Robots for Humanity

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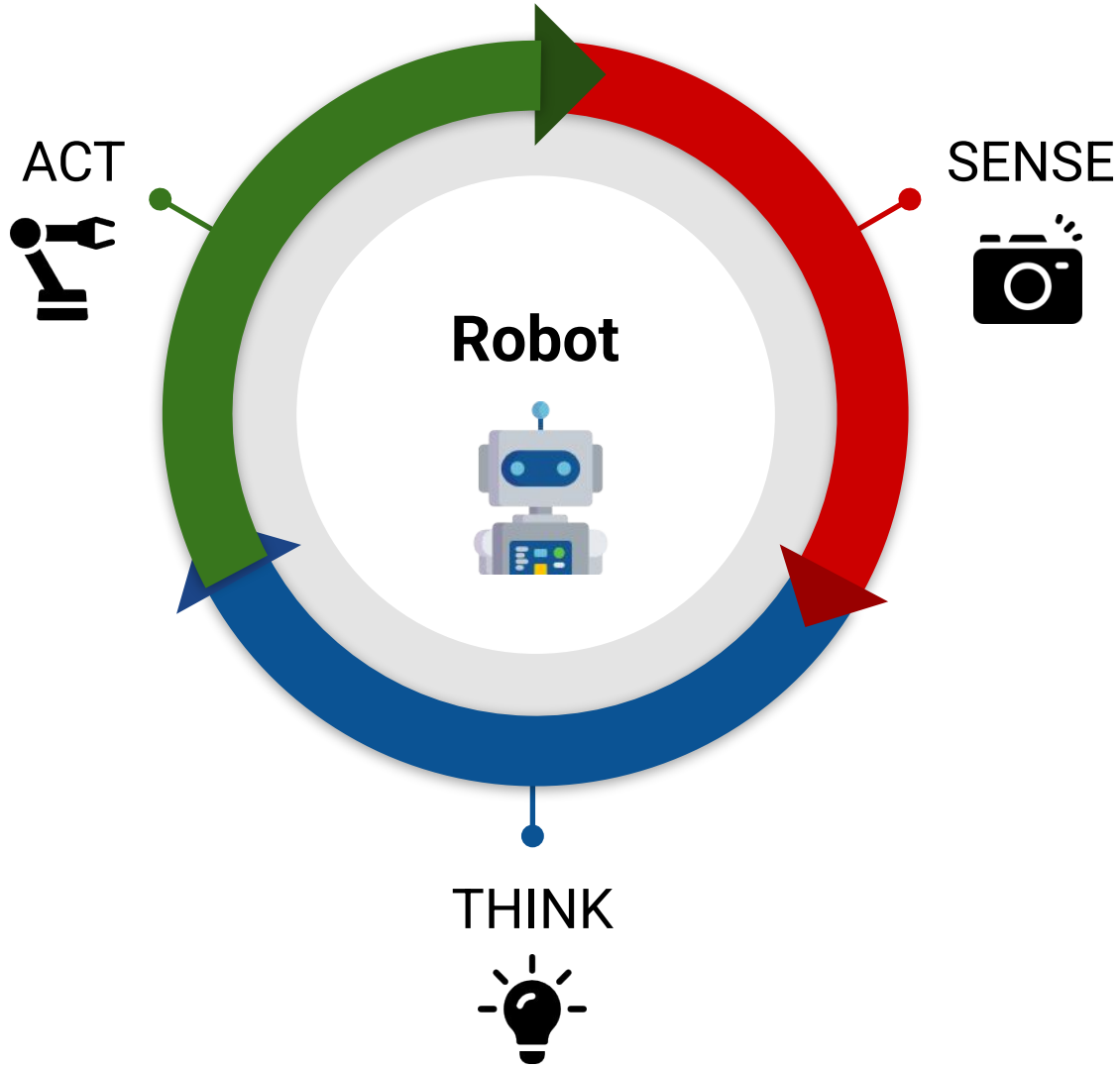
Unimate
1963

Sense-Think-Act Cycle



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Mailbot
1979

What is the next major application of robotics?

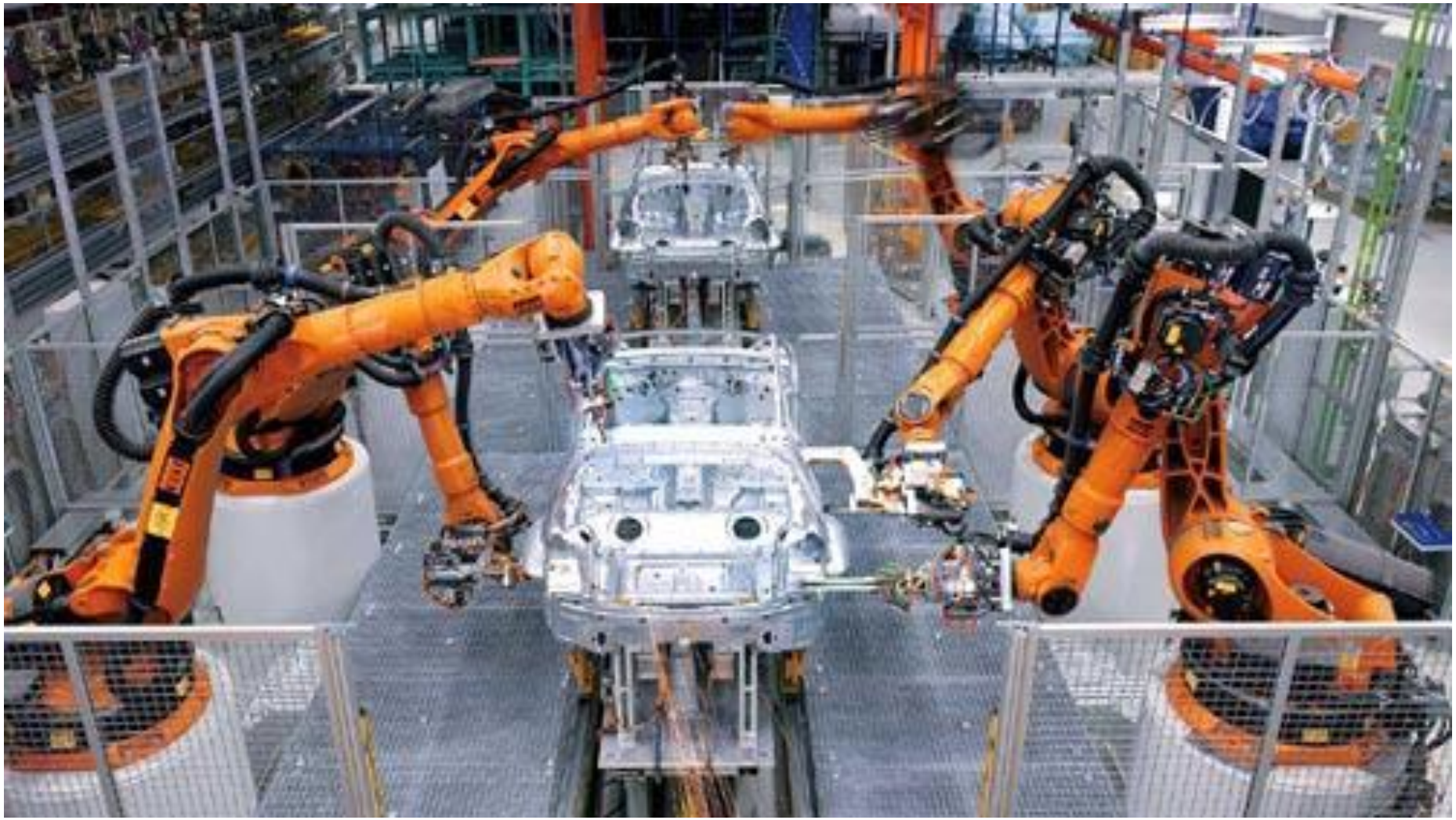
	1960s	1970s	1980s	1990s	2000s	2010s	2020s
Networking		Dialup modems	Ethernet RPC	WiFi CORBA	LTE	4G	5G Zenoh
Computers	Mainframes	Xerox Alto	PC	Laptops	Smartphones Cloud computing	Tablets	Watches Glasses
Robots	Unimate	Stanford arm Shakey Mailbot	PUMA arm CMU Navlab	Roomba Cobots HelpMate	Self-driving car HRP2, PAL PR2 3D Printers	Logistics Relay Other service robots ADAS	Humanoids Robotaxis
AI	Symbolic AI	Planning	Expert systems Logic	Neural nets	Deep learning	Data VLMs / LLMs	GenAI VLAs
Open Source		Unix OS	Emacs	LAMP Stack Python / Java Player & YARP	OpenCV Git ROS	Android Kubernetes TensorFlow	Generative AI Cloud Native
Business Models	"Click"		HW/OS/Apps	Services	SaaS Amazon	Uber / Lyft RaaS	On-demand deliv XaaS

Manufacturing

Logistics

Safety

Industrial Robotics: No People

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https://youtu.be/uH7U_bfRK1w?feature=shared

The Sushi Challenge

Robotic waiter / bus boy

1. Clear a table
2. Set the table
3. Serve a dish of sushi from a moving platform (sushi boat)

https://youtu.be/IE1fiMAfyVM?feature=shared

Why was the Sushi Challenge Hard?

- Chairs!
- Object recognition
- Picking up a plate from a stack
- Shadows
- Time

Note: the moving platform was the easy part!

Could we solve it today?

- Everyday robots tried similar tasks
- Not yet ready for market

But…

Much simpler restaurant robots seem to be a hit

No manipulation

Robots for Humanity


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https://youtu.be/aClukWXmlV4?feature=shared

10 Years

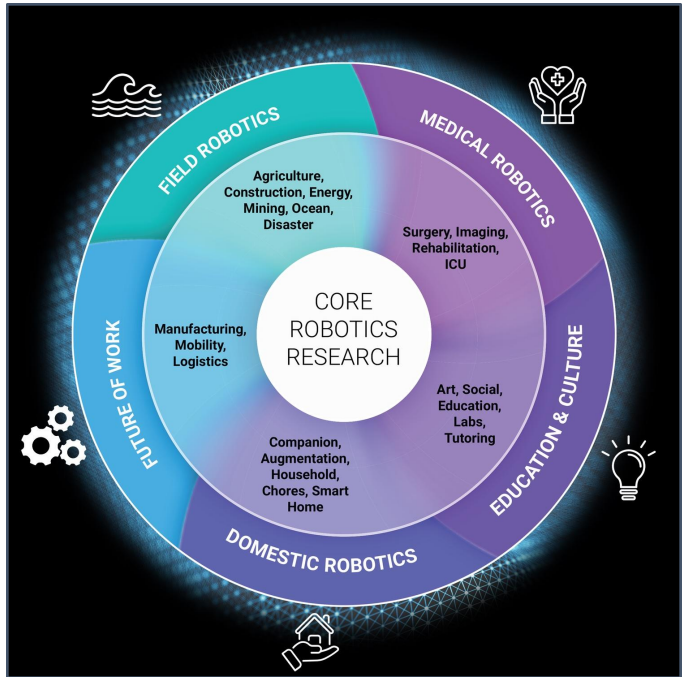

https://youtu.be/kvK7PofUtdk?feature=shared


https://youtu.be/TCSvxh1cbdI?feature=shared

SOAR (Michelle)

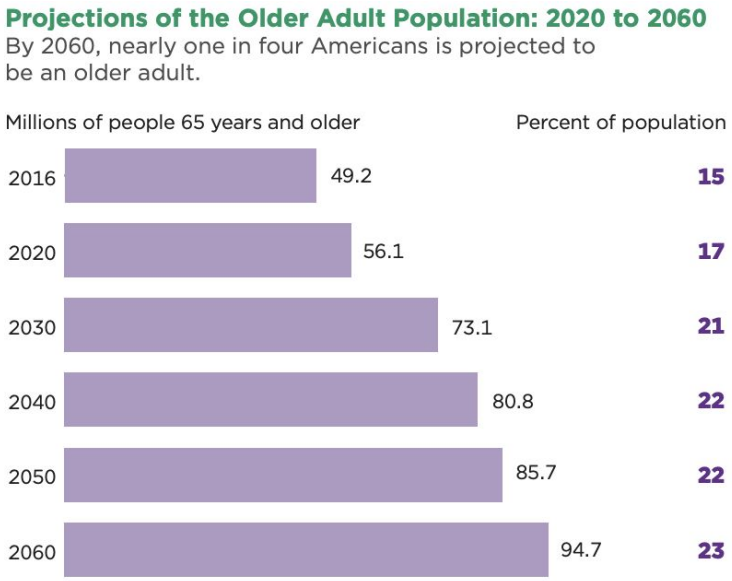
Stanford Older Adult Robotics

Stanford Robotics Center



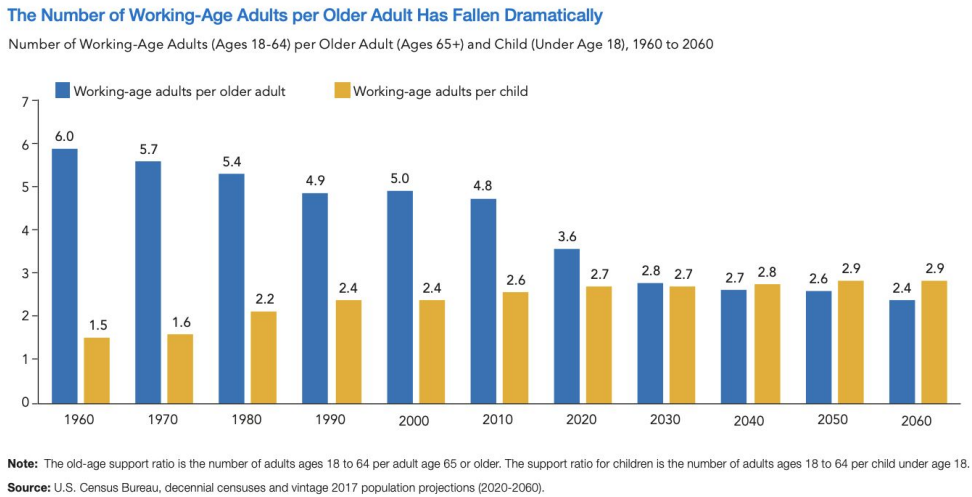
Domestic Robotics: Focus on Older Adults

The baby boomers are turning 80!



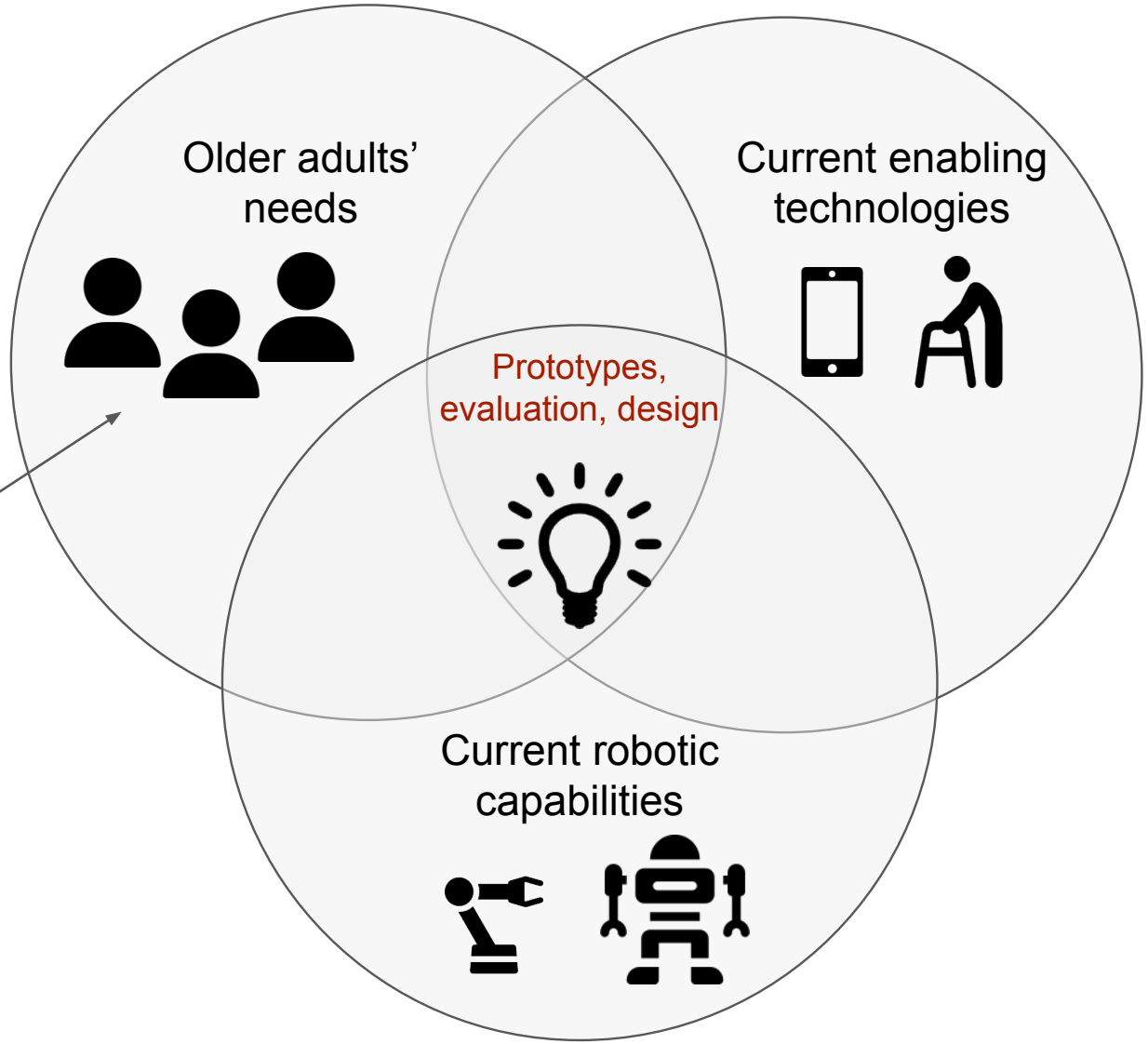
Vespa, Medina, and Armstrong, “Demographic Turning Points for the United States: Population Projections for 2020 to 2060”, *Current Population Reports*, P25-1144, U.S. Census Bureau, Washington, DC, 2020.

We are reaching a caregiving precipice…



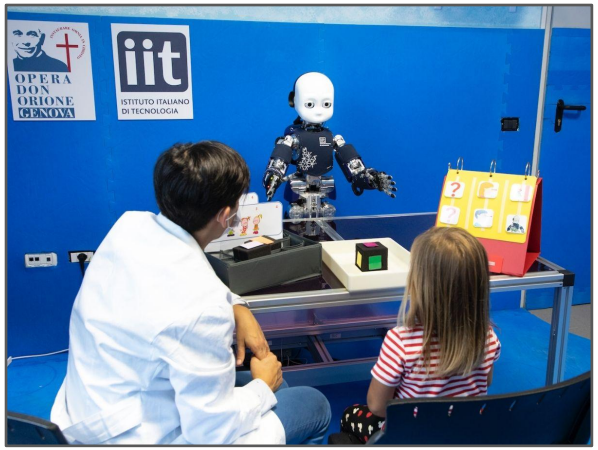
Mather, et al. "America's Changing Population: What to Expect in the 2020 Census", *Population Bulletin* Vol. 74, No. 1, June 2019.

Our SOAR Approach



Including caregivers and medical team

The Robotics Landscape: Evaluation and Collaboration



Understanding Older Adults' Needs

Reactive

Assistance with limitations

Example:
walker or wheelchair

Proactive

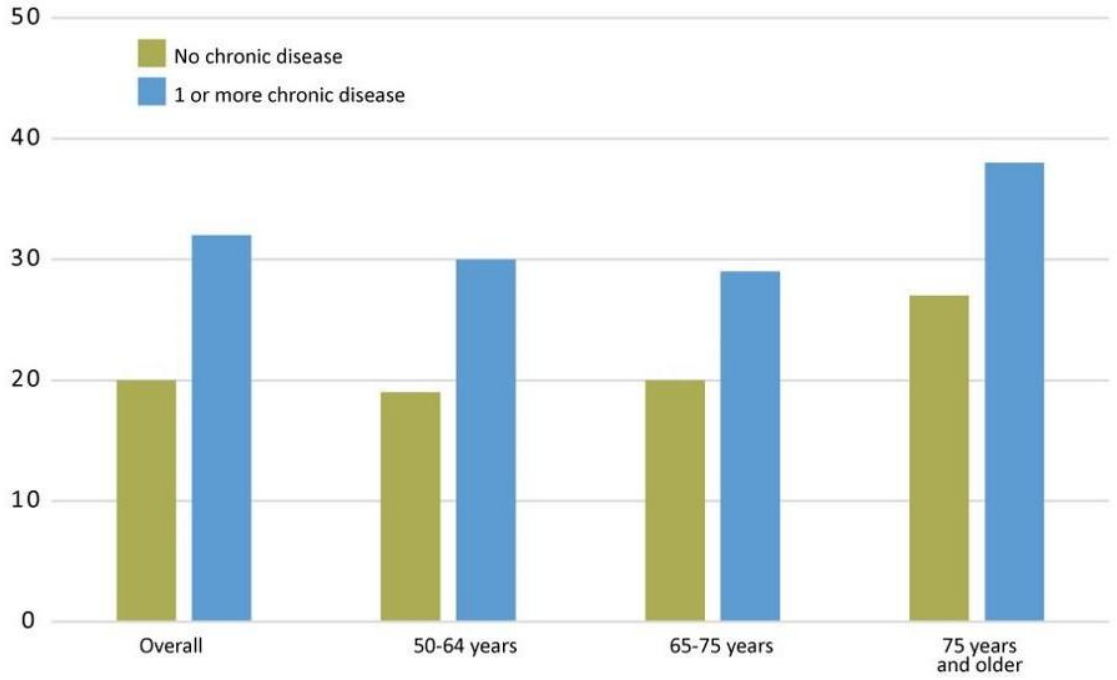
Support for longevity

Example:
exercise app

Older Adults' Needs: Exercise

For the least active adults, an extra 5 minutes/day of moderate-to-vigorous activity might prevent up to 6% of all deaths

% of Physically Inactive US Adults Ages 50+ (CDC)



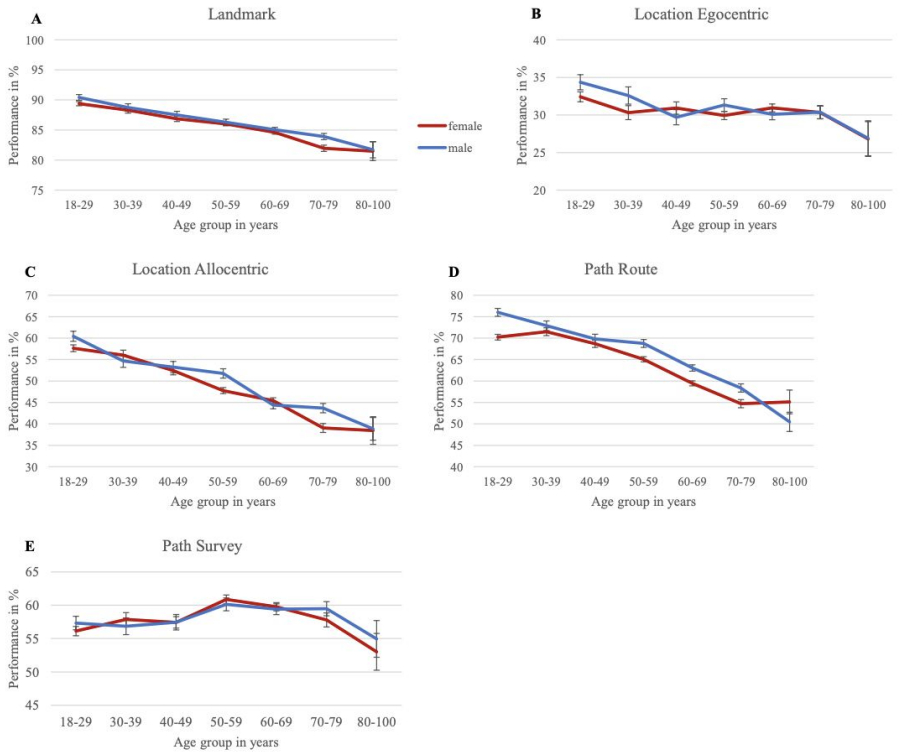
Older Adults' Needs: Reducing Loneliness

Loneliness increases dementia risk 31%; associated with 100 deaths/hour

University of Michigan National (US) Poll on Healthy Aging

Older Adults' Needs: Help with Navigation

Navigation ability declines with age



van der Ham, I.J.M., Claessen, M.H.G., Evers, A.W.M. *et al.* Large-scale assessment of human navigation ability across the lifespan. *Sci Rep* 10, 3299 (2020). https://doi.org/10.1038/s41598-020-60302-0

Older Adults' Needs: Walking Safety

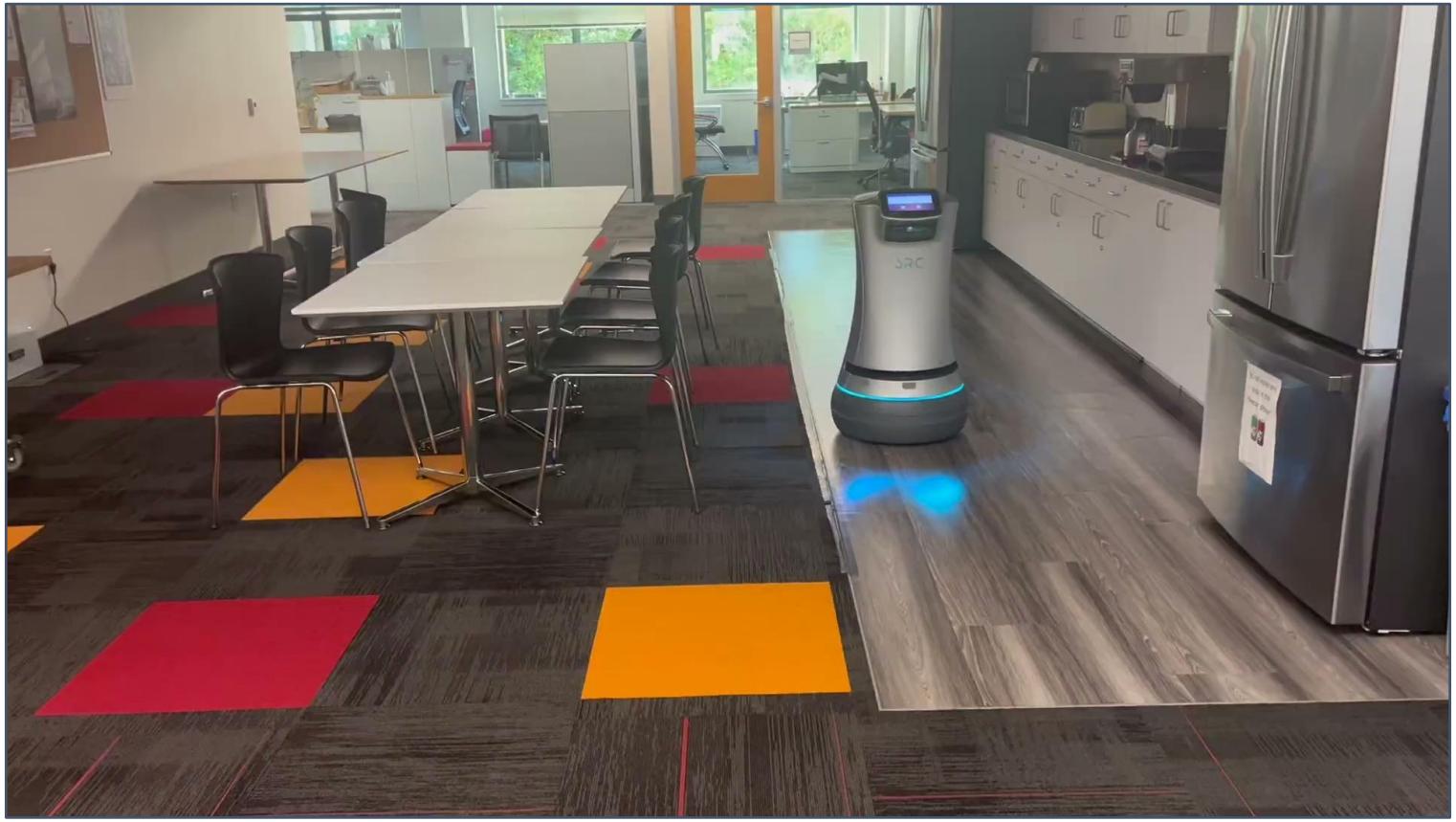
Worries about falling

- 1 out of 4 US adults >65 reports falling in a given year.
- Falling once doubles your chances of falling again.
- Falls are the leading cause of fatal and nonfatal injuries for this age group.

Mobility assistance needs

- ¼ of US adults >65 use at least one mobility device.
- However, mobility devices have an image problem…
- "You never see a walker on the beach."

From Needs to Prototypes: Social Micro-exercise



Robotics-Supported Social Walking

From Prototypes to Participatory Design

The SRC as a community hub building partnerships to local senior communities

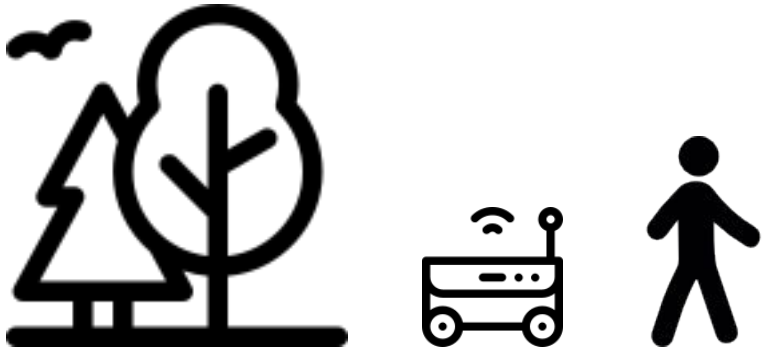
- Continuing care retirement communities (Channing House, Vi, Forum at Rancho San Antonio)
- Adult day centers (Live Oak, Rosener House)
- Senior community centers

Talks and workshops with groups of older adults

- Current focus: barriers to walking
- Some lessons learned
    - concerns about falling
    - reluctance to use walkers
    - the cognitive burden of looking for environmental hazards

On to research: An outdoor walking companion robot

- Lead, follow, or move side-by-side with you (and a caregiver?!)
- Boost environmental awareness
- Make health and safety suggestions



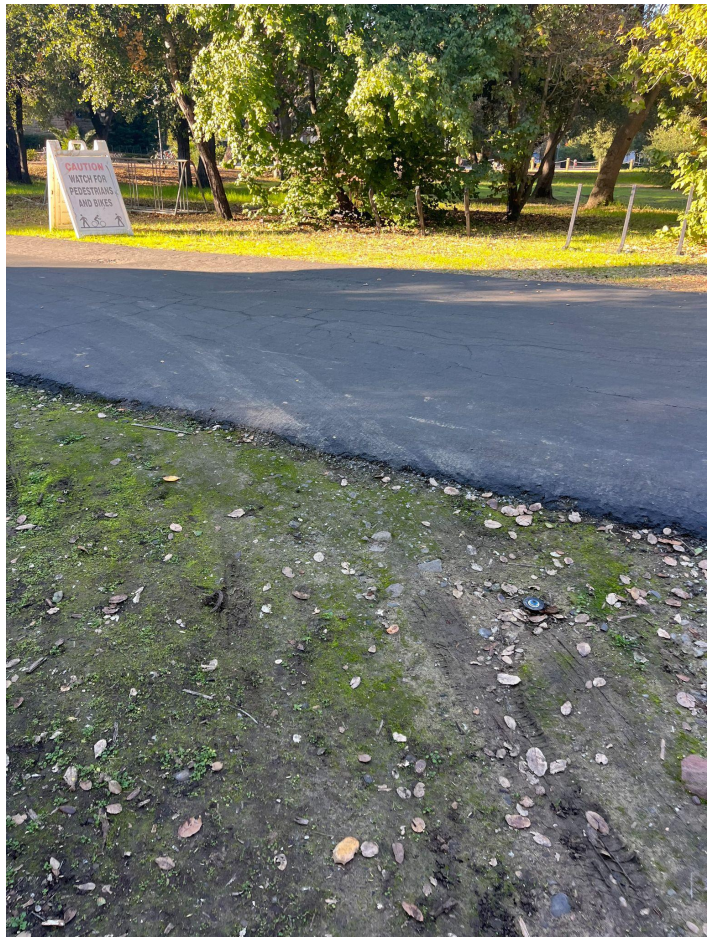
The Stanford Robotics Center

STANFORD CENTER ON LONGEVITY

Stanford Office of Community Engagement

Making the Robot Go!

Close Captioning the Physical World



This confirms what we were worried about. I'm glad you paused here.

What I see

You're right at the **edge where soft ground meets pavement**:

- Mossy, muddy soil with leaves and small rocks
- A **broken, uneven asphalt edge**
- No curb cut or defined crossing
- A sign warning about **pedestrians and bikes**—so traffic here is real

This is a **high-risk transition point**.

Key hazards

1. Slippery, unstable footing

- Moss + damp soil = very low traction
- Foot can slide *forward* just as weight transfers
- **High risk for backward or sideways falls**

2. Hidden step up onto pavement

- The pavement edge is **irregular**, not a clean curb
- Height change is hard to judge from this angle
- **Classic fall scenario:** toe catches or foot slips while stepping up

3. Loose gravel and debris

- Small stones and leaf fragments act like ball bearings
- Even good shoes lose grip here

4. Bike traffic crossing your path

- Bicycles may approach from either direction
- Riders often look ahead, not down
- You're vulnerable while focused on your footing

5. No safe pause zone

- There's nowhere flat and stable to stop mid-transition
- Once you commit, you must complete the step

Strong safety guidance

Best option (recommended)

Do not step up here.
Instead:

- Walk *along the edge* of the pavement until you find:
  - A curb cut
  - A paved connection
  - A formal crossing or ramp

This may add distance, but it hugely lowers fall risk.

If you must step up here (only if unavoidable)

- Stop completely and look for bikes **before** moving
- Plant your stronger foot **fully on the pavement**
- Lean slightly forward (not upright, not backward)
- Push up using leg strength—not momentum
- Do **not** rush because of oncoming traffic

If you use a cane or trekking pole, this is exactly wh it helps.

Bottom line

This spot combines **three of the biggest fall risk factors**:

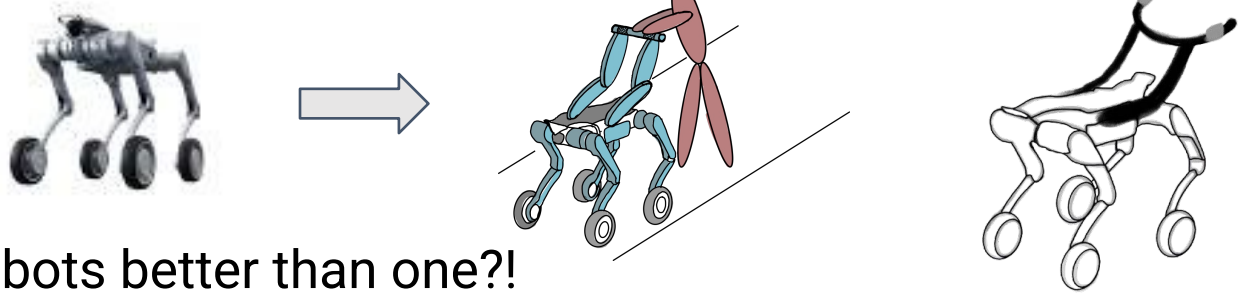
1. Slippery surface
2. Uneven height change
3. Distraction from bikes/traffic

From a safety perspective, this is a place to **reroute, not push through**.

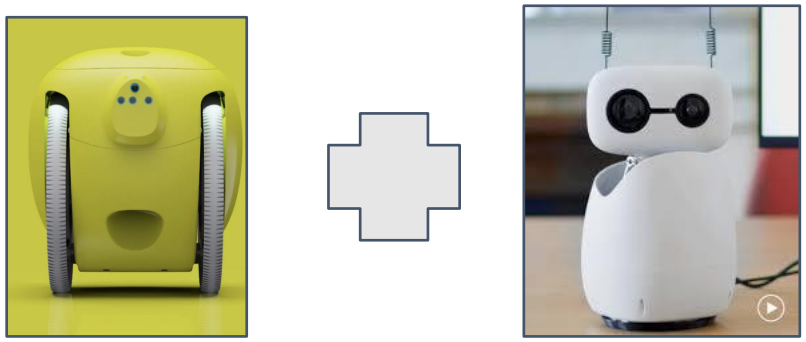
If you want, take one more photo **to the left and right along the pavement**, and I'll help you choose the safest direction forward.

Towards Senior-Friendly Walking Companion Robots

Adapting a wheeled quadruped for senior use



Are two robots better than one?!



Conclusion: The SOAR Mission

Build bridges from academic research to older adult communities

- Assistive robotics
- Robotics for longevity

Catalyze new interdisciplinary robotics research that can make a difference for older adults

Our Team

SRC: Michelle Baldonado, Steve Cousins, Jing Liang, Zen Yaskawa
Students: Etienne Jacquot, Heather Nolte
Community partners: Channing House, Vi, Forum at Rancho San Antonio, Live Oak

Thank you to the Stanford Center on Longevity (supporting NMOL Fellow Jing Liang) and the Stanford Office of Community of Engagement (CEIP grant for a wheeled quadruped)