.org/10.1109/IROS.2012.6385907

Debreceni-Nagy, A., Horváth, J., Nagy, S., Bajusz-Leny, Á., & Jenei, Z. (2019). Feasibility of six-point goal attainment scale among subacute and chronic stroke patients.
International journal of rehabilitation research. *42*(4), 365–370. https://doi.org/10.1097/MRR.0000000000000372

Grice, P. M., & Kemp, C. C. (2019). In-home and remote use of robotic body surrogates by people with profound motor deficits. *PloS one*, *14*(3), e0212904. https://doi.org/10.1371/journal.pone.0212904

Kapusta, A., Erickson, Z.M., Clever, H.M., Yu, W., Liu, C., Turk, G., & Kemp, C. (2019). Personalized collaborative plans for robot-assisted dressing via optimization and simulation. *Auton. Robots, 43*, 2183-2207.

Krasny-Pacini, A., Evans, J., Sohlberg, M. M., & Chevignard, M. (2016). Proposed criteria for appraising goal attainment scales used as outcome measures in rehabilitation research.
Archives of physical medicine and rehabilitation, *97*(1), 157–170. https://doi.org/10.1016/j.apmr.2015.08.424

Machado, W. C., & Scramin, A. P. (2010). Functional (in)dependence in the dependent relationship of quadriplegic men with their (un)replaceable parents/caregivers.

Revista da Escola de Enfermagem da USP, 44(1), 53–60. https://doi.org/10.1590/s0080-62342010000100008

Nguyen, V. (2021, July 1). Summer Research on In-Home Use by Henry Evans. Stretch RE1 Forum. https://forum.hello-robot.com/t/summer-research-on-in-home-use-by-henry-evans/237

Park, D., Hoshi, Y., & Kemp, C. (2018). A Multimodal Anomaly Detector for Robot-Assisted Feeding Using an LSTM-Based Variational Autoencoder. *IEEE Robotics and Automation Letters, 3*, 1544-1551.

Reid, A. & Chesson, R. (1998). Goal attainment scaling: Is it appropriate for stroke patients and their physiotherapists? Physiotherapy, 84(3), 136-144. https://doi.org/10.1016/S0031-9406(05)66518-2.

Robots For Humanity. (n.d.). In the beginning. https://r4h.org.

Robinson-Smith, G., Johnston, M. V., & Allen, J. (2000). Self-care self-efficacy, quality of life, and depression after stroke. Archives of physical medicine and rehabilitation, 81(4), 460–464. https://doi.org/10.1053/mr.2000.3863

Schulz, R., & Beach, S. R. (1999). Caregiving as a risk factor for mortality: The caregiver health effects study. JAMA, 282(23), 2215–2219. https://doi.org/10.1001/jama.282.23.2215