

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





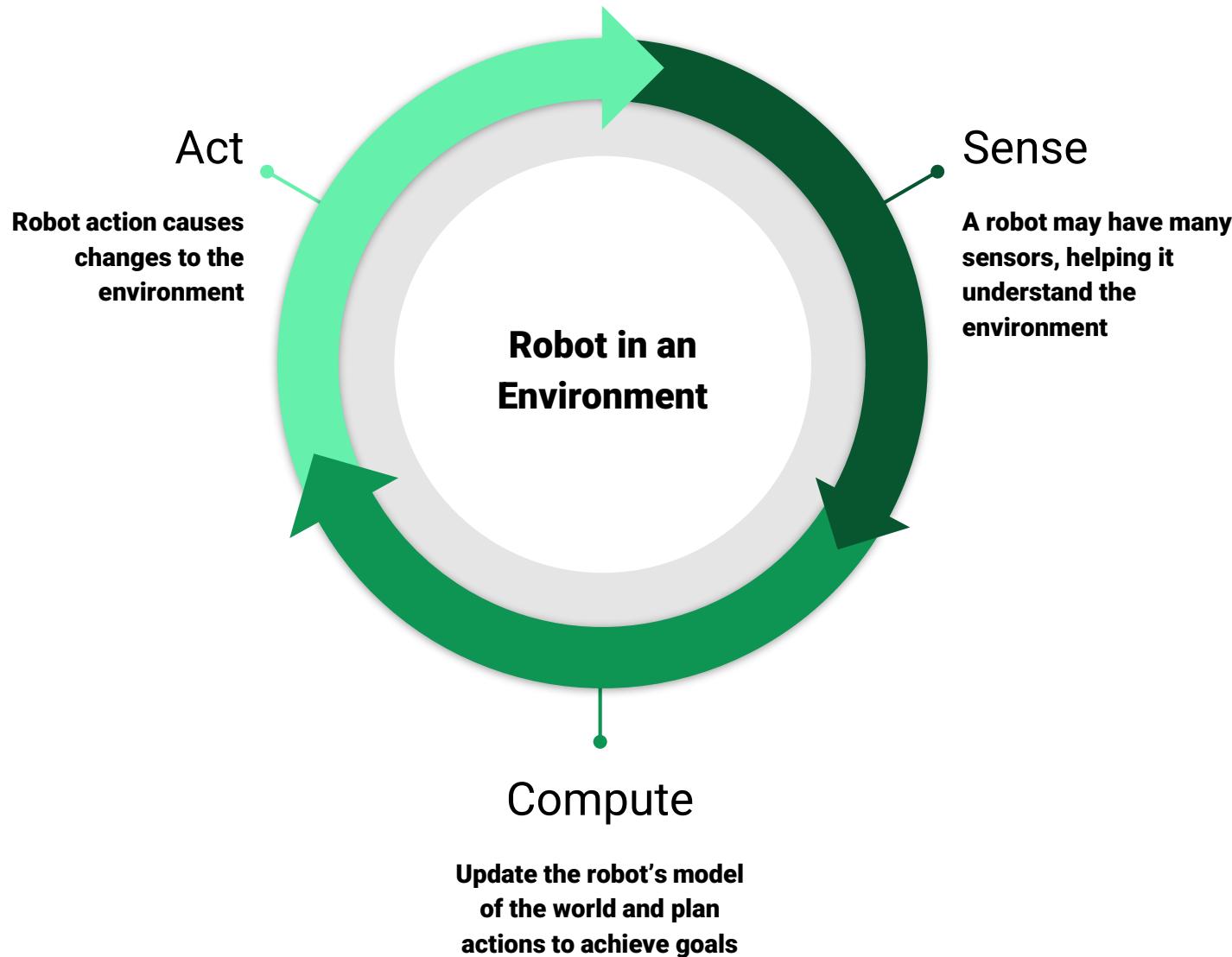
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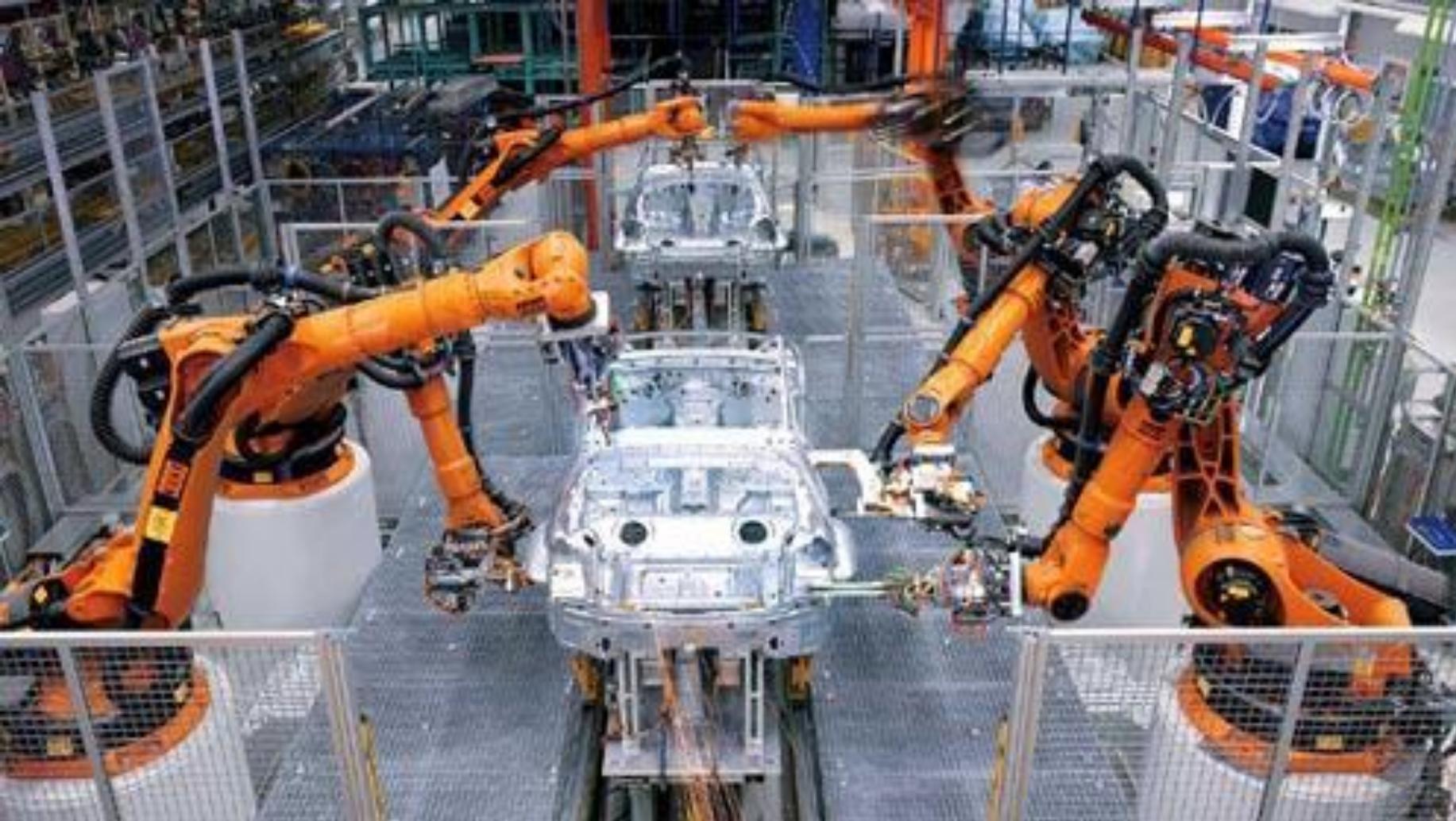
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2. What is a Robot?

Sense-Compute-Act cycle



Industrial Robotics: No People



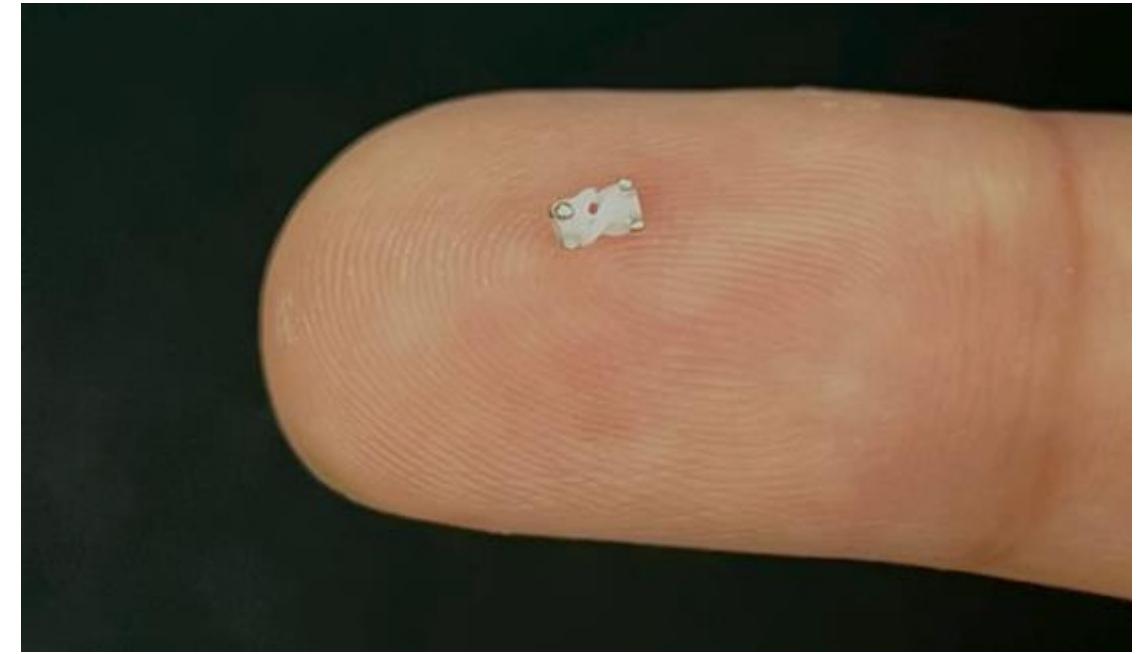
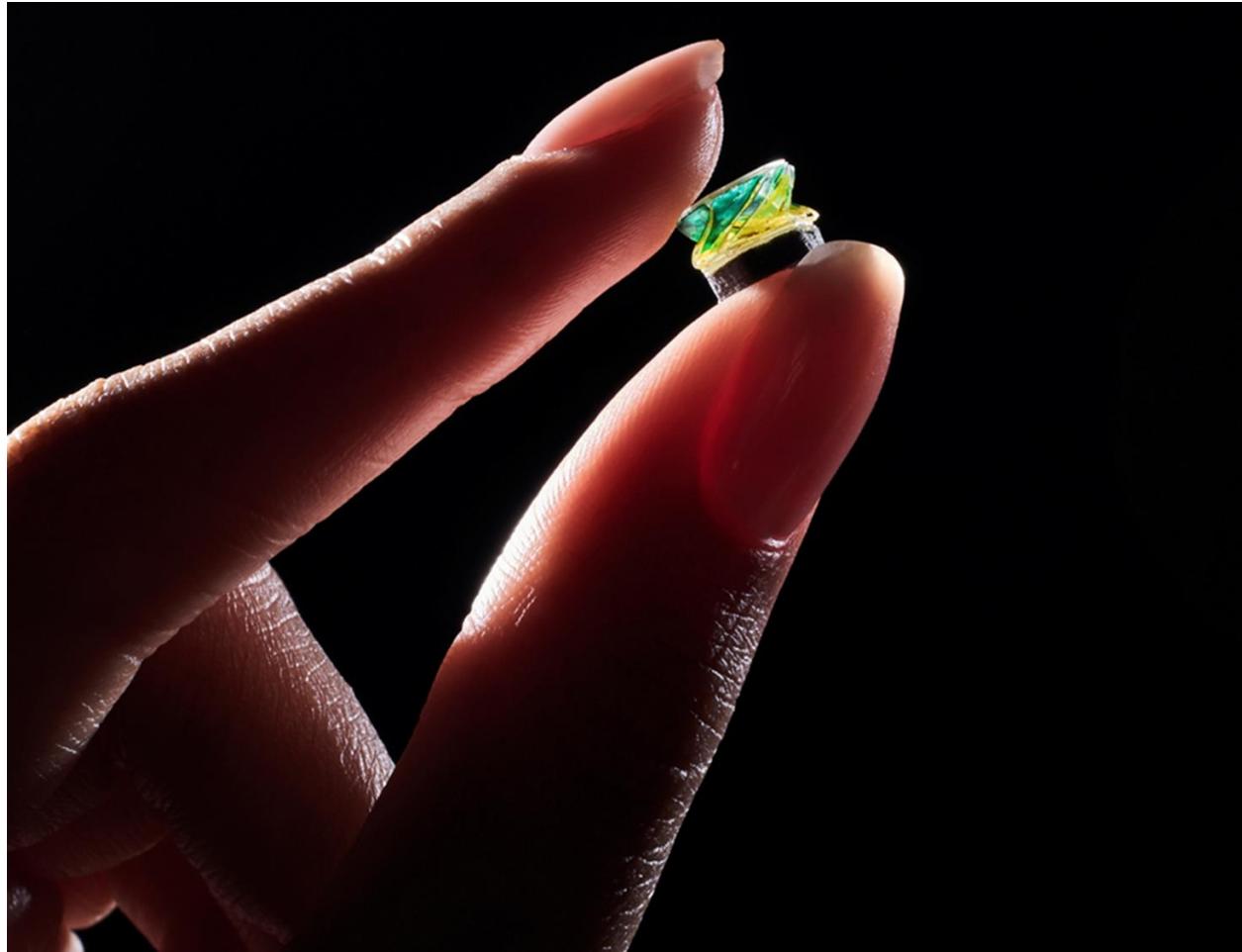
Roomba



3D Printers

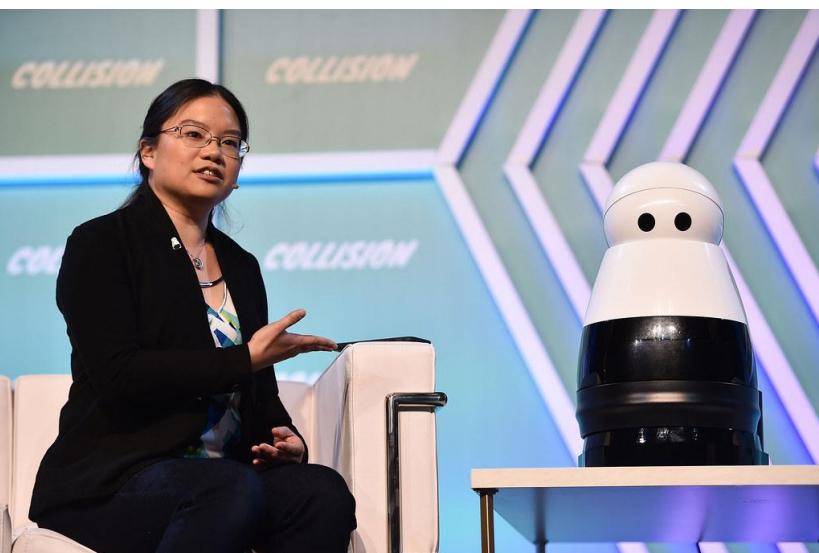
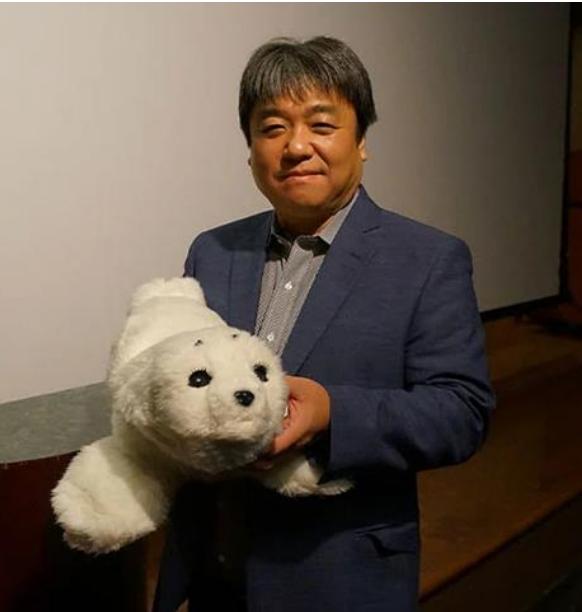


Magnetic Spinners





Social Robots





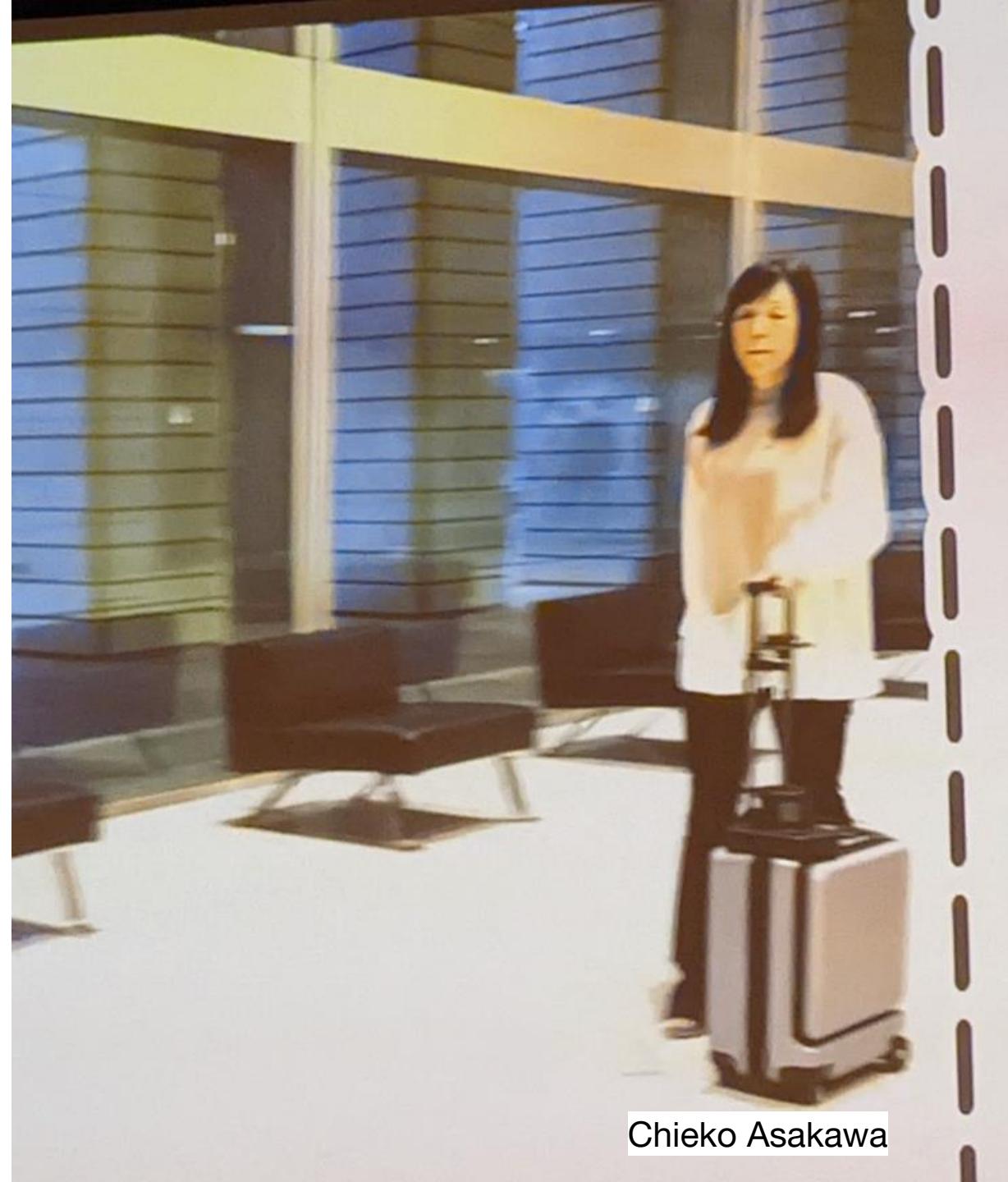
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Quadrupeds



Self-driving cars





Chieko Asakawa



Humanoids



Telepresence

Seemed like a great idea...

Henry depends on it for his talk

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

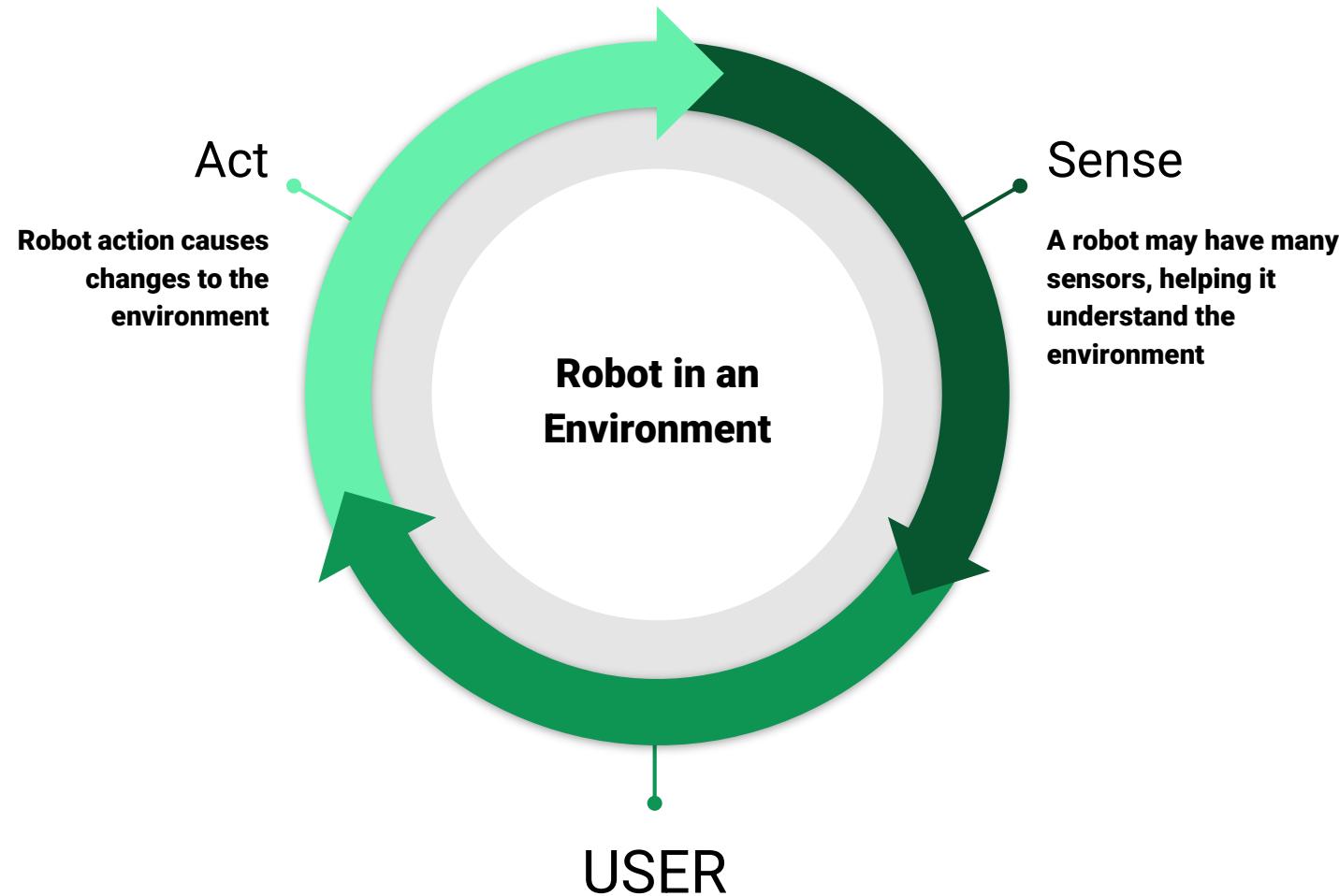


But it wasn't successful!

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?

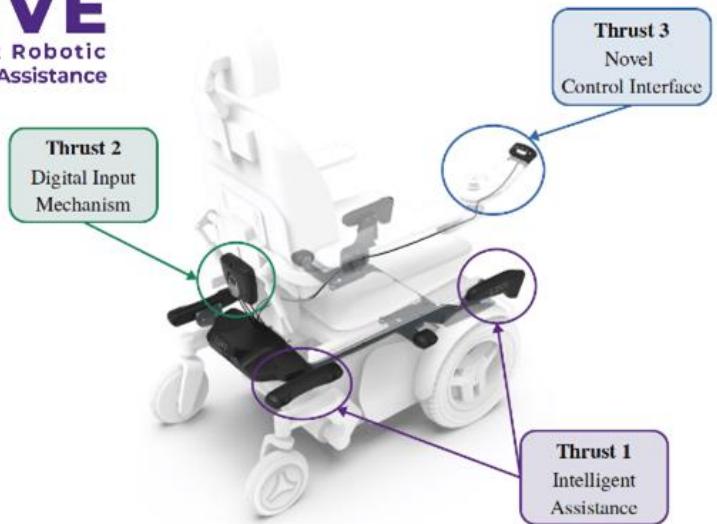


Oussama Khatib controlling OceanOne



PHOTO CREDIT: STANFORD

Smart Wheelchair (Argal Lab, Northwestern)



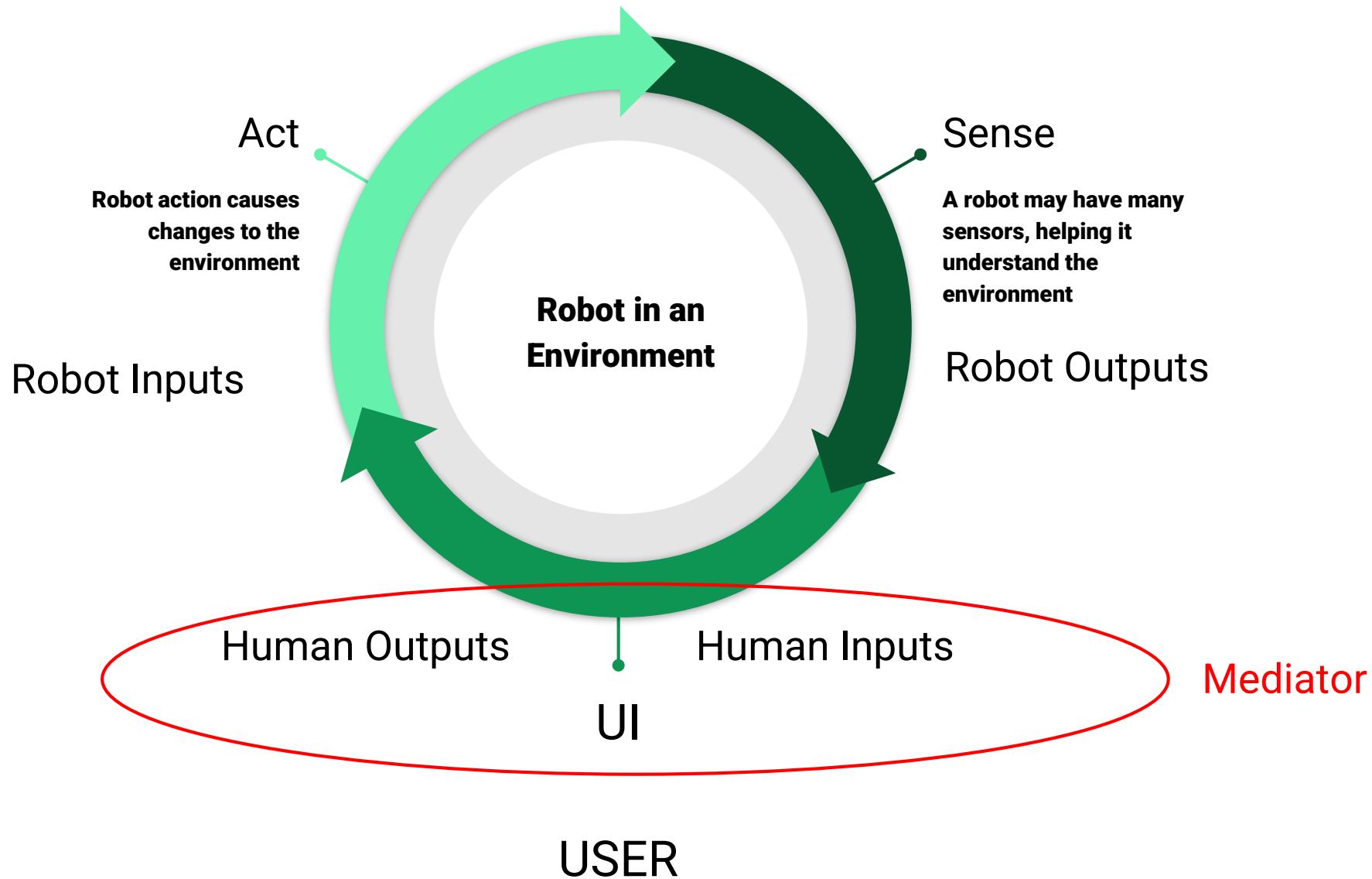
Addressing barriers
to
independent mobility



argallab
assistive & rehabilitation robotics laboratory

Human autonomy *through* robotics autonomy.

Remote Control Cycle



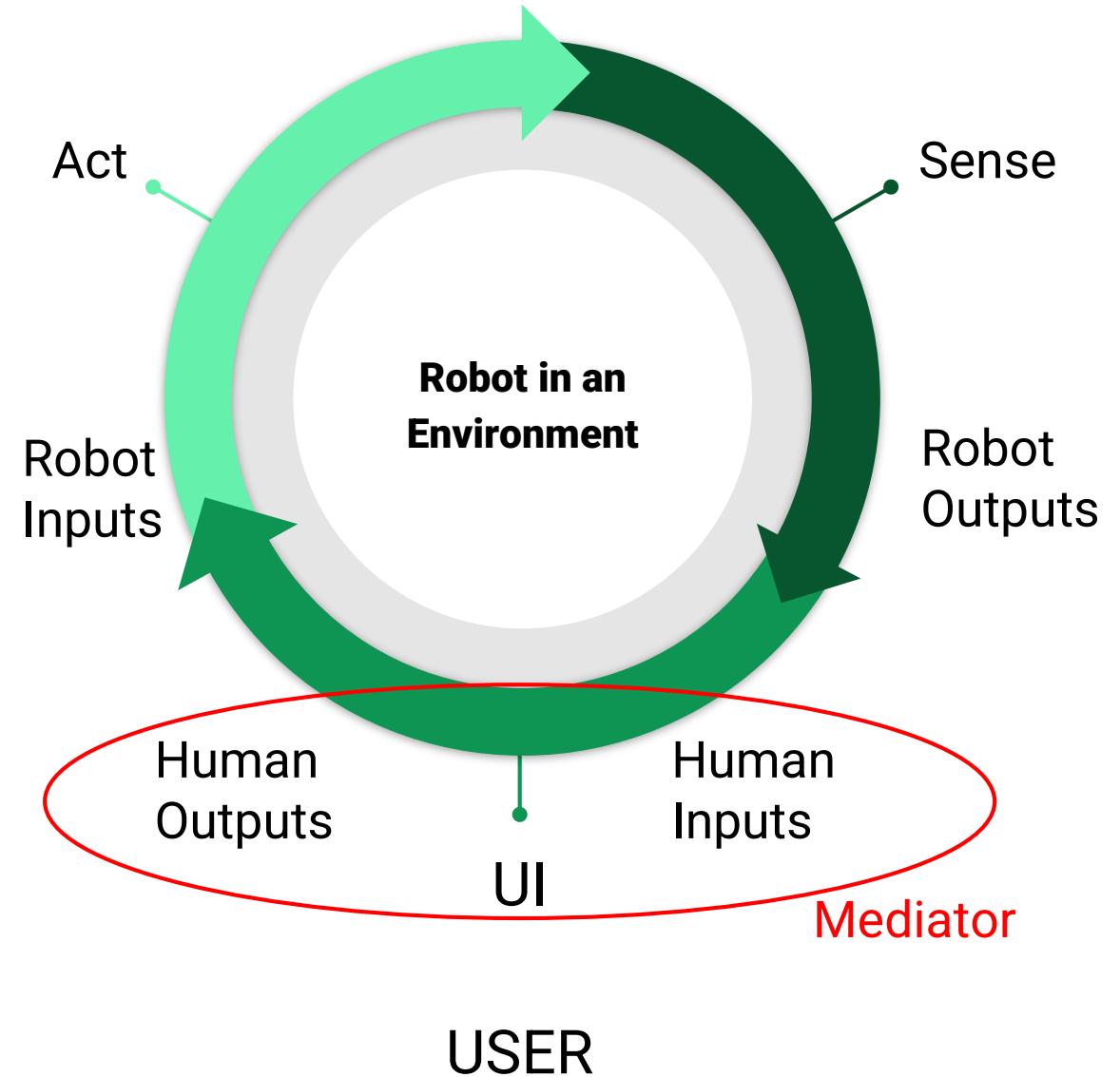
Building Mediators

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?



Relay
ROBOTICS

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	Yaskawa Motoman	HelpMate	Roomba Kiva Self-driving cars PR2 3D Printers	Relay Logistics Other service robots Tesla self-driving	Humanoids
		Shakey Mailbot					
AI	Symbolic AI	Planning	Expert systems Logic	Neural nets	Deep Learning	Object recognition	LLMs / ChatGPT
Open Source	Unix OS			LAMP Stack Python / Java	OpenCV ROS		
Business Models	“Click”		HW/OS/Apps	Services	SaaS	Uber / Lyft RaaS	
	1960s	1970s	1980s	1990s	2000s	2010s	2020s



CMU RI founded



Willow Garage

AI vs. IA

“Intelligent Augmentation”