

README // about these slides

These are the slides for the talk presented at CHI 2026 by Yun Ho and Romain Nith.

All the links in this PDF are clickable and lead you to YouTube videos, paper, etc.

You can watch the talk [here: https://www.youtube.com/watch?v=kfl6RXGHsm4](https://www.youtube.com/watch?v=kfl6RXGHsm4)

You can watch the video [here: https://www.youtube.com/watch?v=pJM2Z8mmwAw](https://www.youtube.com/watch?v=pJM2Z8mmwAw)

If you need a PPTX/editable version for your class, email us hci@uchicago.edu

More information on this paper (or others of our lab): <https://lab.plopes.org/#embodied-ai> [genEMS](https://lab.plopes.org/#genEMS)



Generative Muscle Stimulation: Providing Users with Physical Assistance by Constraining Multimodal-AI with Embodied Knowledge

Yun Ho*, Romain Nith*, Peili Jiang, Steven He, Bruno Felalaga, Shan-Yuan Teng, Pedro Lopes. In Proc. [CHI'26](#) (full paper) (* authors contributed equally)

CHI best paper award (top 1%)

We propose a new form of embodied-AI that assists users' bodies directly via muscle-stimulation. Moreover, it does not deliver fixed muscle stimulation instructions but *generates* this form of physical-AI assistance according to user's needs and context. Our system gathers information: body pose (IMU suit) + point-of-view (objects, hand-poses) + location (e.g., "Chicago"), etc. These are fed to a multimodal-AI that creates textual-instructions allowing it to infer how to use everyday objects (e.g., a bike rack, analog cameras, and more). Before it stimulates, our system constrains the generated instructions to ensure they respect the user's biomechanical constraints (e.g., their current pose, joint limits or even their preferences).



[CHI'26 paper](#)



[Project page \(data/code\)](#)



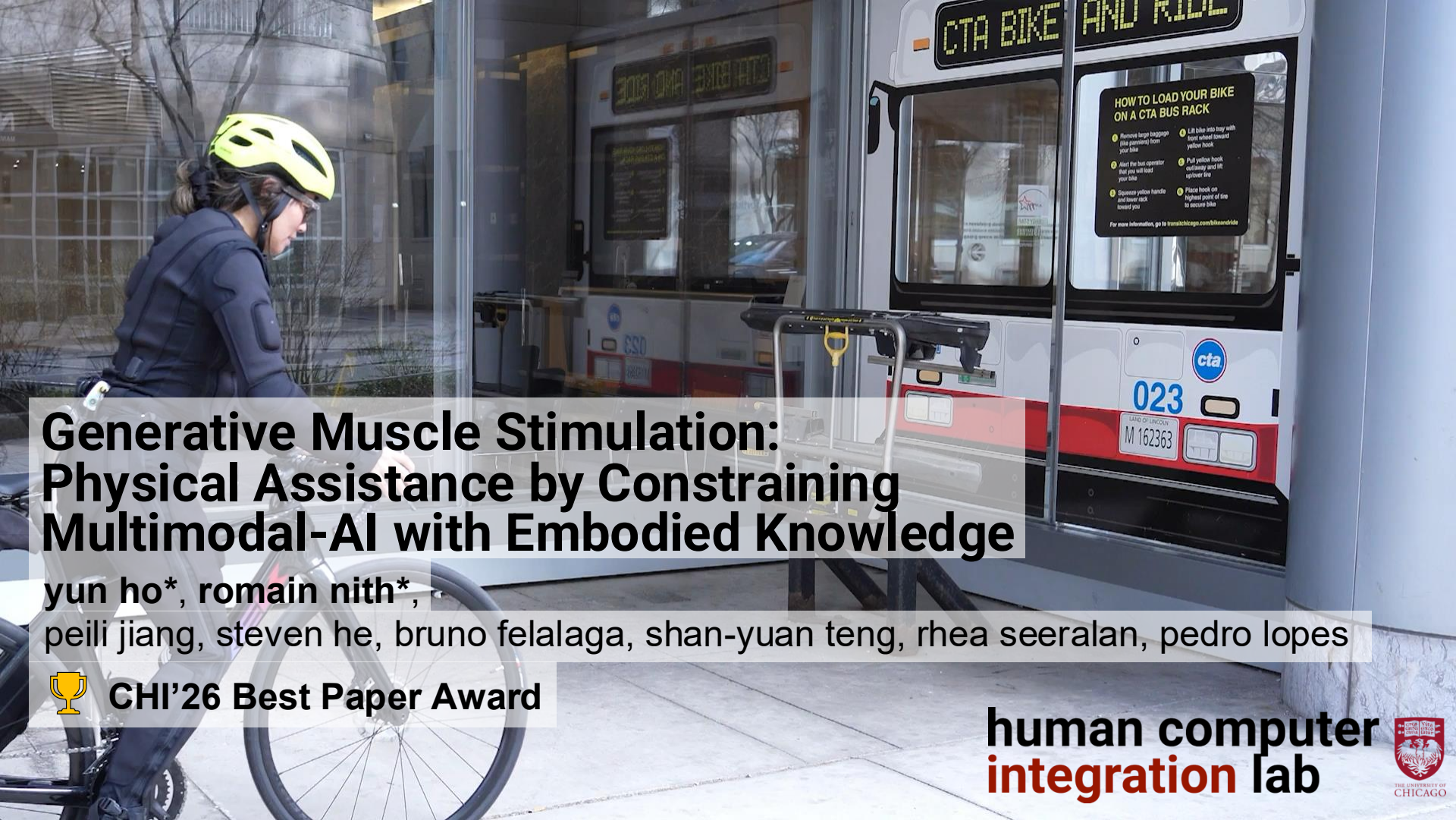
[video](#)



[CHI talk \(pre-recorded\)](#)



[CHI talk \(live\)](#)



Generative Muscle Stimulation: Physical Assistance by Constraining Multimodal-AI with Embodied Knowledge

yun ho*, remain nith*,
peili jiang, steven he, bruno felalaga, shan-yuan teng, rhea seeralan, pedro lopes



CHI'26 Best Paper Award

human computer
integration lab



motivation

Step 1: Find the indefinite integral of $f(x)$

The integral of each term in the polynomial is calculated as follows:

$$\int (33x^5 - 106x^4 + 126x^3 + 67x^2 + 15x) dx$$

This gives:

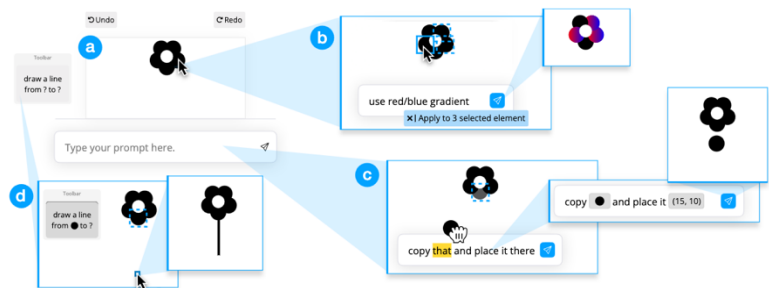
$$\frac{33}{6}x^6 - \frac{106}{5}x^5 + \frac{126}{4}x^4 + \frac{67}{3}x^3 + \frac{15}{2}x^2 + C$$

Which simplifies to:

$$5.5x^6 - 21.2x^5 + 31.5x^4 + 22.33x^3 + 7.5x^2 + C$$

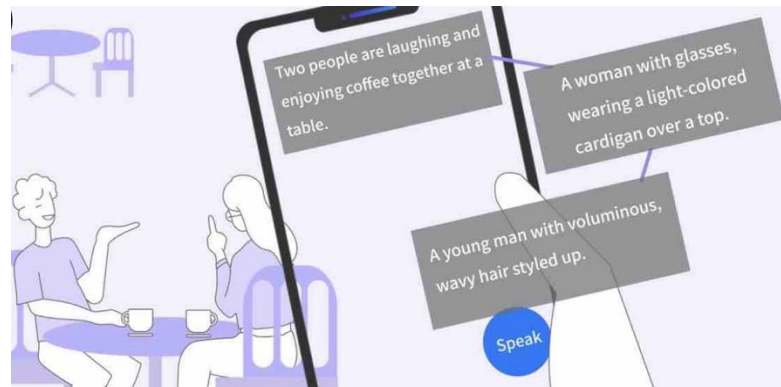
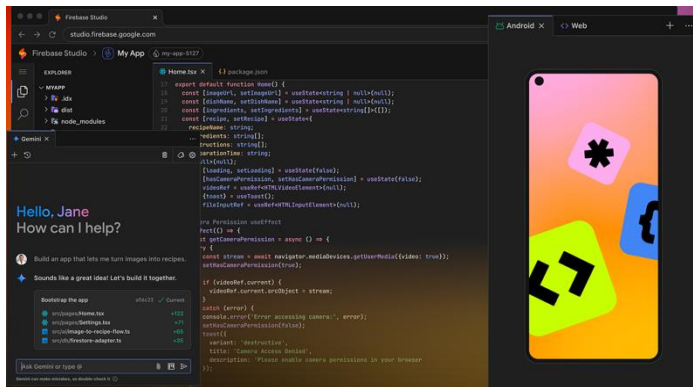
Step 2: Set the integral equal to 2

We want to find when the integral equals 2, so we set the expression equal to 2:



ChatGPT

Masson et. al., CHI'24



Firebase Studio

Chang et. al., UIST'24

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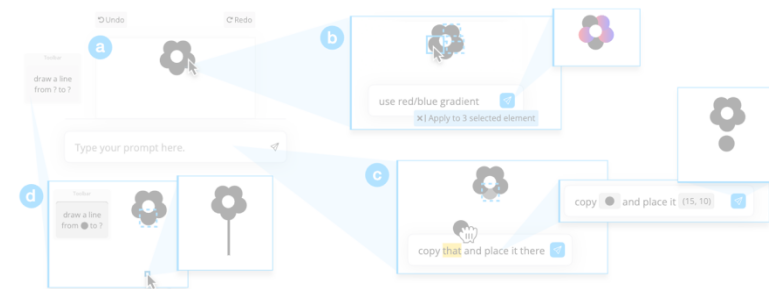
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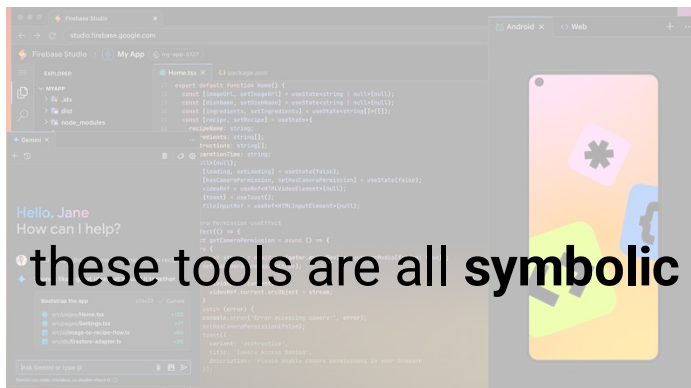
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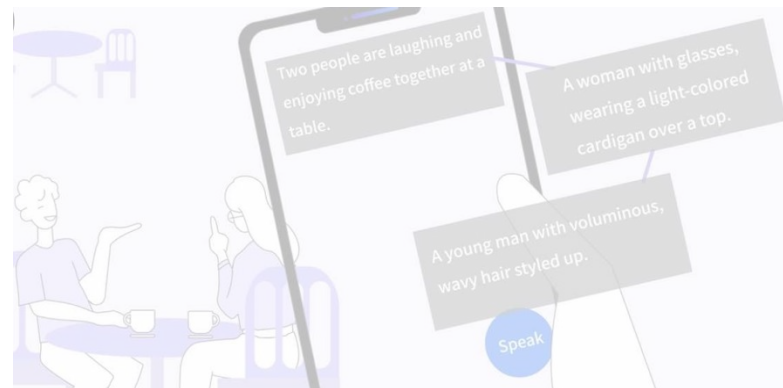
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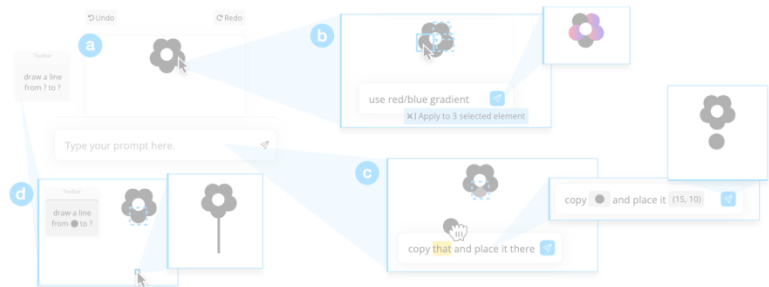
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ChatGPT



Masson et. al., CHI'24

The screenshot shows the Firebase Studio interface. On the left, there is a code editor with Swift code. On the right, there is a mobile app preview showing a pink background with a flower icon and a blue button. The text "Hello, Jane How can I help?" is visible on the preview.

these tools are all symbolic

Firebase Studio

The illustration shows two people sitting at a table with coffee cups. A smartphone in the foreground displays a list of prompts:

- Two people are laughing and enjoying coffee together at a table.
- A woman with glasses, wearing a light-colored cardigan over a top.
- A young man with voluminous, wavy hair styled up.

A "Speak" button is visible at the bottom.

Chang et. al., UIST'24

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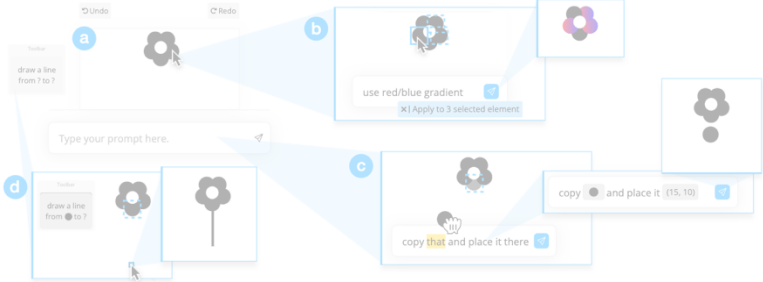
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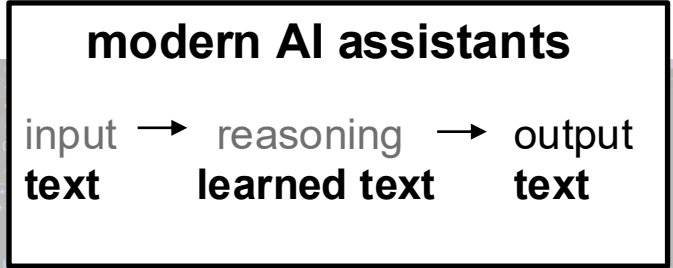
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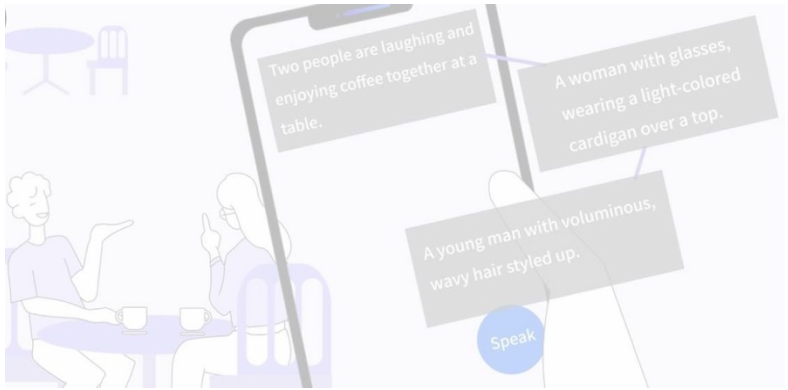
Masson et. al., CHI'24



How can I help?

these tools are all symbolic

Firestore Studio



Chang et. al., UIST'24

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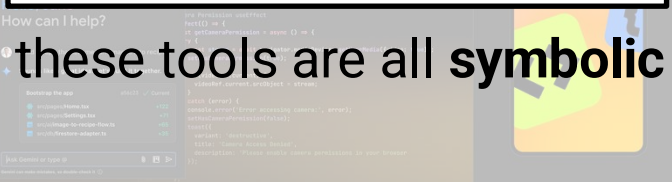
ChatGPT

modern AI assistants

input \rightarrow reasoning \rightarrow output
text **learned text** **text**

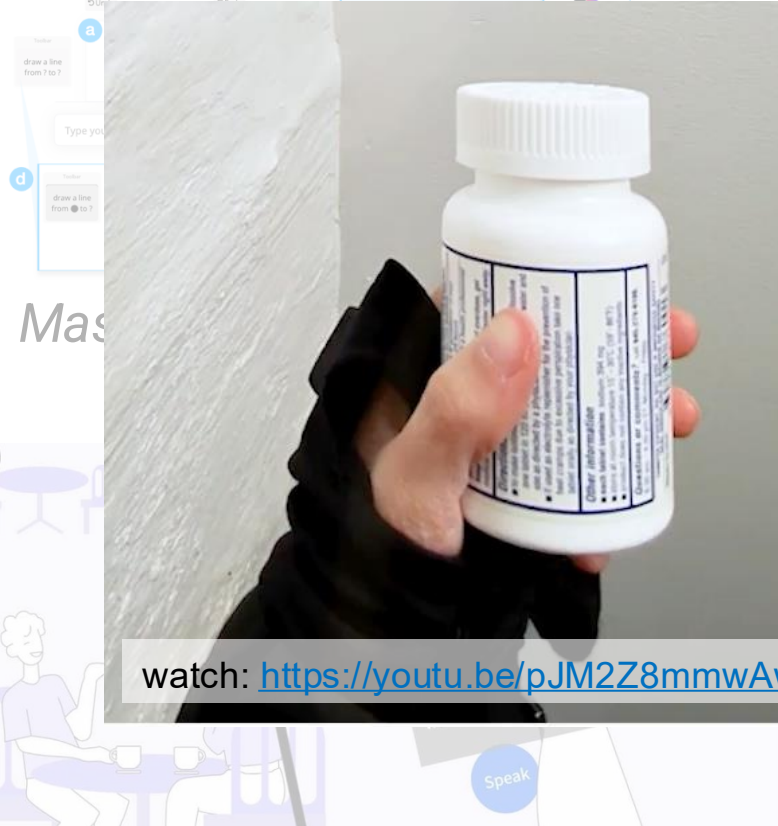
How can I help?

these tools are all **symbolic**



Firestore Studio

“help me open this”



watch: <https://youtu.be/pJM2Z8mmwAw>

Chang et. al., UIST'24

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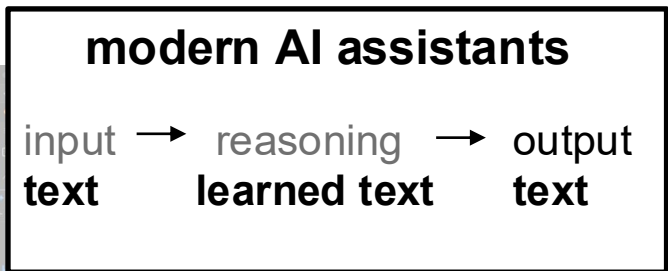
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ChatGPT



How can I help?

- these tools are all **symbolic**

Firestore Studio

“help me open this”

embodied AI assistants

input \rightarrow reasoning \rightarrow output
body **non-verbal** **body**

this new tool is **embodied**

Chang et. al., UIST'24

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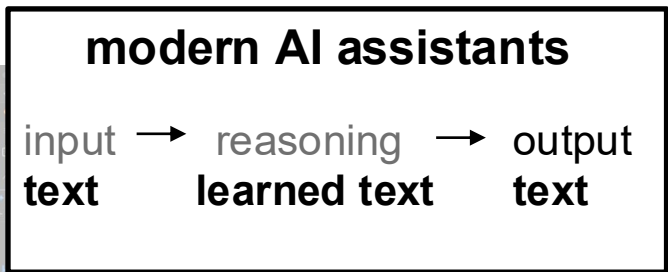
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embodied AI assistants

input \rightarrow reasoning \rightarrow output
body **non-verbal** **body**

this new tool is **embodied**
 let's see a longer example

Chang et. al., UIST'24

our approach





this user wears a suit embedded with **electrical muscle stimulation (EMS)** pads



the suit also includes inertial measurement units (IMUs) for full-body tracking



they also wear **smart glasses** providing a **first-person (POV) video feed**

watch: <https://youtu.be/pJM2Z8mmwAw>

USER

*EMS, help me with this
bike rack*



CTA BIKE

HOW TO LOAD YOUR BIKE ON A CTA BUS RACK

- 1 Remove large baggage (like panniers) from your bike
- 2 Alert the bus operator that you will load your bike
- 3 Squeeze yellow handle and lower rack toward you
- 4 Lift bike into tray with front wheel toward yellow hook
- 5 Pull yellow hook out/away and lift up/over tire
- 6 Place hook on highest point of tire to secure bike

For more information, go to transitchicago.com/bikeandride

watch: <https://youtu.be/pJM2Z8mmwAw>



CTA BIKE

CTA BIKE

023

USER

HOW TO LOAD YOUR BIKE ON A CTA BUS RACK

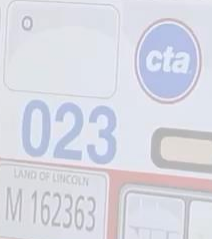
- 1 Remove large baggage (like panniers) from your bike
- 2 Alert the bus operator that you will load your bike
- 3 Squeeze yellow handle and lower rack toward you

- 4 Lift bike up from front wheel
- 5 Pull yellow cutaway up over handlebars to secure
- 6 Place hood highest position

For more information, go to transit.chicago.gov



EMS, help me with this bike rack



(system responses cached to minimize latency for clarity)

watch: <https://youtu.be/pJM2Z8mmwAw>



CTA BIKE

2019 ONE-FARE CITY

HOW TO LOAD YOUR BIKE ON A CTA BUS RACK

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SYSTEM

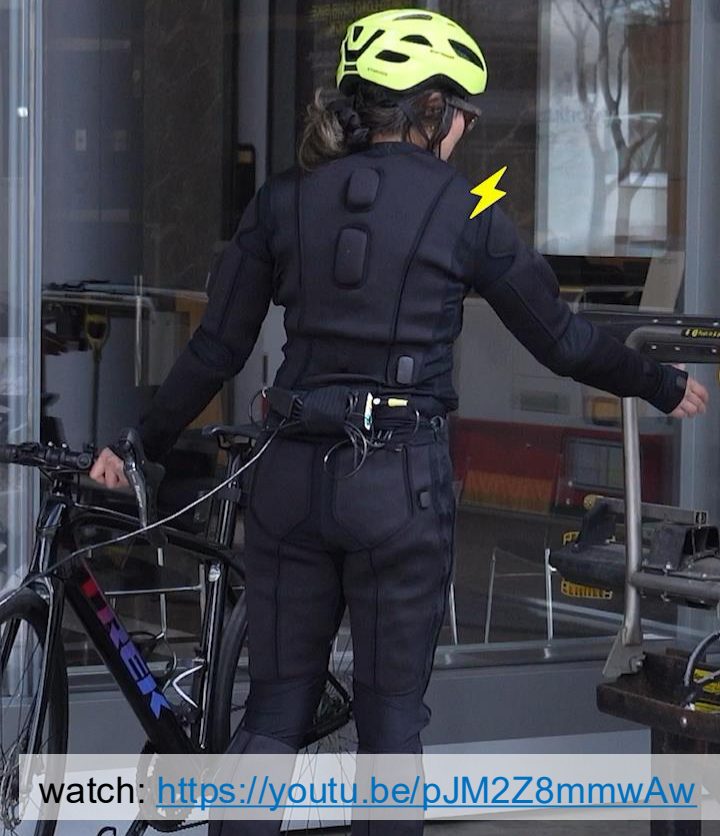
I am going to move your right arm and hand

023

LAND OF LINCOLN
M 162363

watch: <https://youtu.be/pJM2Z8mmwAw>

the system **stimulates** the **shoulder**,
guiding the arm to **reach** the handle...



HOW TO LOAD YOUR BIKE ON A CTA BUS RACK

- 1 Remove large baggage (like panniers) from your bike
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For more information, go to transitchicago.com/bikeandride

watch: <https://youtu.be/pJM2Z8mmwAw>

implementation



HOW TO LOAD YOUR BIKE ON A CTA BUS RACK

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- 4 Lift bike into tray with front wheel toward yellow hook
- 5 Pull yellow hook out/away and tilt up/over tire
- 6 Place hook on highest point of tire to secure bike

For more information, go to busandbikes.com/bikeandride

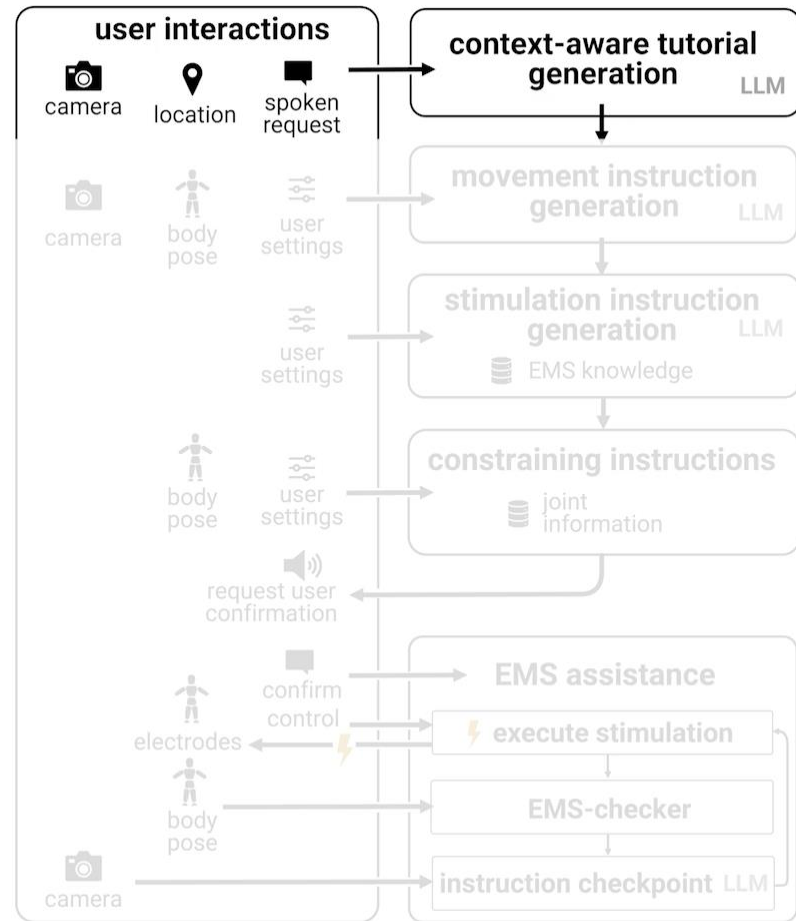
watch: <https://youtu.be/pJM2Z8mmwAw>



tutorial output

- 1) Positioned on the Bus Front: Stand on the right side when you face the rack (if space and traffic allow).
 - 2) Lower the Rack: Often, you'll squeeze or pull up on a handle (in this case, the yellow one at the top) to release and lower the rack into the loading position. Some racks are already lowered—just follow the instructions shown on any label if needed.
- (...)

LLM

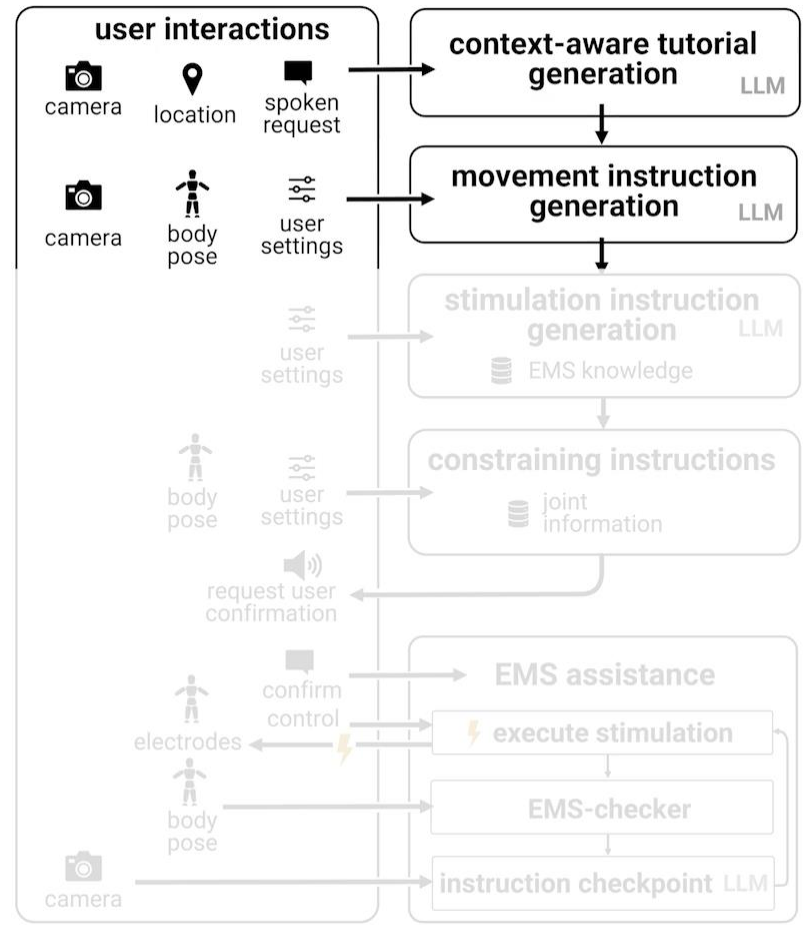


watch: <https://youtu.be/pJM2Z8mmwAw>



movement output

- Right:
- 1) Move your right arm forward, rotating your forearm about 90 degrees clockwise so your palm faces the yellow handle on the bottom of the rack.
 - 2) Grip the yellow handle and pull it gently toward you, about 2–3 cm—until you feel the latch disengage.
 - 3) Guide the rack forward, let it rotate downward about 90 degrees into the horizontal, open position.

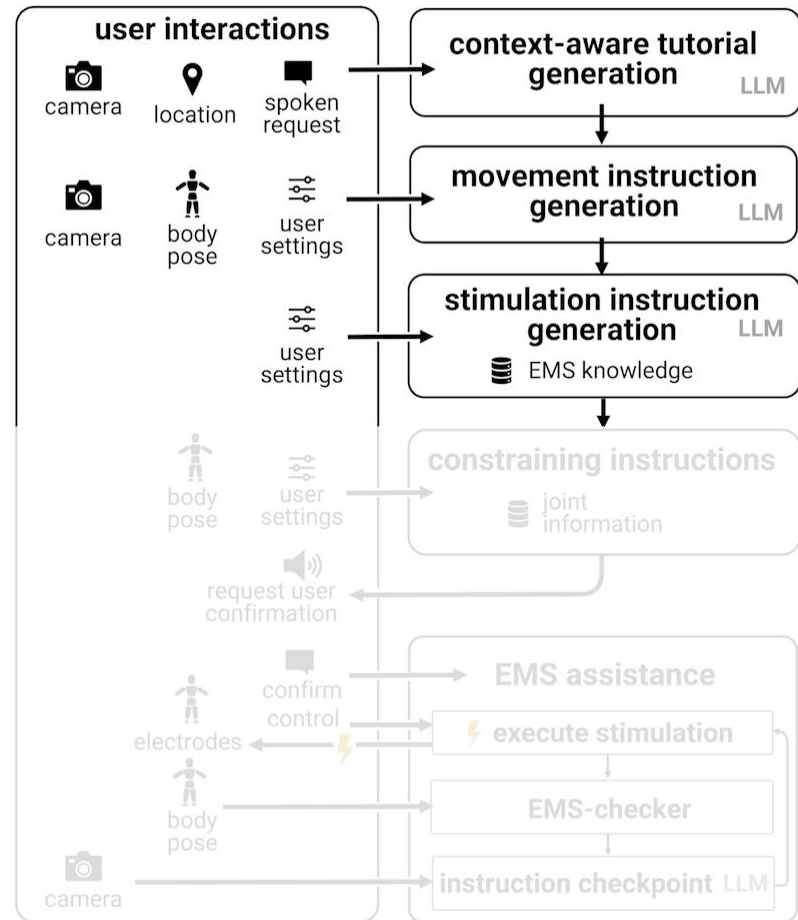


watch: <https://youtu.be/pJM2Z8mmwAw>



stimulation output

- 1) `<right>[elbow][extension][forward][45]`
`<right>[wrist][rotate][clockwise][90]`
- 2) `<right>[grip][flexion][inward][15]`
`<right>[pull][extension][backward][5]`
- 3) `<right>[elbow][flexion][upward][90]`



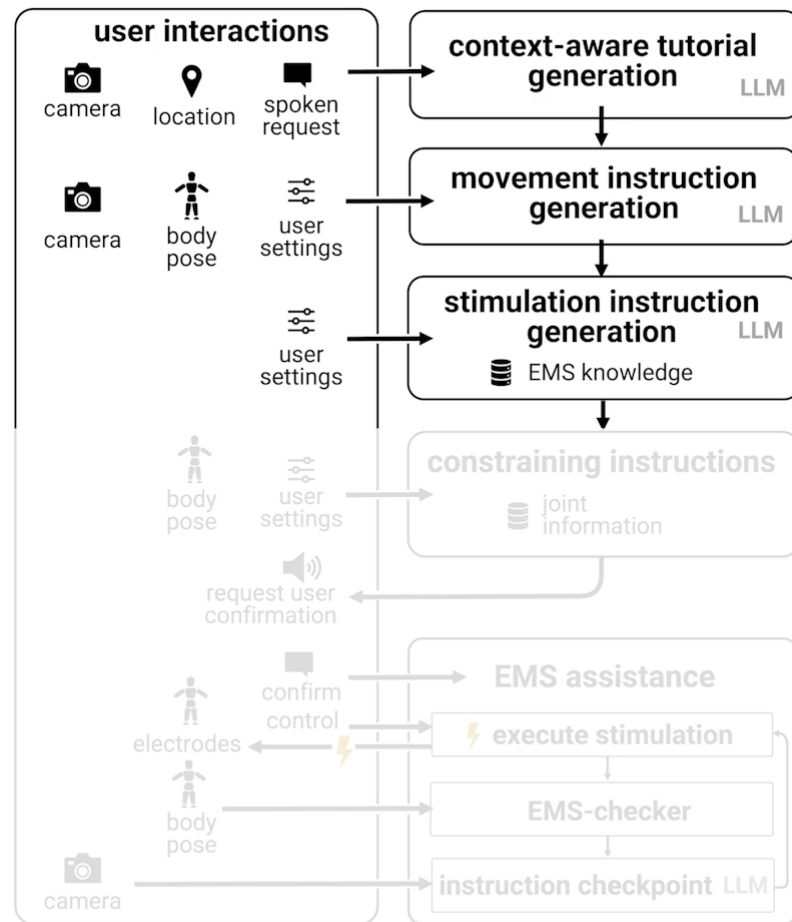
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LLM



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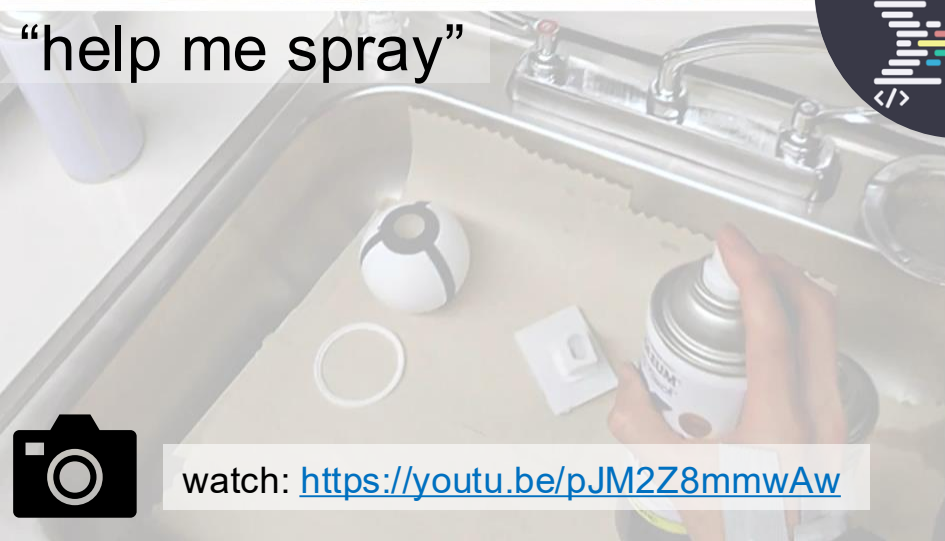
“help me with
this bike rack”

“help me open this”

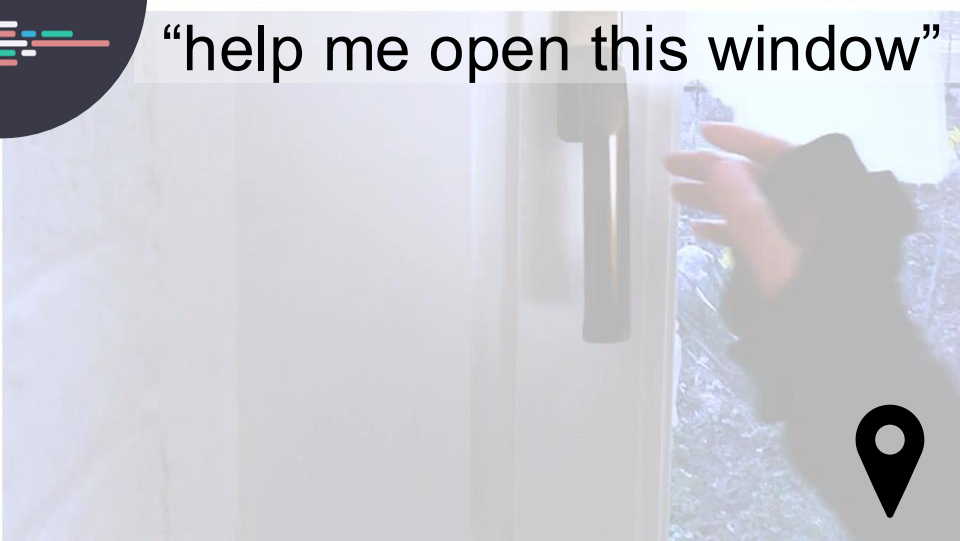


“help me spray”

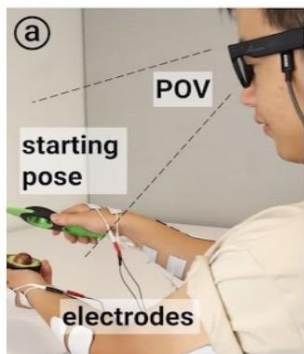
“help me open
this window”



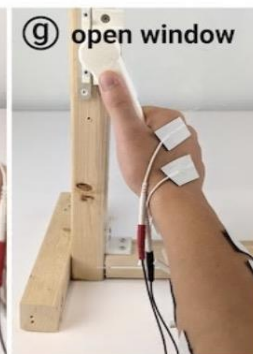
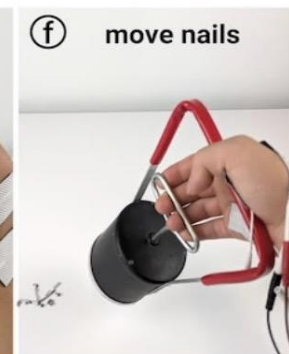
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user study



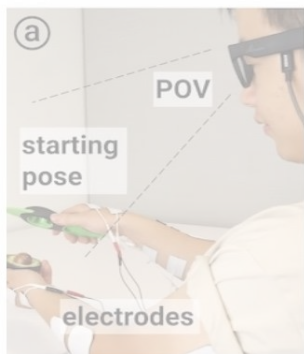
study setup



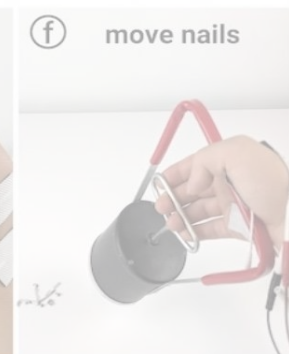
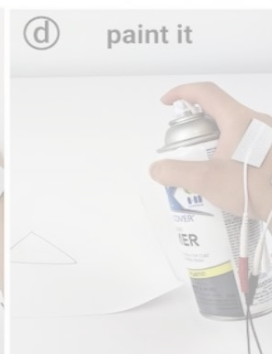
EMS-instructions with (purposely) forced-errors

correct instruction

user study



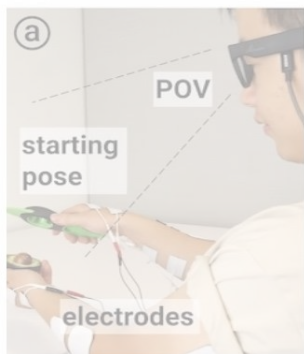
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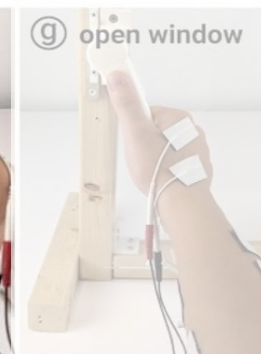
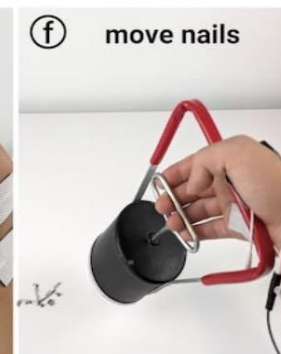
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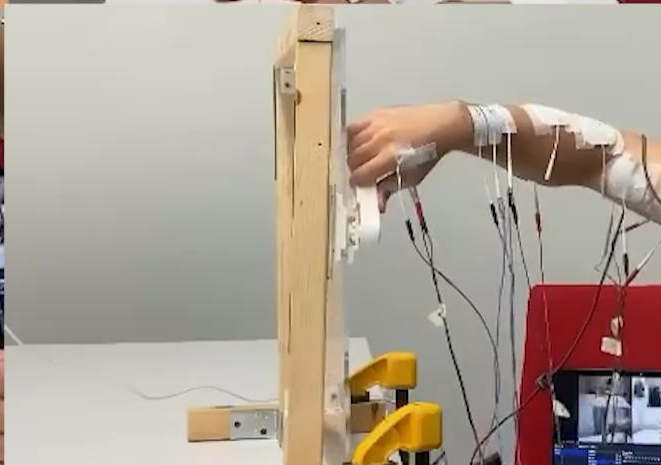
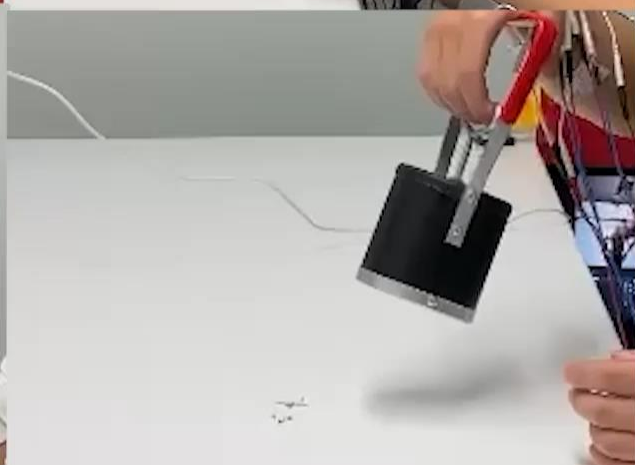
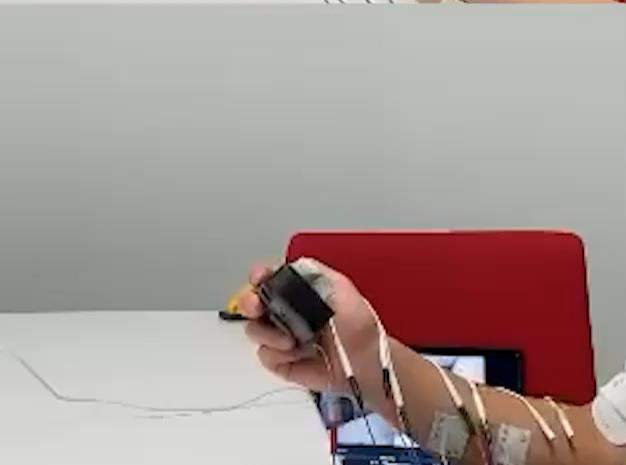
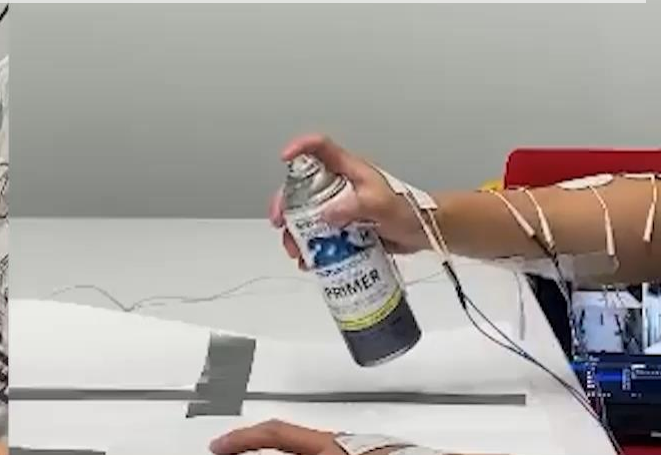
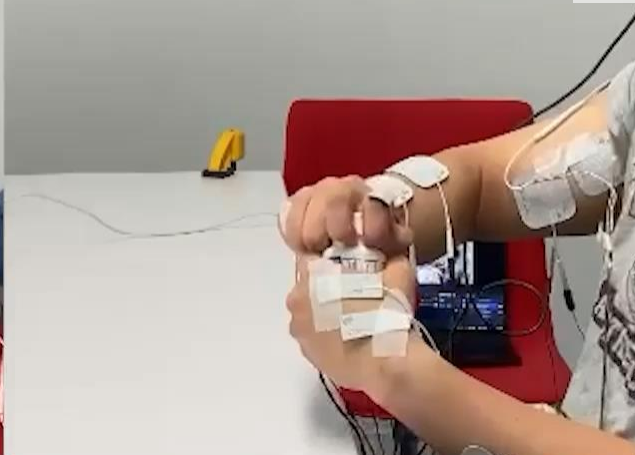
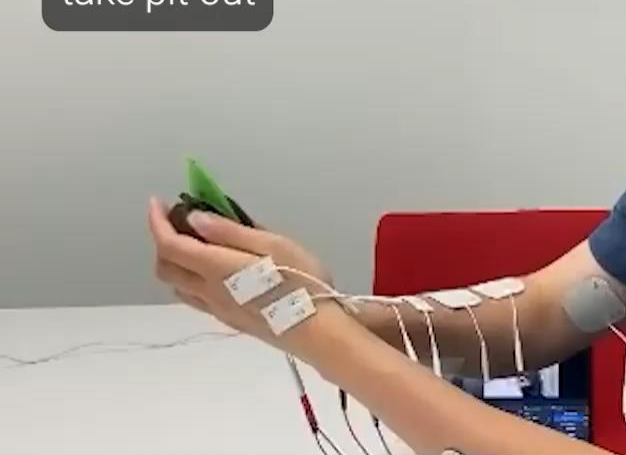


EMS-instructions with (purposely) forced-errors

correct instruction

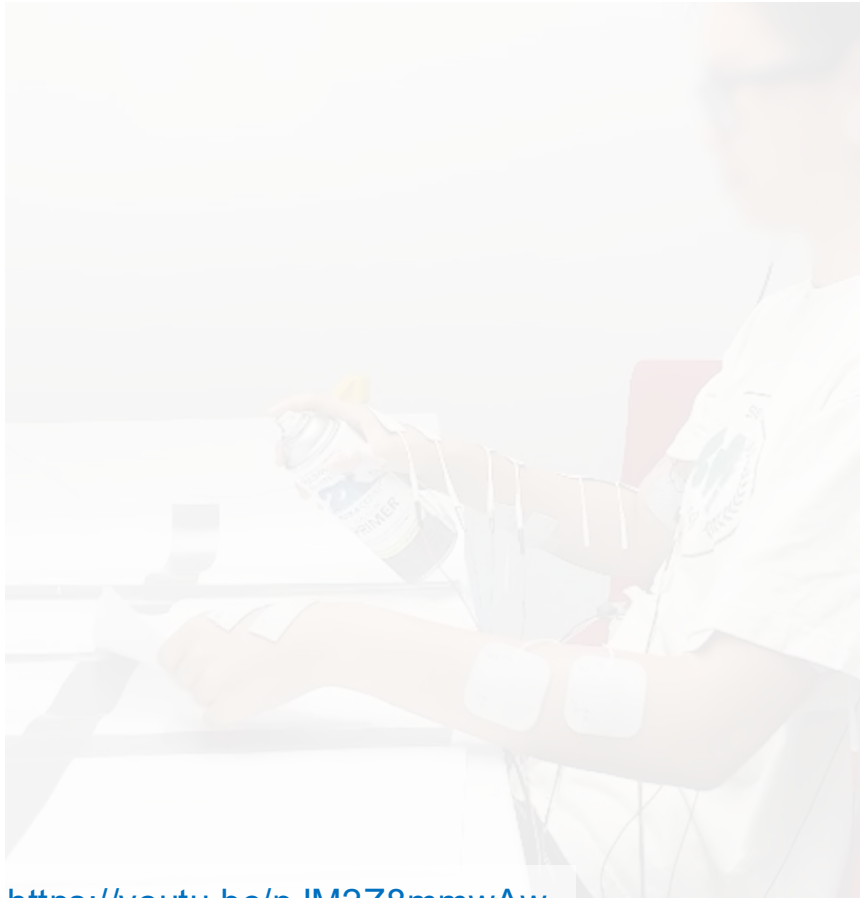
take pit out

watch: <https://youtu.be/pJM2Z8mmwAw>

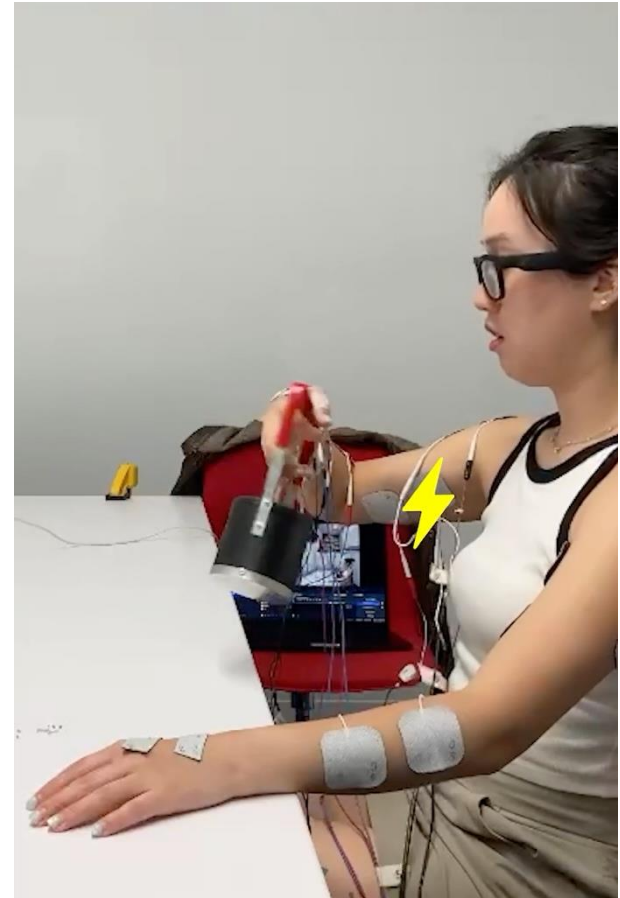


our study used pre-cached EMS-instructions without any sound output

EMS-instruction with forced error

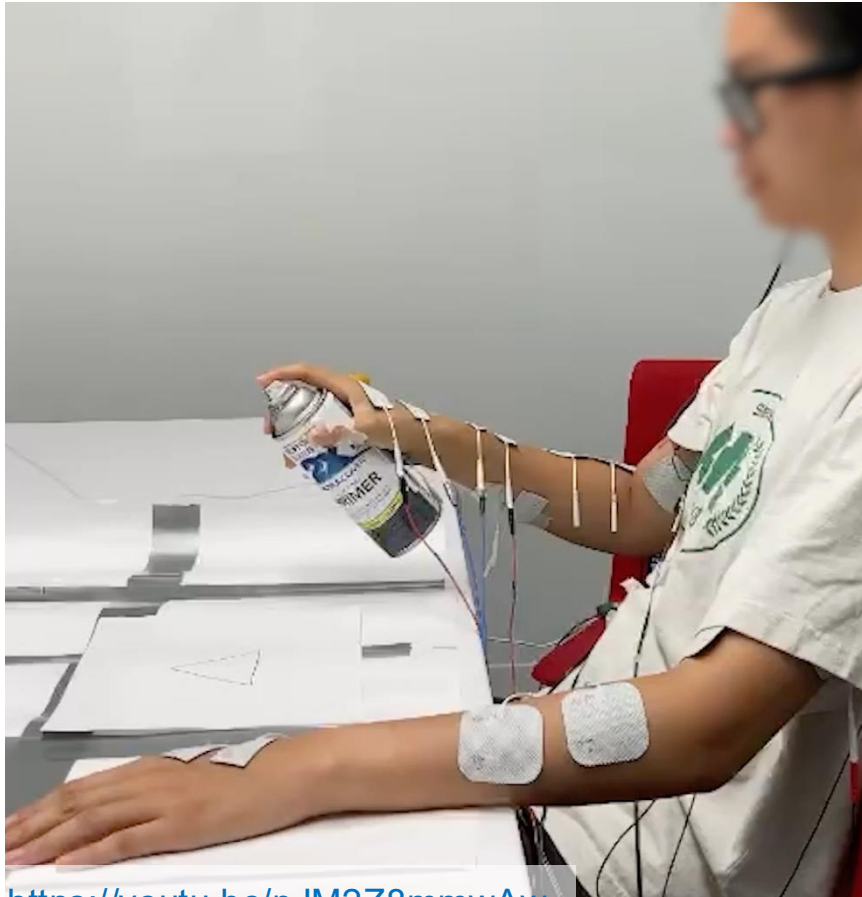


correct EMS-instruction

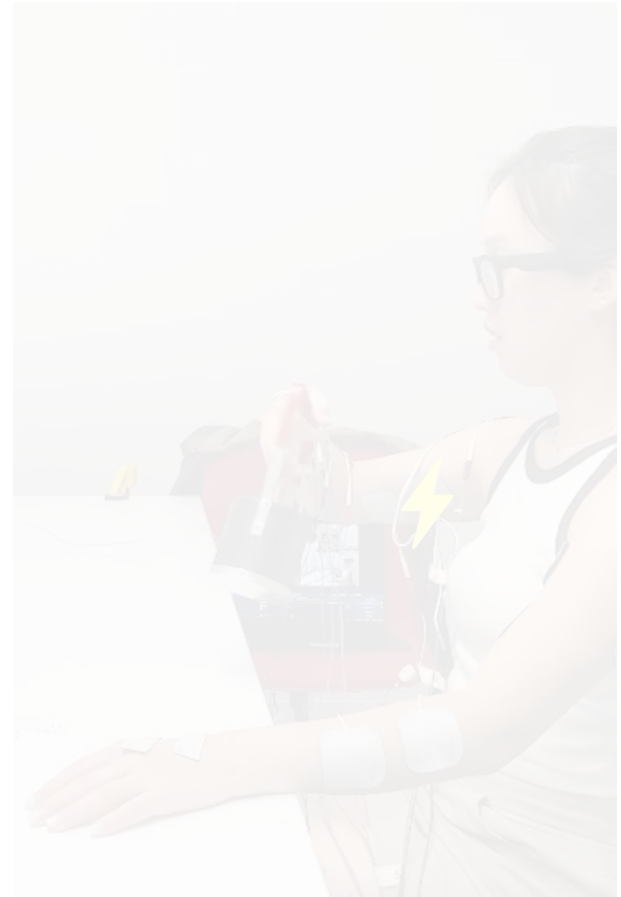


watch: <https://youtu.be/pJM2Z8mmwAw>

EMS-instruction with forced error

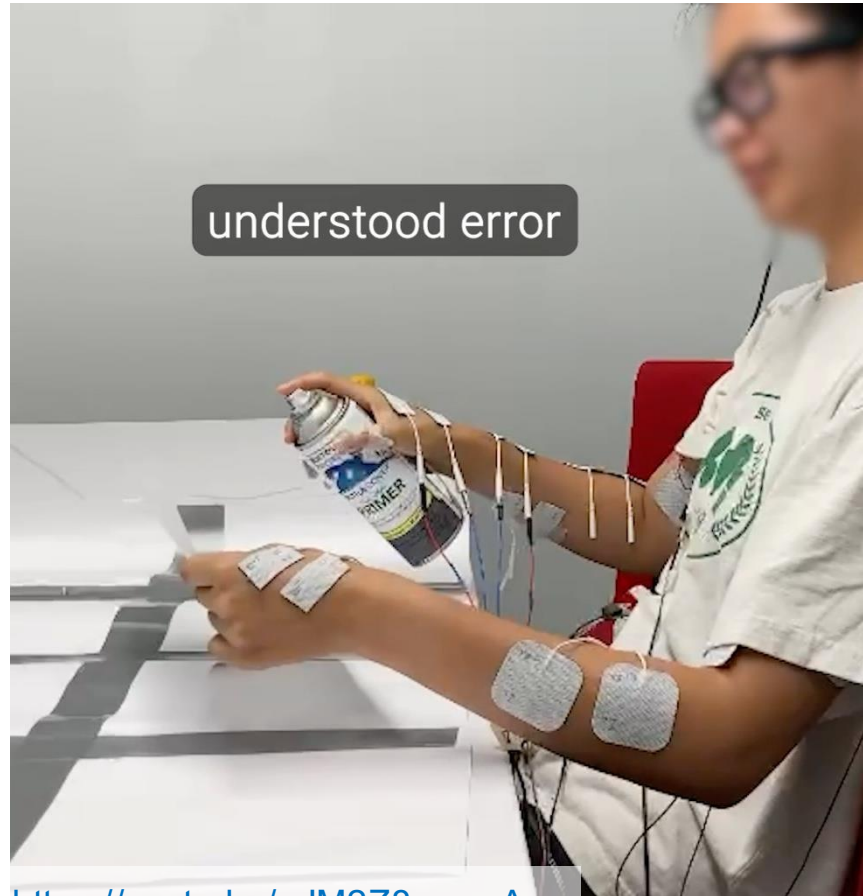


correct EMS-instruction

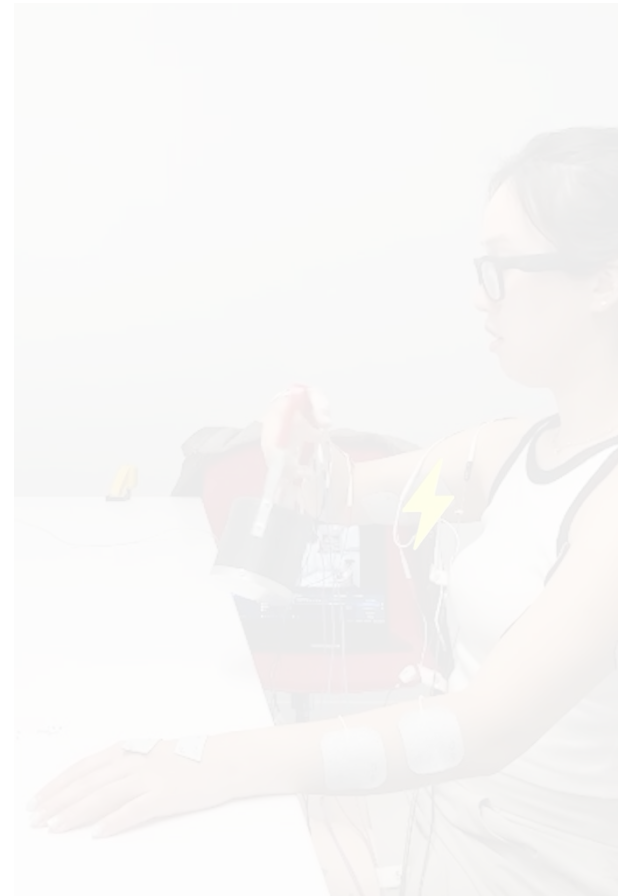


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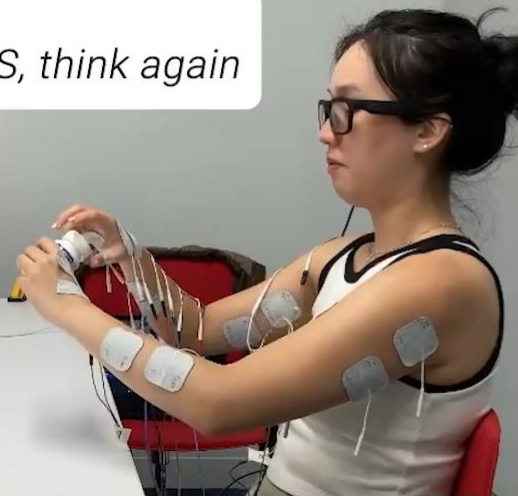


correct EMS-instruction



watch: <https://youtu.be/pJM2Z8mmwAw>

USER
EMS, think again



USER
EMS, think again



USER
EMS, think again



USER
EMS, think again



USER
EMS, think again



USER
EMS, think again



watch: <https://youtu.be/pJM2Z8mmwAw>

conclusions & future directions

1. generate new EMS-assistance with a single system
2. ethical concerns of embodied-AI
3. AI assistance through other modalities
4. would automation on the body lead to learning?

1. generate new EMS-assistance **with a single system**

prior EMS systems:
pre-defined movements



affordance++ [Lopes, CHI'15]

1. generate new EMS-assistance with a single system

prior EMS systems:
pre-defined movements



our approach:
flexible and context-aware



2. ethical concerns of embodied-AI

The Ethics of AI Ethics: An Evaluation of Guidelines

Thilo Hagendorff

Patterns

A high-level overview of AI ethics

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THE BIGGER PICTURE The development and deployment of AI in business has. This disruptive technology is revolutionizing entire industries and... However, triggered by high-profile cases of harm (e.g., Facebook-Cambridge Analytica), this has spurred stakeholders to respond governments, NGOs, academic research, principles, and frameworks. This literature has flourished, often... This review embraces inherent interdisciplinary in the field by providing a... drawing upon philosophy, law, and computer science. Readers will learn... from AI to translating ethics into engineering practice. This serves as a... as well as future debates—including the intersection of data ethics and AI's... home and political impacts, and future-centric AI.

SUMMARY

Artificial intelligence (AI) ethics is a field that has emerged as a response to the impact of AI. It can be read as a nascent field and as a subset of the wider... stresses concerns raised by the development and deployment of new... data analytics, and blockchain technologies. The principal aim of this article... discussion of the field by way of introducing basic concepts and... themes in AI ethics. The first part introduces concepts by noting what... "ethics", etc., the second part explores some predecessors to AI ethics,... of technology, and science and technology studies; the third part... to AI ethics namely, principles, processes, and ethical consciousness; an... central theme in translating ethics to its engineering practice. We conclude... inherent interdisciplinary future directions and debates in AI ethics.

INTRODUCTION

Artificial intelligence (AI) ethics is a field that has emerged as a response to the growing concern regarding the impact of AI. Indeed, there have been an increasing number of high-profile... cases of harm that has resulted either because of the misuse of... the technology (e.g., polypharmacy, cyber misquoting... facial recognition surveillance, mass data collection without con...

article to be provided... that serves as an... during basic concept... themes in AI ethics... contributes to the field's... the engineering... and addressing its... parties. At last, the...

Beyond Moral Dilemmas: Exploring the Ethical Landscape in HRI

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ABSTRACT
HRI research... to it... roles, re... based, man... the need to... dynamic li... inevitably a... specifically... dynamic of... work in a... industry of... creating and... education i... that for lo... out of ethi... to explore...

Keywords
Ethics in H...

1. INTRODUCTION

Ethics in the field of... decision-m... about the... and robot i... ask only... also in the... various a... very partic... As such, it... that have p... that ethical... therefore... overview of... hours, to b...

Robotics in... scenarios or... for protot... use, as do... of AI work... points, a... able who... 2007, 2011, 2013, 2015, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 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3823, 3824, 382

3. AI assistance through other modalities



auditory



visual



tangible



WorldScribe
[Chang, UIST'24]



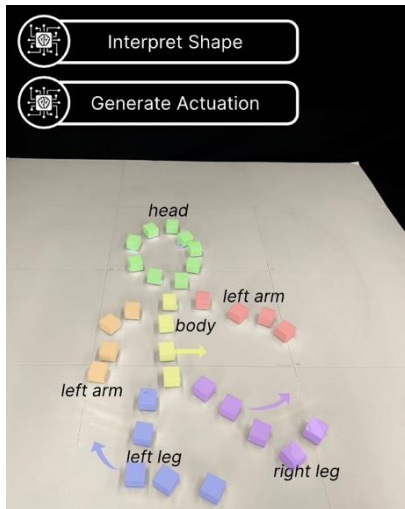
Input
Frame



LEGO

*“cut a portion of clay
mix with both hands”*

LEGO
[Lai, ECCV'24]



Shape n' Swarm
[Jeung, UIST'25]

3. AI assistance through other modalities



auditory



visual



tangible



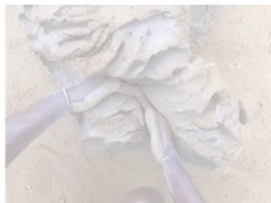
physical



WorldScribe
[Chang, UIST'24]



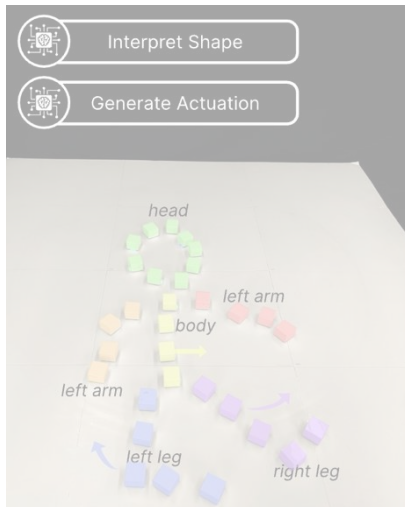
Input
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Shape n' Swarm
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3. AI assistance through other modalities



auditory



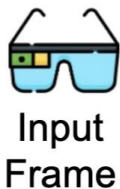
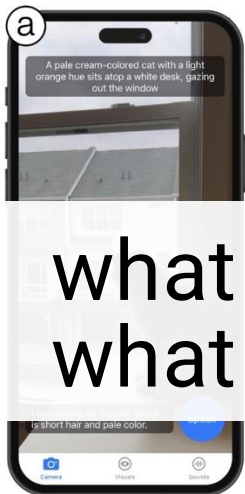
visual



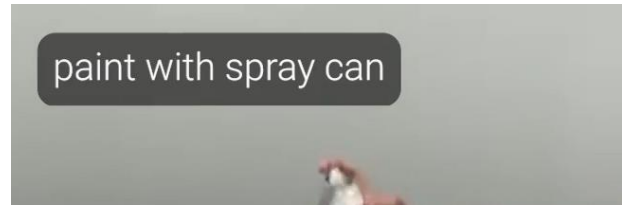
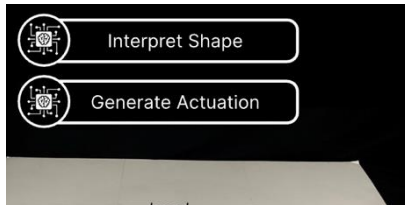
tangible



physical

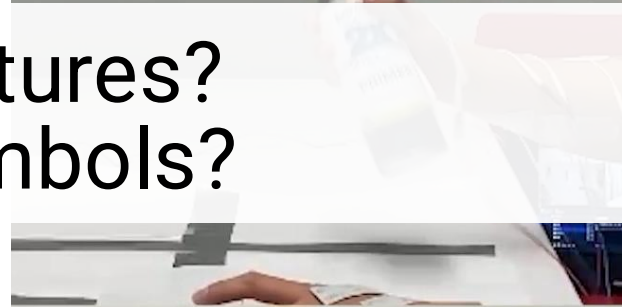


Input Frame



what are the limitations of gestures?
what are the boundaries of symbols?

*“cut a portion of clay
mix with both hands”*



WorldScribe
[Chang, UIST'24]

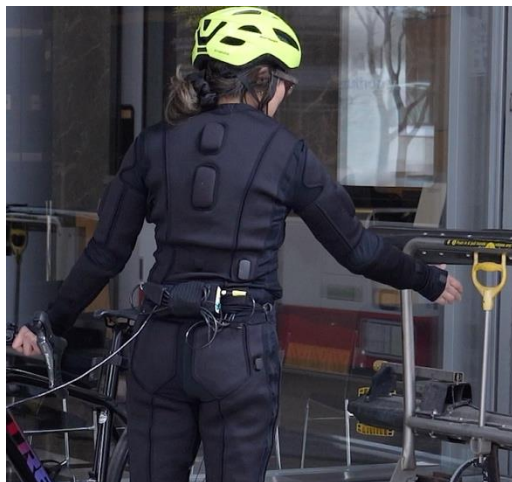
LEGO
[Lai, ECCV'24]

Shape n' Swarm
[Jeung, UIST'25]

4. would automation on the body lead to learning?

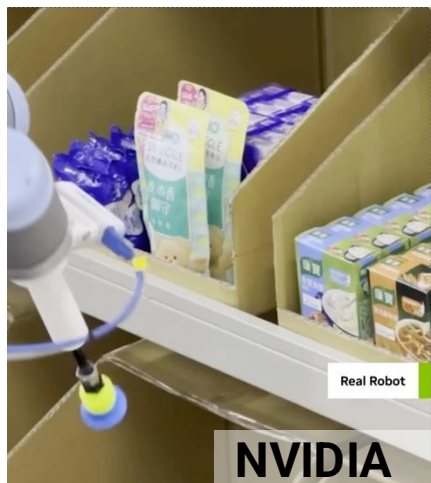


robot automation

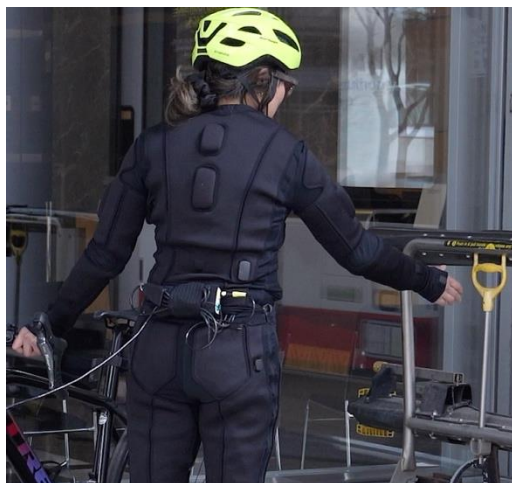


body automation

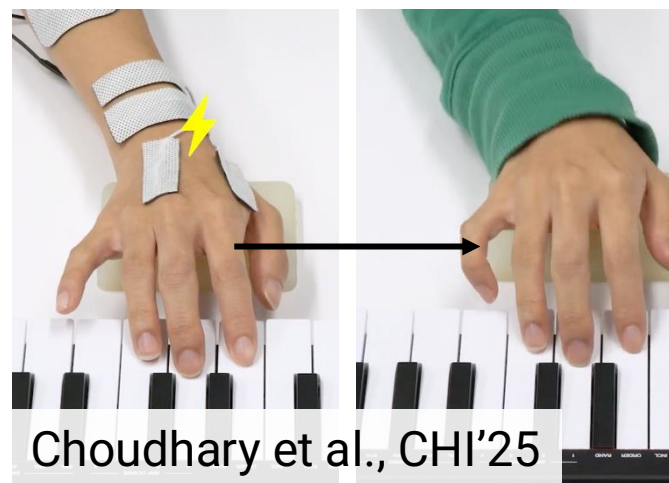
4. would automation on the body lead to learning?



NVIDIA
robot automation

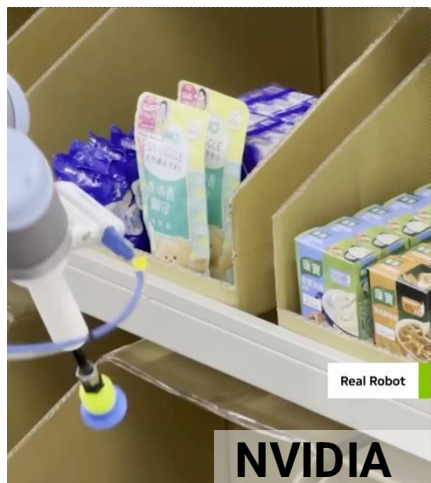


body automation

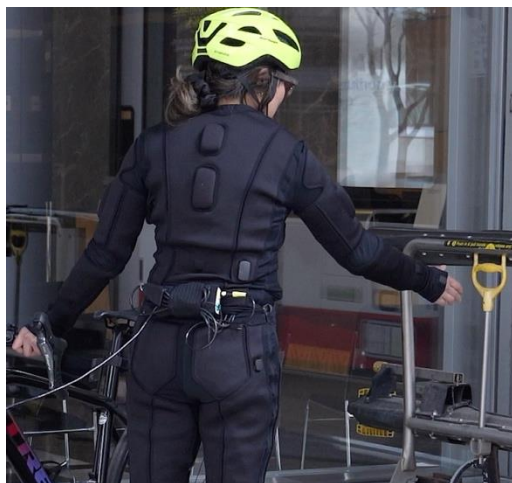


Choudhary et al., CHI'25

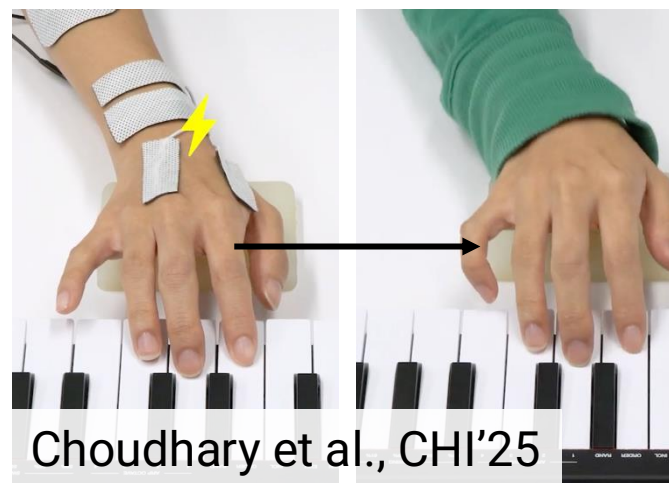
4. would automation on the body lead to learning?



NVIDIA
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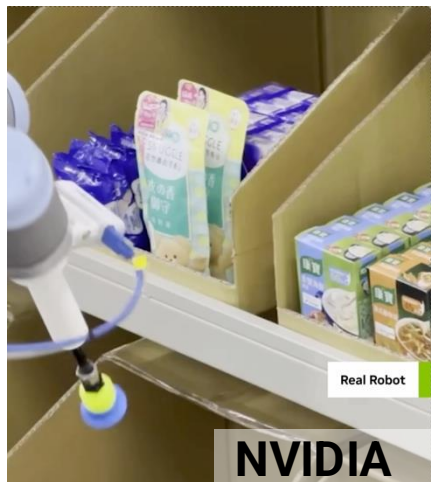


body automation

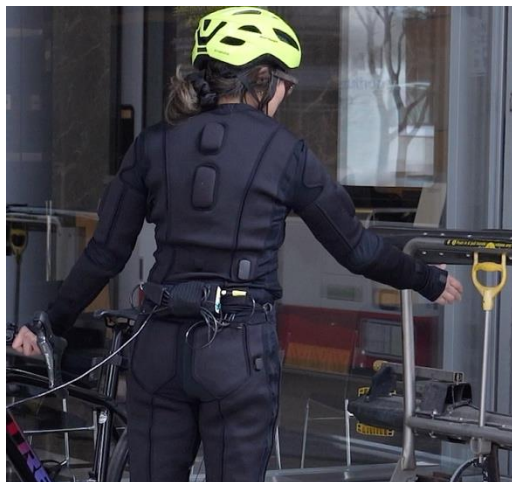


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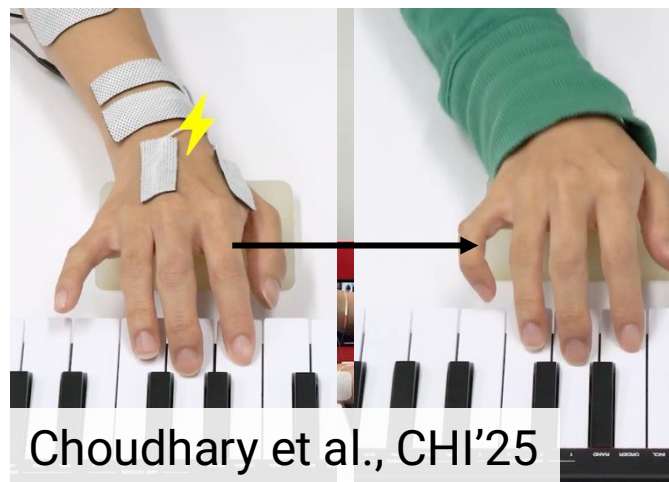
4. would automation on the body lead to learning?



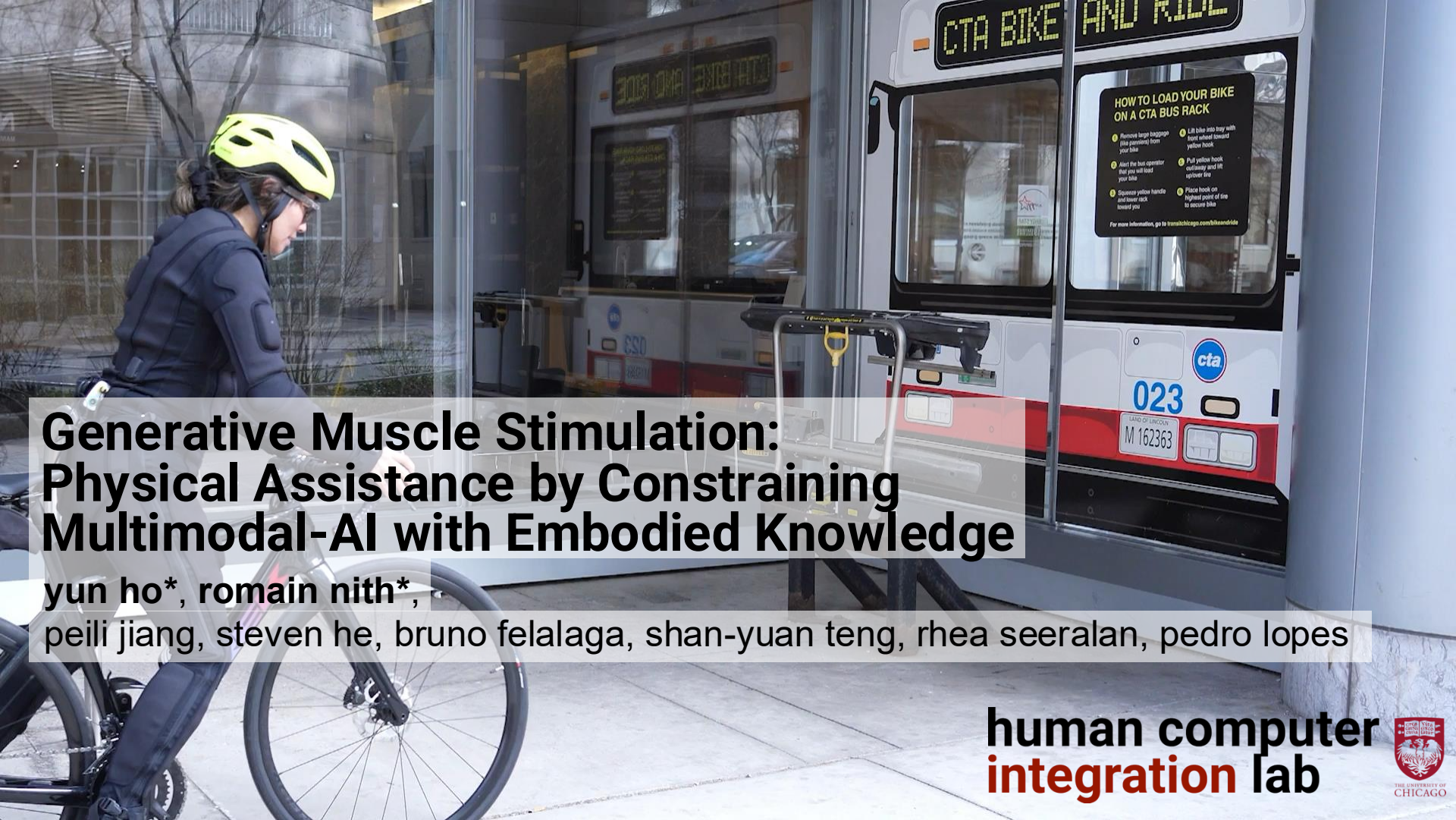
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body learning



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Generative Muscle Stimulation: Physical Assistance by Constraining Multimodal-AI with Embodied Knowledge

yun ho*, remain nith*,
peili jiang, steven he, bruno felalaga, shan-yuan teng, rhea seeralan, pedro lopes

human computer
integration lab



README // about these slides

These are the slides for the talk presented at CHI 2026 by Yun Ho and Romain Nith.

All the links in this PDF are clickable and lead you to YouTube videos, paper, etc.

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You can watch the video [here: https://www.youtube.com/watch?v=pJM2Z8mmwAw](https://www.youtube.com/watch?v=pJM2Z8mmwAw)

If you need a PPTX/editable version for your class, email us hci@uchicago.edu

More information on this paper (or others of our lab): <https://lab.plopes.org/#embodied-ai> [genEMS](https://lab.plopes.org/#genEMS)



Generative Muscle Stimulation: Providing Users with Physical Assistance by Constraining Multimodal-AI with Embodied Knowledge

Yun Ho*, Romain Nith*, Peili Jiang, Steven He, Bruno Felalaga, Shan-Yuan Teng, Pedro Lopes. In Proc. CHI'26 (full paper) (* authors contributed equally)

CHI best paper award (top 1%)

We propose a new form of embodied-AI that assists users' bodies directly via muscle-stimulation. Moreover, it does not deliver fixed muscle stimulation instructions but *generates* this form of physical-AI assistance according to user's needs and context. Our system gathers information: body pose (IMU suit) + point-of-view (objects, hand-poses) + location (e.g., "Chicago"), etc. These are fed to a multimodal-AI that creates textual-instructions allowing it to infer how to use everyday objects (e.g., a bike rack, analog cameras, and more). Before it stimulates, our system constrains the generated instructions to ensure they respect the user's biomechanical constraints (e.g., their current pose, joint limits or even their preferences).



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