

# Thoughts on Assistive Robotics

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# Outline

1. Robots for Humanity
2. What is a Robot
3. Mediators
4. Caregivers

Autonomy (“do things for me”)

vs

Avatar (“let me sense and operate on the world [remotely] through an interface to a robotic surrogate”)

# 1. Robots for Humanity

# Robots for Humanity

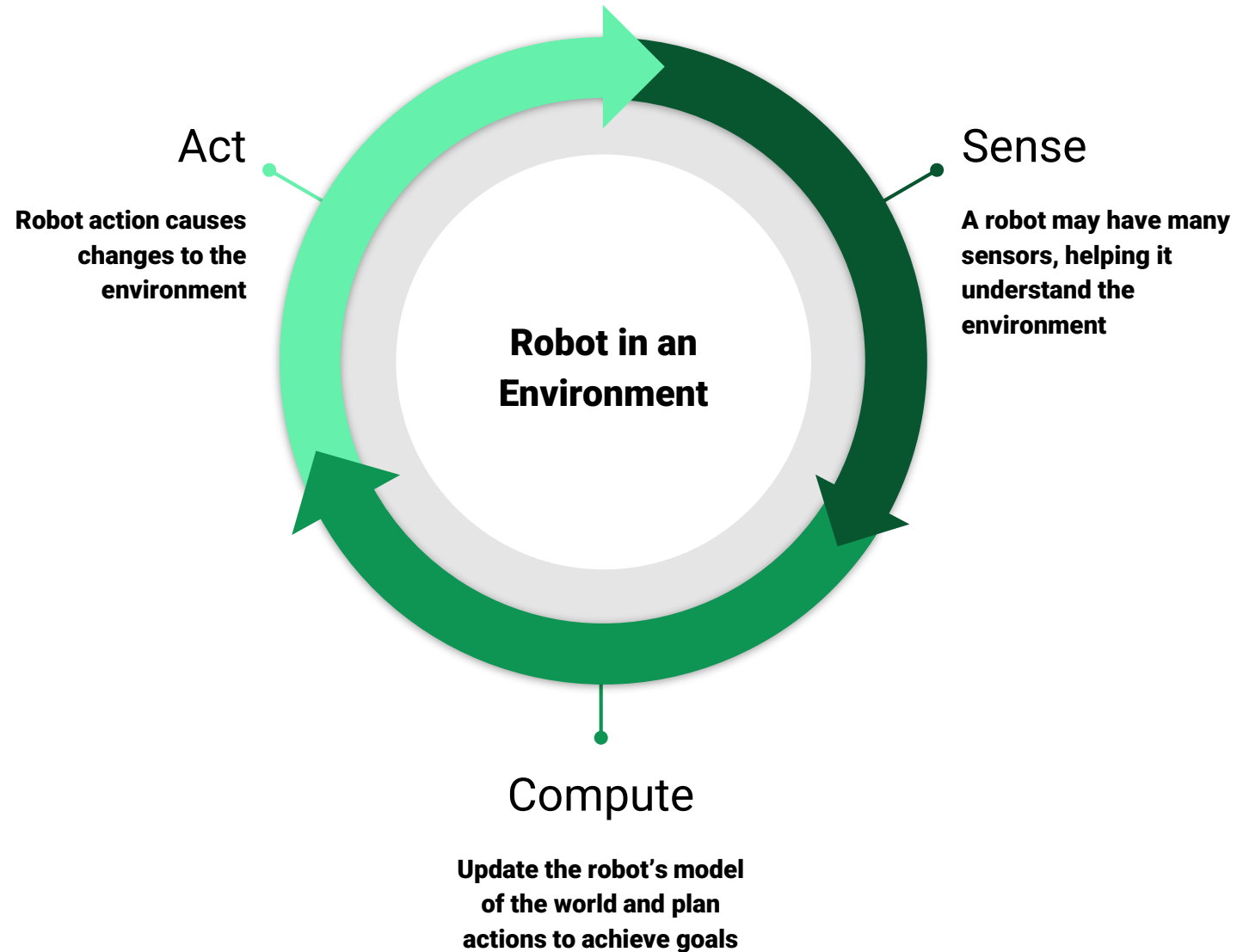




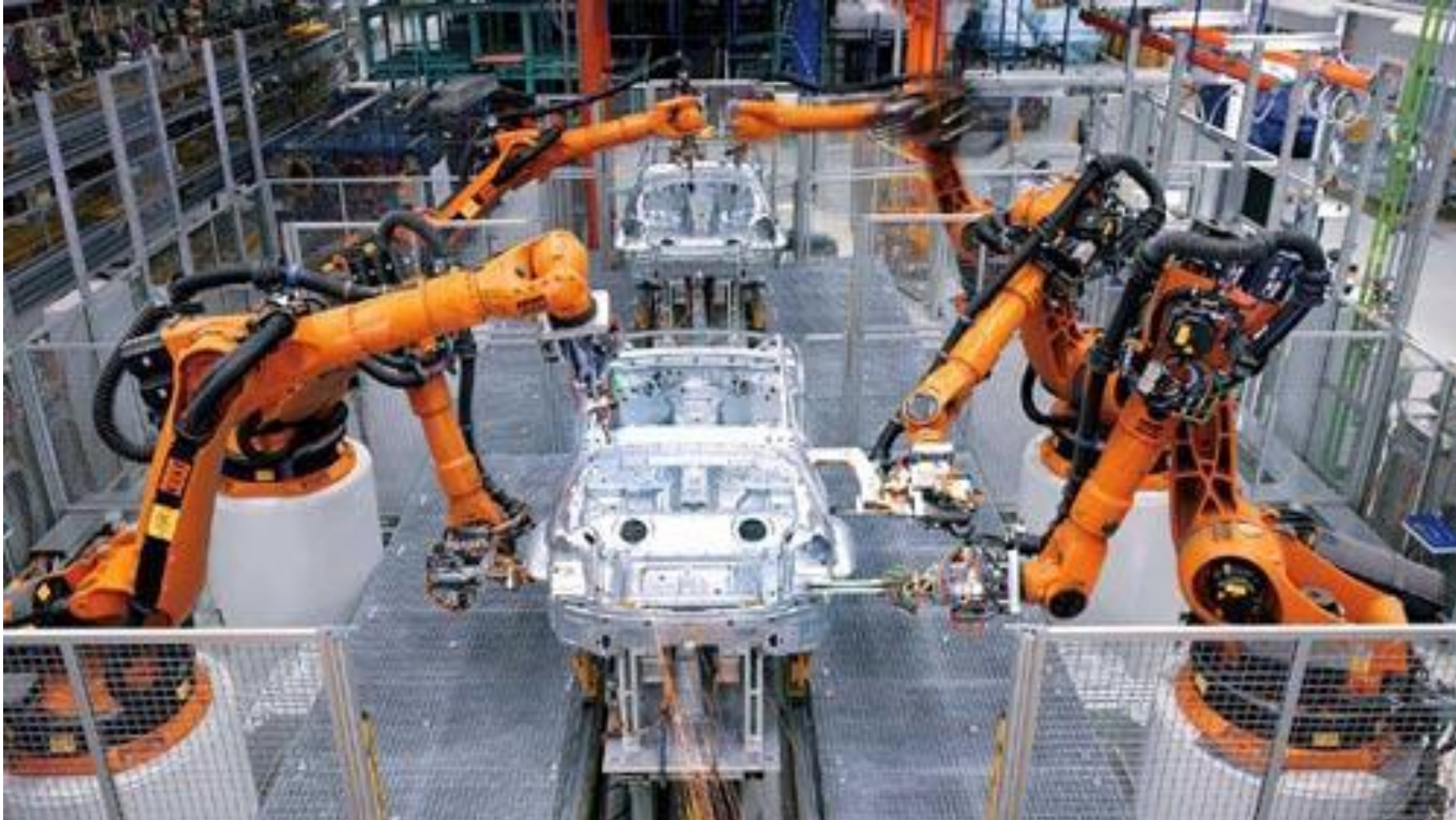


## 2. What is a Robot?

# Sense-Compute-Act cycle



# Industrial Robotics: No People



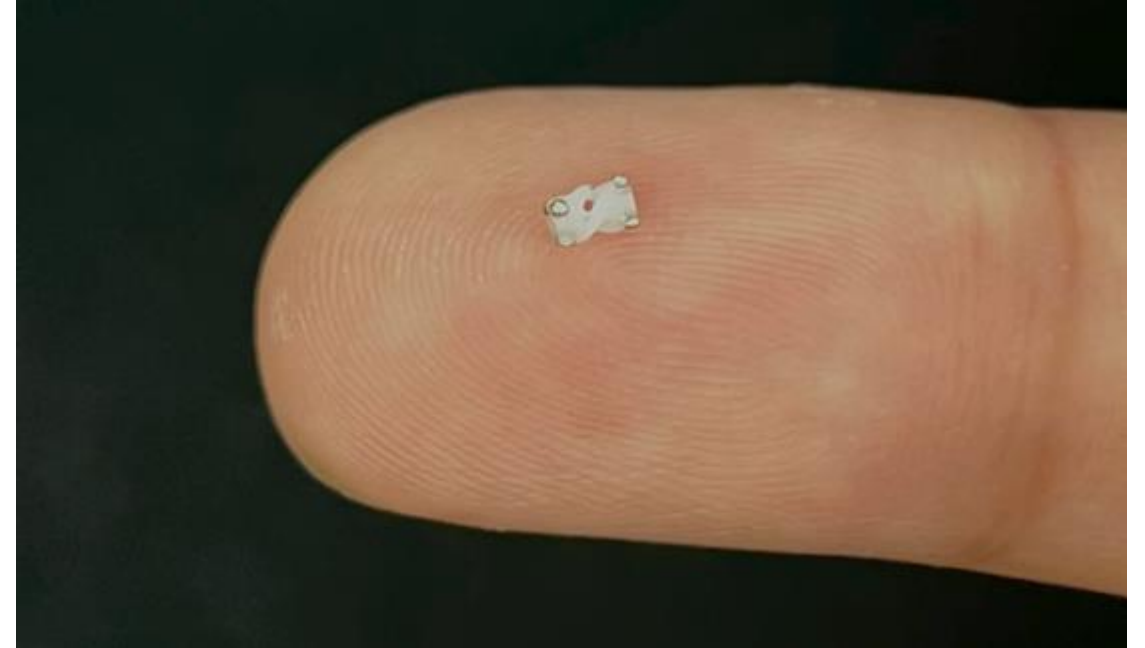
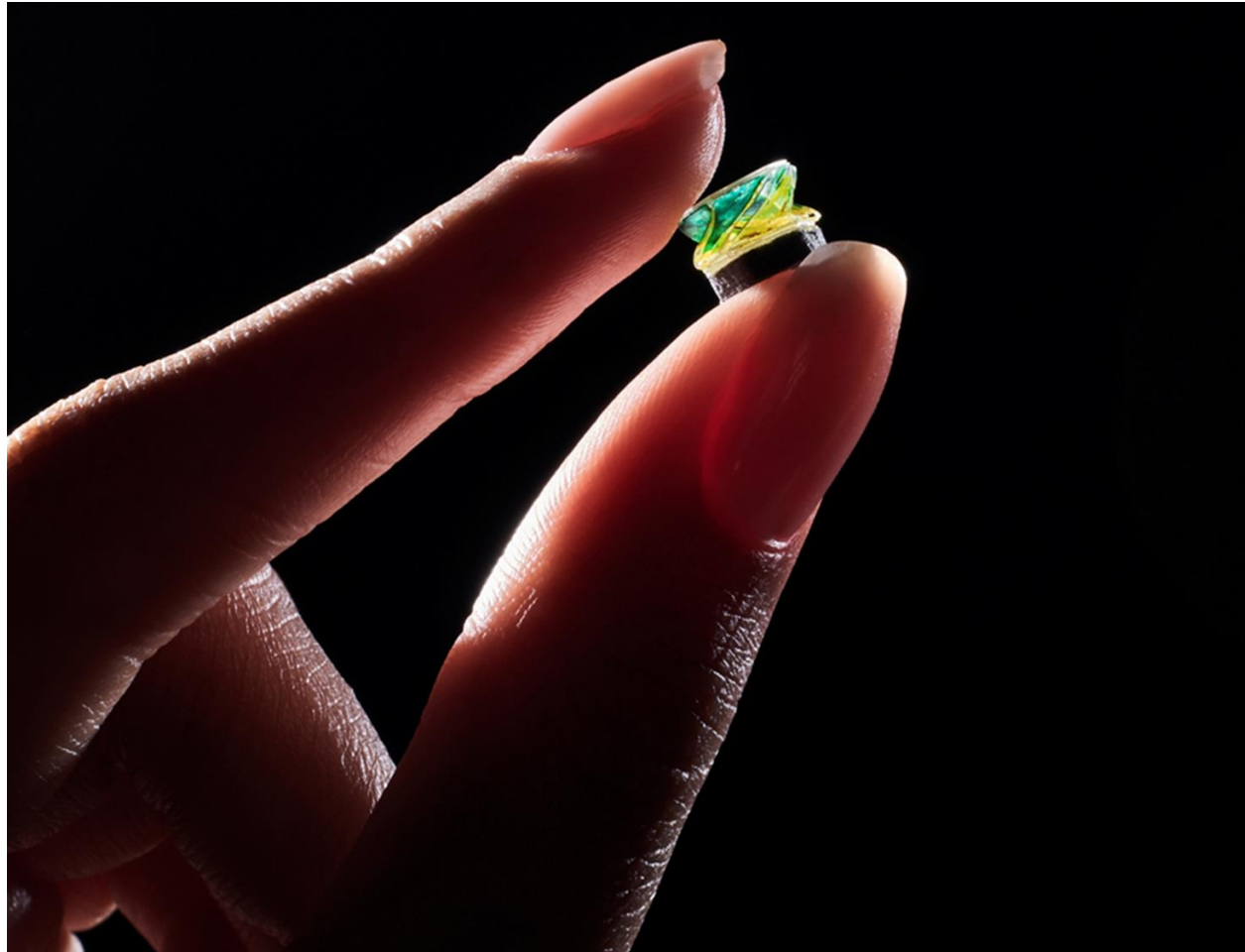
# Roomba

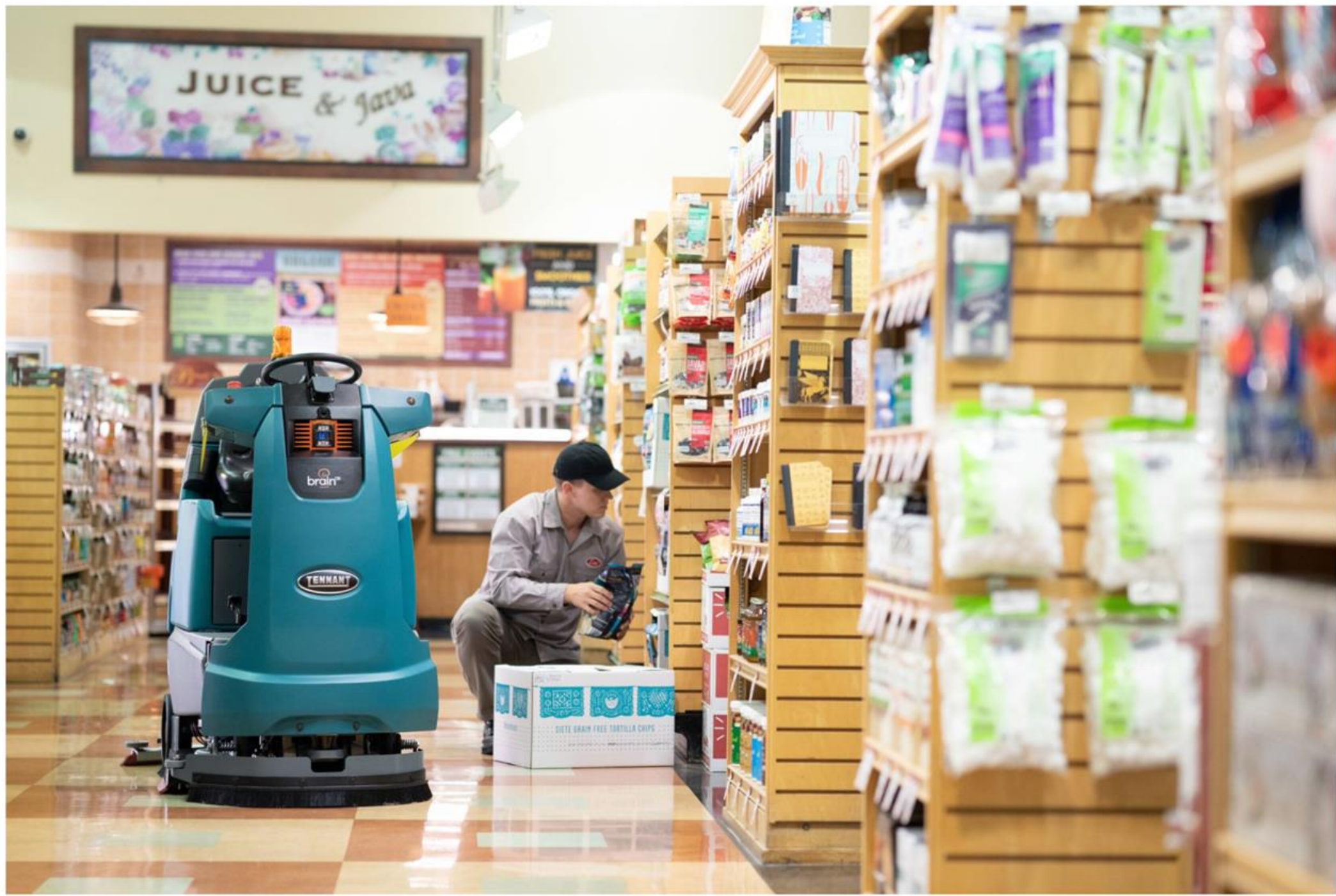


# 3D Printers

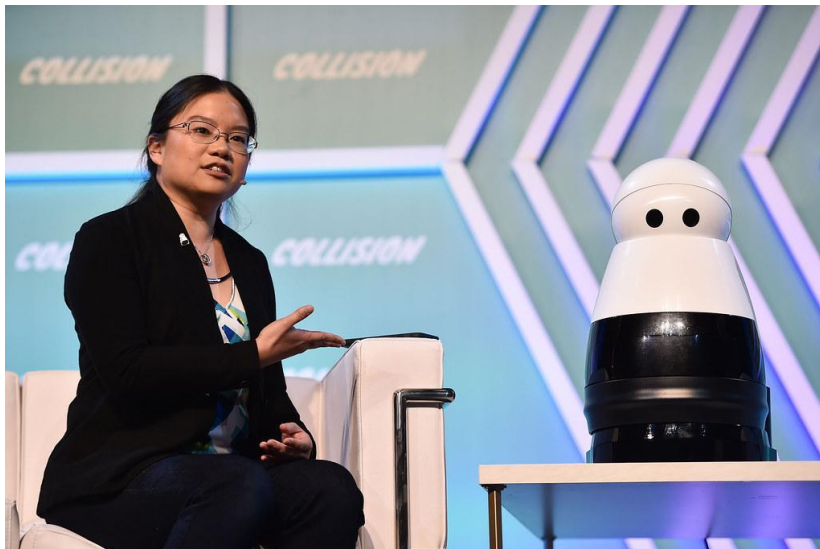
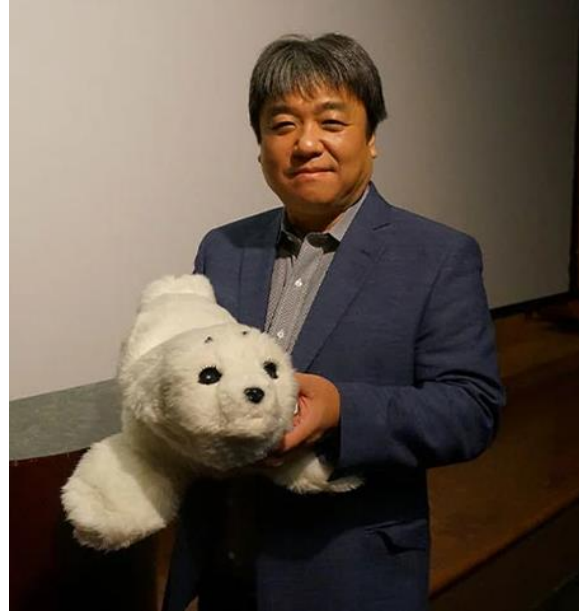


# Magnetic Spinners





# Social Robots





# Quadrupeds



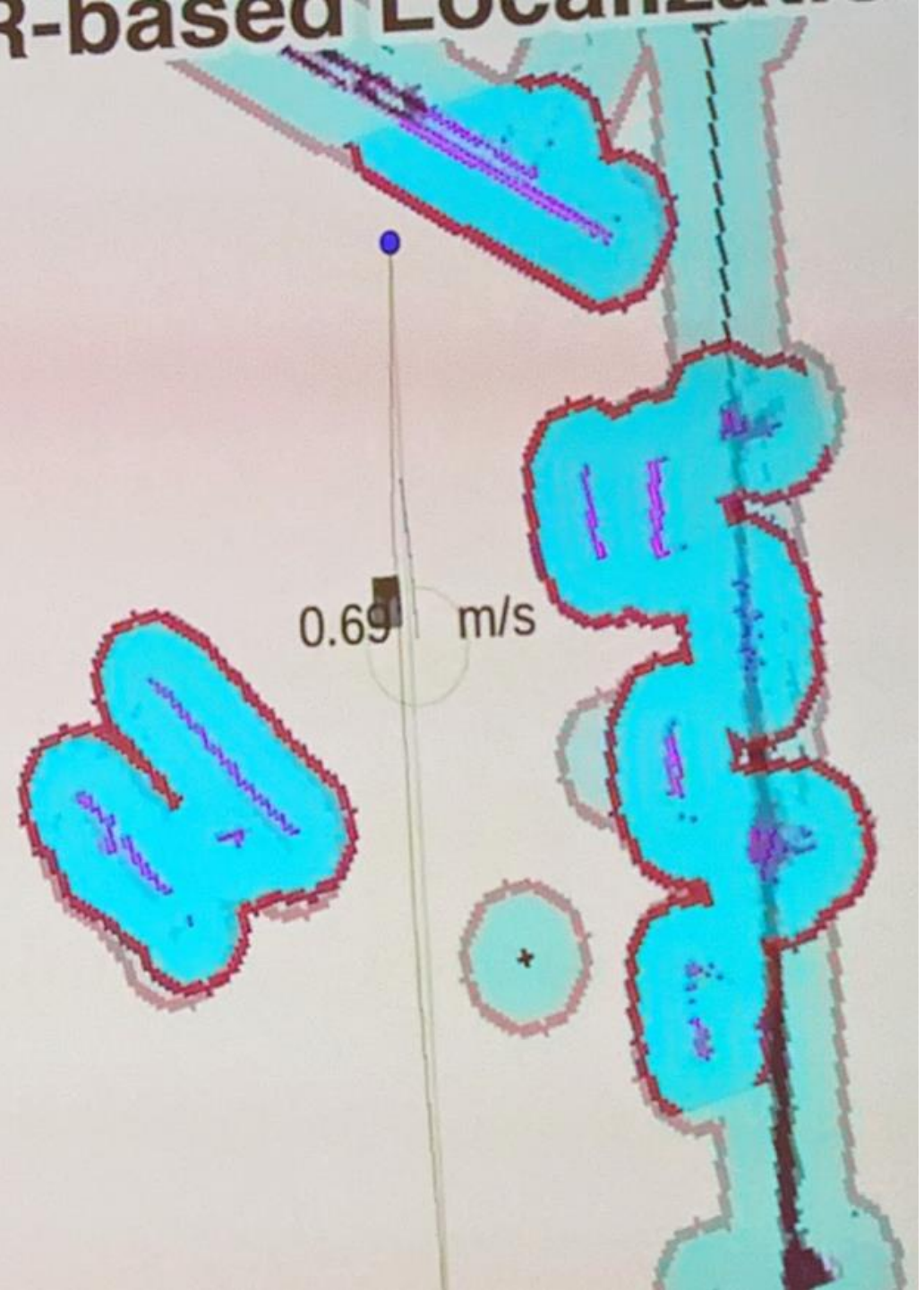
# Self-driving cars



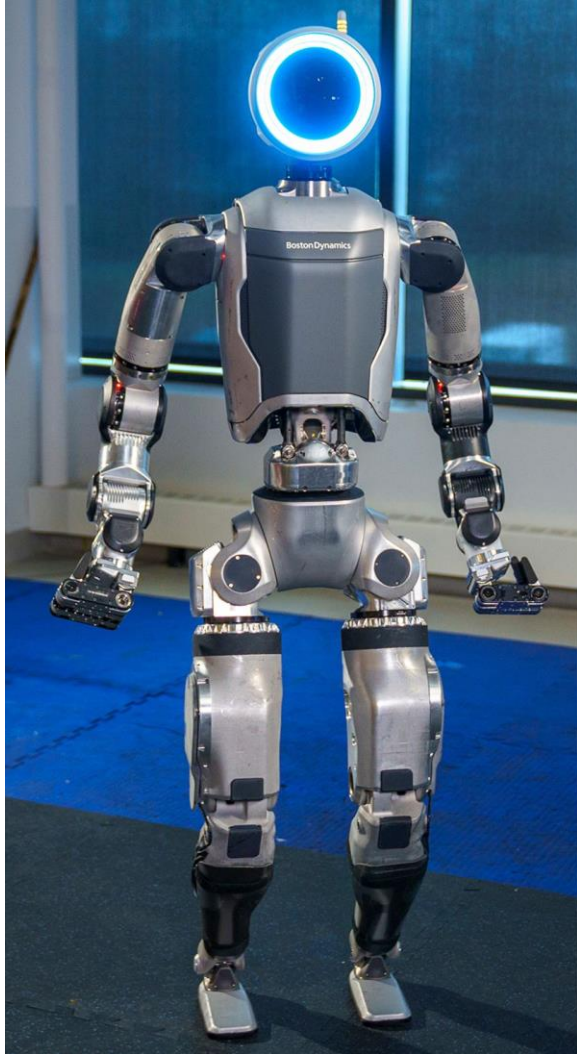
# LiDAR-based Localization



Chieko Asakawa



# Humanoids



# Telepresence

Seemed like a great idea...

Henry depends on it for his talk

[https://youtu.be/PYOyAqp\\_pJM?feature=shared](https://youtu.be/PYOyAqp_pJM?feature=shared)

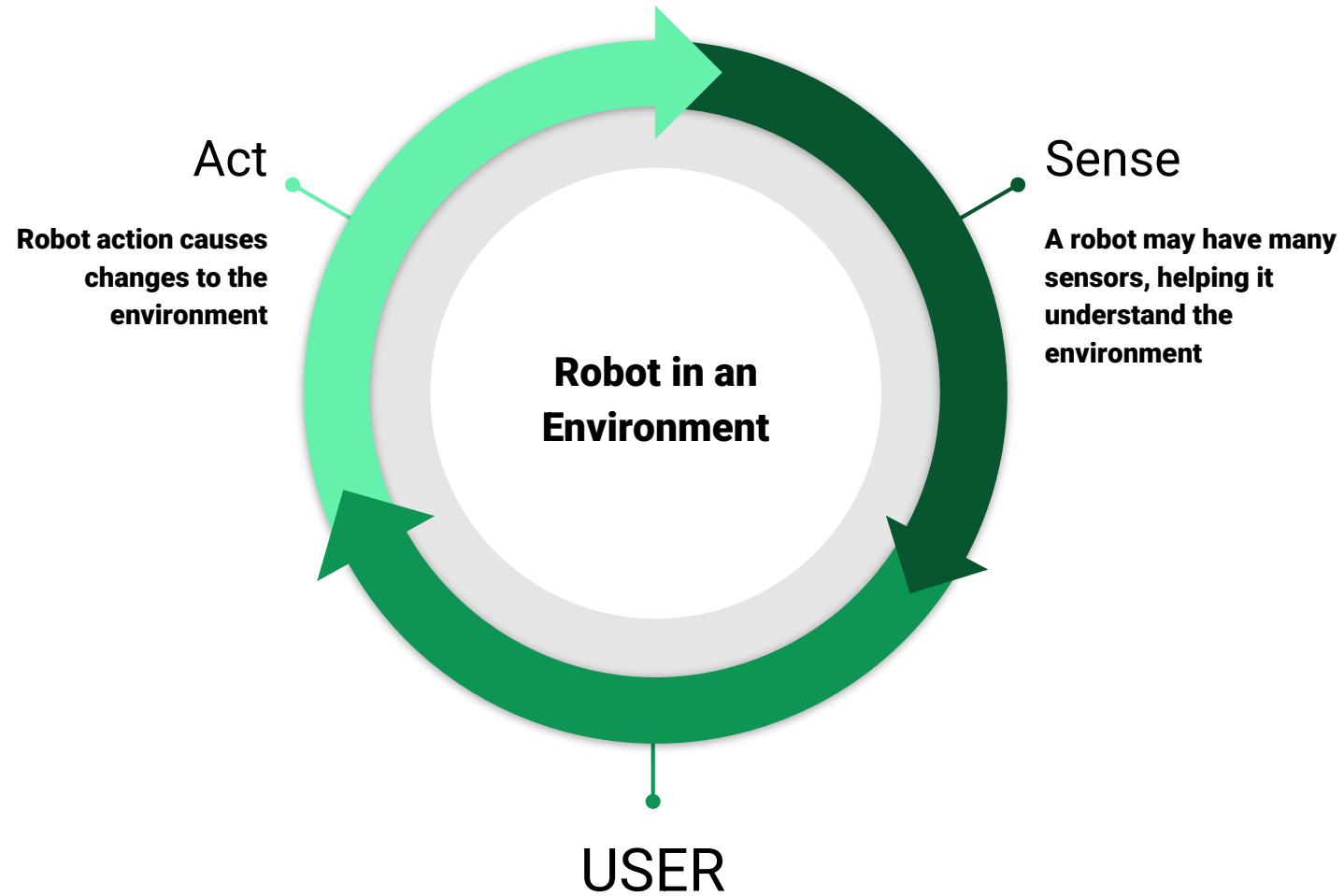


***But it wasn't successful!***

***What happened?***

- Cell phones
- Zoom

# Remote Control Cycle



# 3. Mediators

# User Interface Components

## Human INPUTS

- See
- Hear
- Feel
- Smell
- Taste

## Human OUTPUTS

- Speech
- Move (muscles)
- Keyboard
- Mouse
- 3D input devices
- Buttons, sliders, dials, knobs
- Joysticks

## Robot OUTPUTS

- Display
- Speakers
- Motor commands
- Data communications (WiFi, bluetooth, ...)
- Heat

## Robot INPUTS

- Cameras, lidar, radar, ...
- Microphones, vibration sensors
- Force/torque sensors, accelerometers
- Chemical detectors

# How is Henry controlling this complex robot?



# Oussama Khatib controlling OceanOne

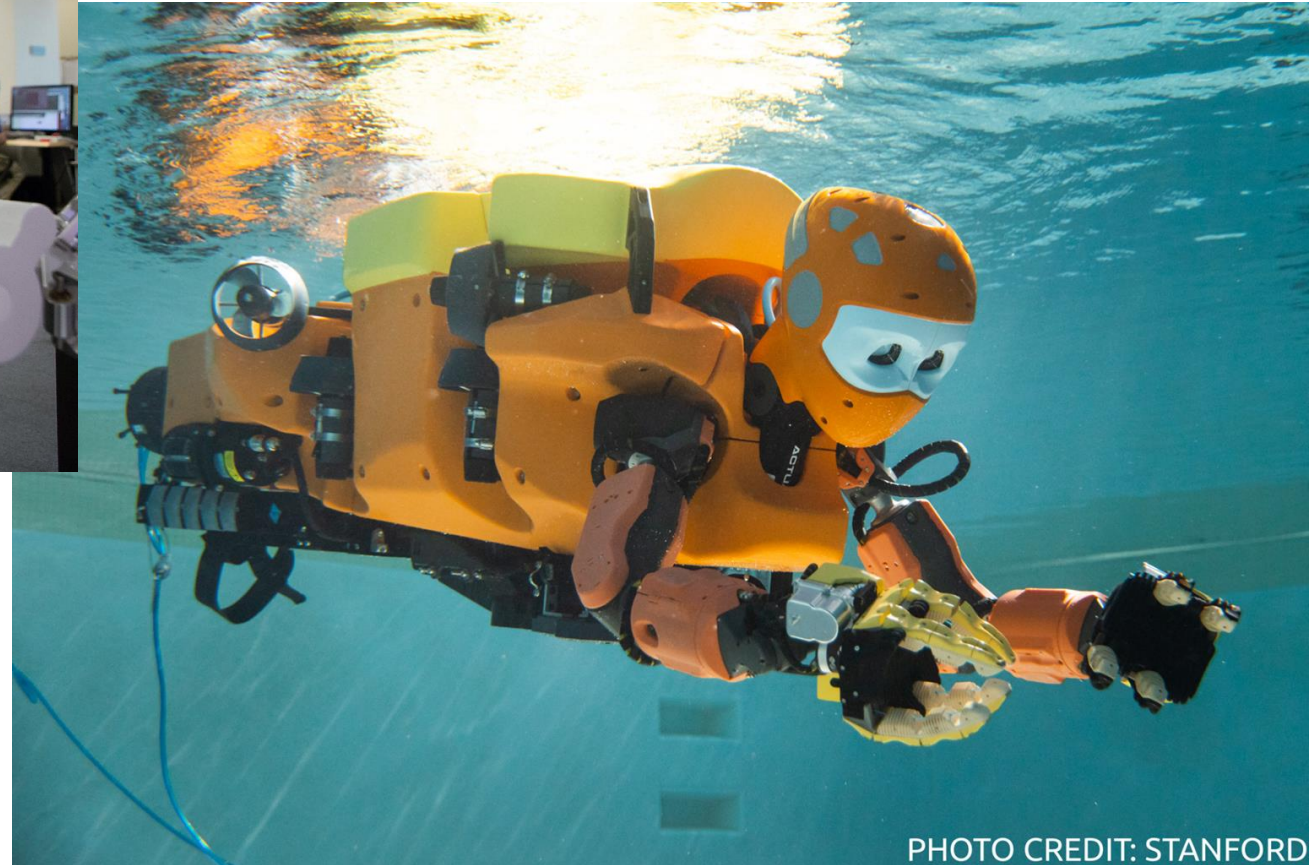
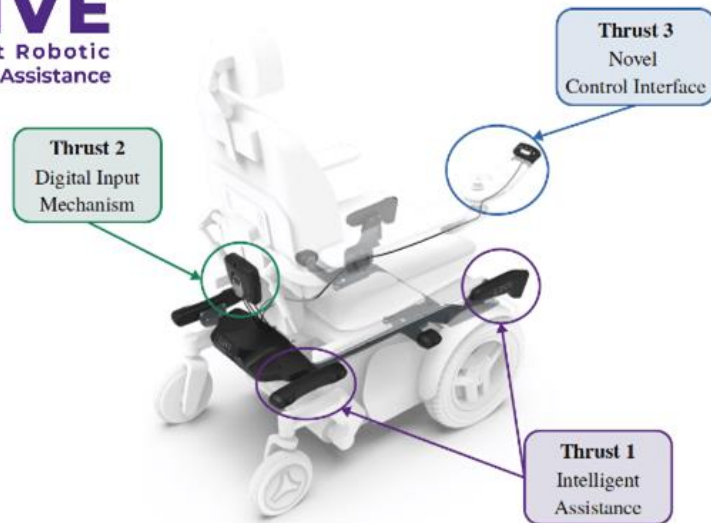


PHOTO CREDIT: STANFORD

# Smart Wheelchair (Argal Lab, Northwestern)



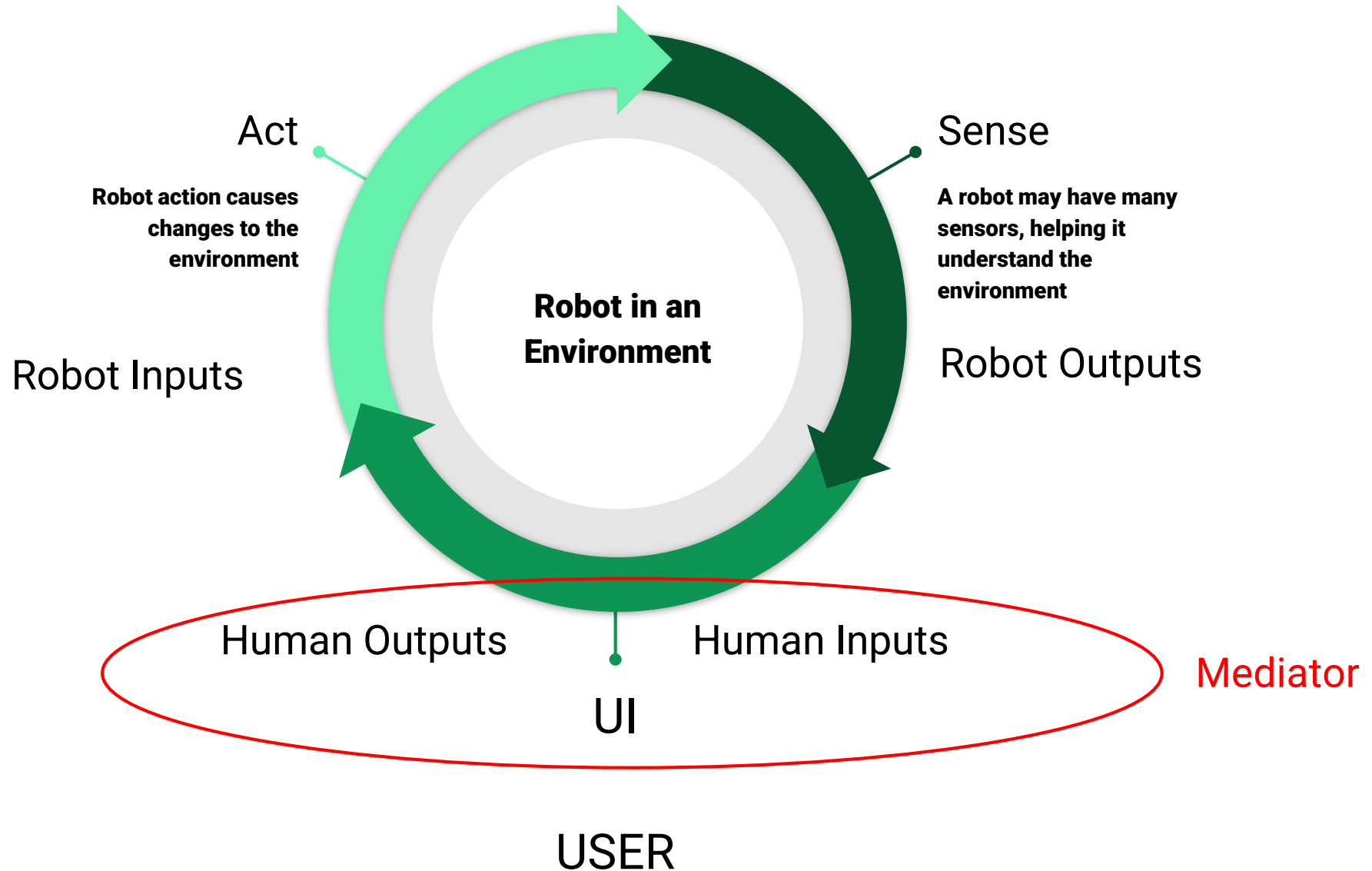
Addressing barriers  
to  
independent mobility

**argallab**  
assistive & rehabilitation robotics laboratory

Human autonomy *through* robotics autonomy.



# Remote Control Cycle



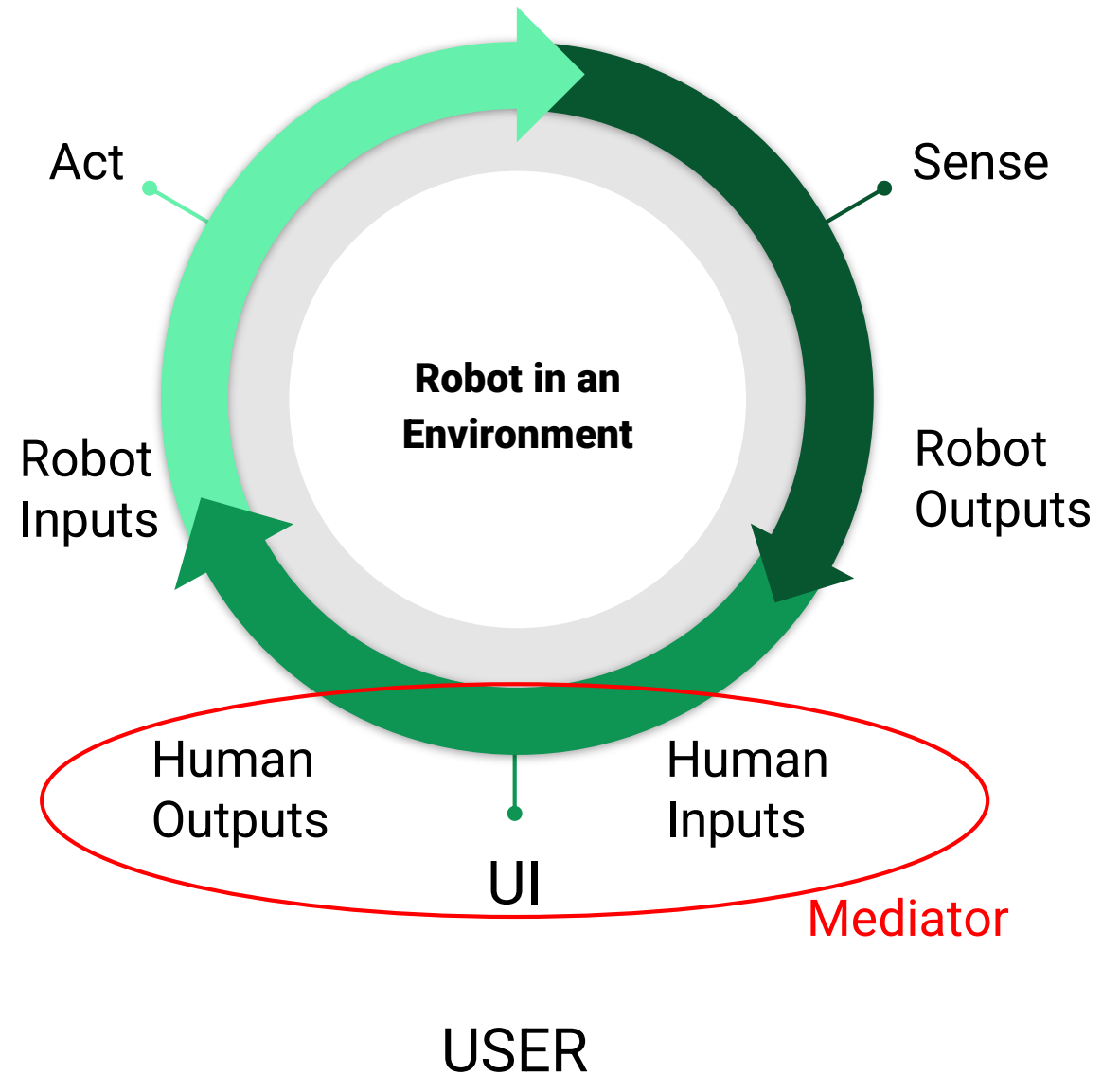
# Building Mediators

A Mediator lets us customize the human interface to meet user needs

Technically feasible, maybe easy with ROS

In practice, challenging:

- Safety (fear of liability)
- Reliability (hard to justify extensive testing)
- Trust (privacy sensitivity)



## 4. Caregivers

# How can robotics help caregivers?

Who is the user?

Who tells the smart wheelchair where to go (and how)?

Can we use robotic perception to help monitor patients?

How do we measure success?

# The Future: Senior independence

## Activities of Daily Living (ADLs)

1. Washing
2. Dressing
3. Feeding
4. Toileting
5. Walking/moving around
6. Transferring (bed  $\longleftrightarrow$  chair)

How many of these can robotics really help with today?

These require safely applying forces to fragile people!

If we focus, how many can robotics help with in 10 years?



10 Years



# Robots for Humanity revisited



# Questions?



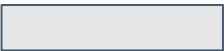


# Selected History of Robotics

Networking			Ethernet	WiFi	LTE	4G	5G
Computers	Xerox Alto		PC	Laptops	Smartphones Cloud computing	Tablets	Smart glasses?
Robots	Unimate	Kuka robots  Shakey Mailbot	Yaskawa Motoman	HelpMate	Roomba Kiva Self-driving cars <b>PR2</b> 3D Printers	<b>Relay</b> Logistics Other service robots Tesla self-driving	Humanoids
AI	Symbolic AI	Planning	Expert systems Logic	Neural nets	Deep Learning	Object recognition	LLMs / ChatGPT
Open Source	Unix OS			LAMP Stack Python / Java	OpenCV <b>ROS</b>		
Business Models	“Click”		HW/OS/Apps	Services	SaaS	Uber / Lyft <b>RaaS</b>	
	1960s	1970s	1980s	1990s	2000s	2010s	2020s



CMU RI founded



Willow Garage

AI vs. IA  
“Intelligent Augmentation”