AI-POWERED AR ACCESSIBILITY

JON E. FROEHLICH
Professor, Computer Science
University of Washington

Human-Centered ML Workshop, Apple, Aug 8, 2024

DESIGN USE BUILD

MAKEABILITY LAB

PAUL G. ALLEN SCHOOL
OF COMPUTER SCIENCE & ENGINEERING

UNIVERSITY of WASHINGTON

JON E. FROEHLICH

Professor, Allen School of CS
Core Faculty, Urban Design
Director, Makeability Lab
Associate Director, CREATE
Associate Director, PacTrans

MAKEABILITY LAB

Mikey Saugstad
Research Engineer

Xia Su
PhD Student

Daniel Campos Zamora
PhD Student

Chu Li
PhD Student

Jaewook Lee
PhD Student

Arnavi Chheda-Kothary
PhD Student

Jared Hwang
PhD Student

Our Mission

DESIGN, BUILD, & STUDY INTERACTIVE TOOLS & TECHNIQUES TO ADDRESS PRESSING SOCIETAL CHALLENGES

MAKEABILITY LAB

FOUR FOCUS AREAS

ENVIRONMENTAL SUSTAINABILITY

HEALTH & WELLNESS

ACCESSIBILITY

STEM EDUCATION

MAKEABILITY LAB

FOUR FOCUS AREAS

ENVIRONMENTAL SUSTAINABILITY

HEALTH & WELLNESS

ACCESSIBILITY

STEM EDUCATION

ENVIRONMENTAL SUSTAINABILITY

HEALTH & WELLNESS

ACCESSIBILITY

STEM EDUCATION

How to...

make the *real world* more accessible for people with disabilities through AI and interactive technology

TRY IT!

PROJECT SIDEWALK

http://projectsidewalk.org

Mikey Saugstad
Research Engineer

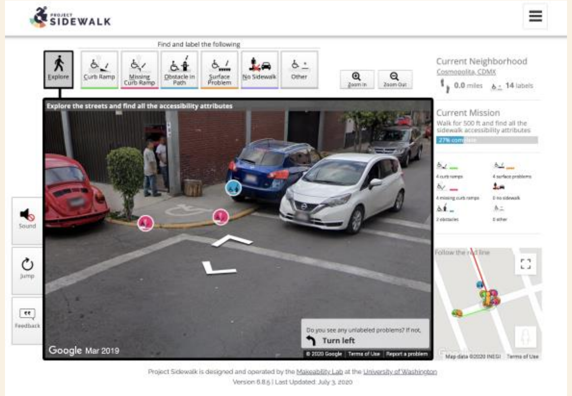
Chu Li
PhD Student

Kotaro Hara
PhD Alum
Now Prof at SMU

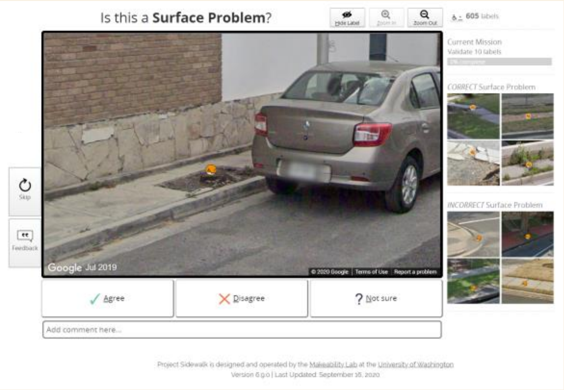
Manaswi Saha
PhD Alum
Now at Accenture Labs

ONLINE MAP IMAGERY

REMOTE CROWDSOURCING INTERFACES



Labeling missions



Validation missions

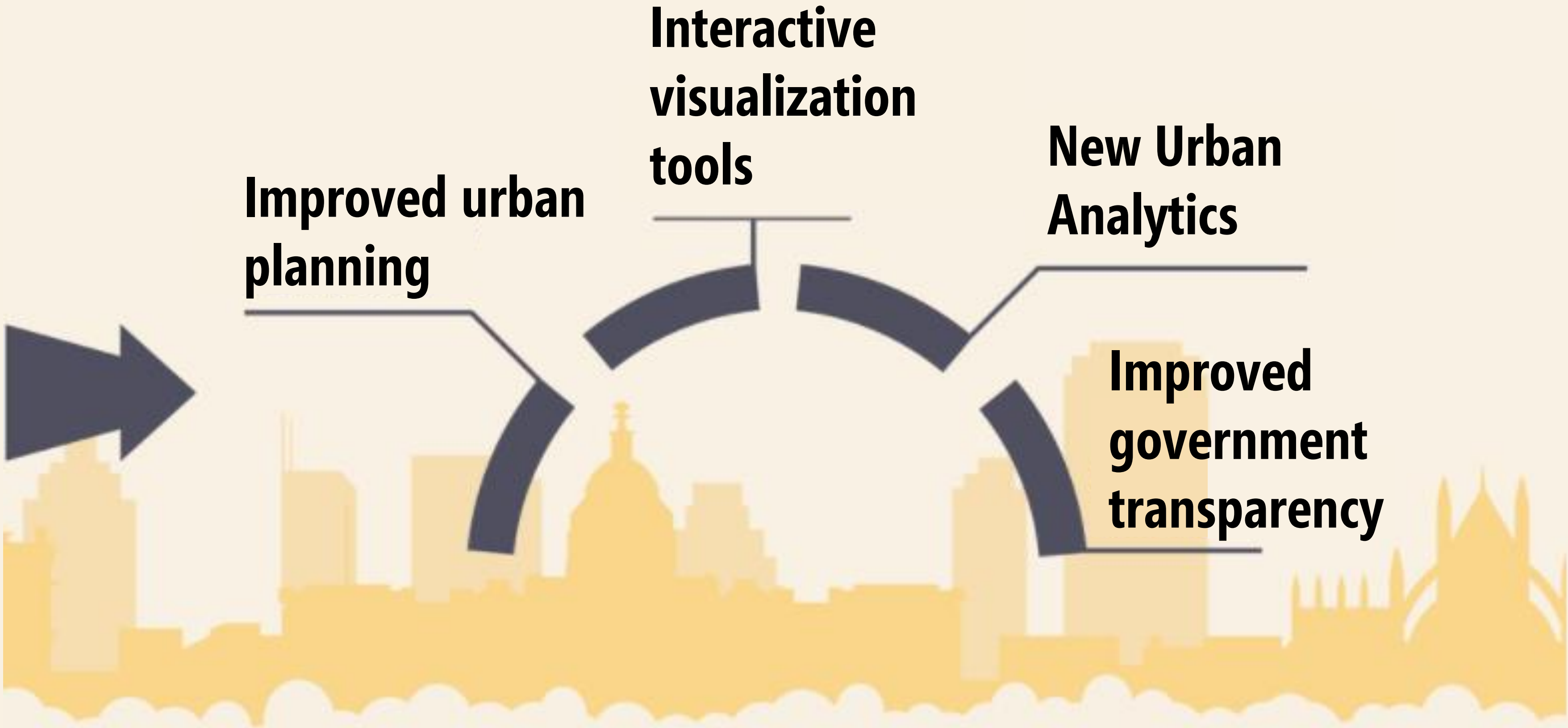
HUMAN LABELS

MACHINE LEARNING

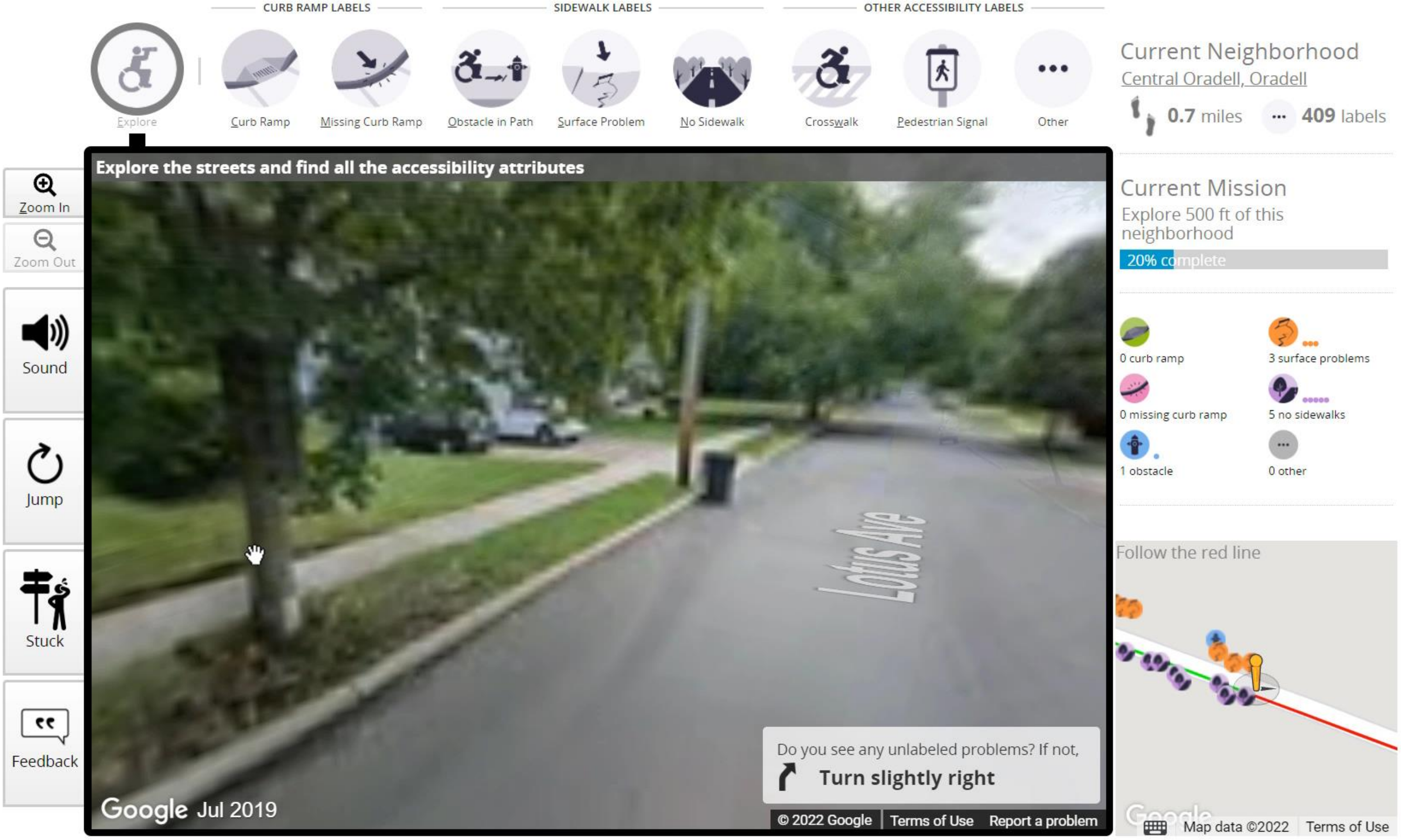
PROJECT SIDEWALK
HTTP://PROJECTSIDEWALK.IO

OUTCOMES

MACHINE LEARNING



PROJECT SIDEWALK
HTTP://PROJECTSIDEWALK.IO


CURB RAMP LABELS
SIDEWALK LABELS
OTHER ACCESSIBILITY LABELS
Explore
Curb Ramp
Missing Curb Ramp
Obstacle in Path
Surface Problem
No Sidewalk
Crosswalk
Pedestrian Signal
Other
Current Neighborhood
Central Oradell, Oradell
0.7 miles
409 labels
Explore the streets and find all the accessibility attributes
Zoom In
Zoom Out
Sound
Jump
Stuck
Feedback
Lotus Ave
Current Mission
Explore 500 ft of this neighborhood
20% complete
0 curb ramp
3 surface problems
0 missing curb ramp
5 no sidewalks
1 obstacle
0 other
Follow the red line
Do you see any unlabeled problems? If not,
Turn slightly right
Google Jul 2019
© 2022 Google
Terms of Use
Report a problem
Map data ©2022
Terms of Use

PROJECT SIDEWALK DEPLOYMENTS

4 CONTINENTS, 8 COUNTRIES, 21 CITIES

14K USERS	1.01M LABELS	691K VALIDATIONS	18.3K KM AUDITED

ONU-HABITAT
POR UN MEJOR FUTURO URBANO

ENFOQUE ACTIVISTA

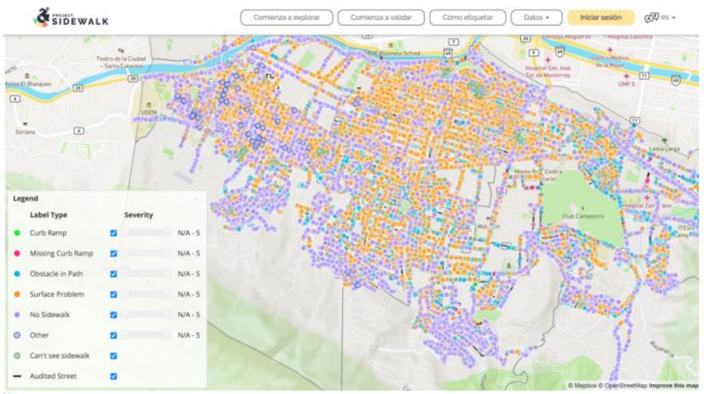
E

EvaluANDO: del activismo peatonal a la colaboración comunitaria para el registro de obstáculos en las banquetas

Escrito por
Claudina de Gyves y Ana Rodríguez

Ubicación
San Pedro Garza García, México

Palabras clave
activismo peatonal, movilidad sostenible, infraestructura peatonal, participación remota



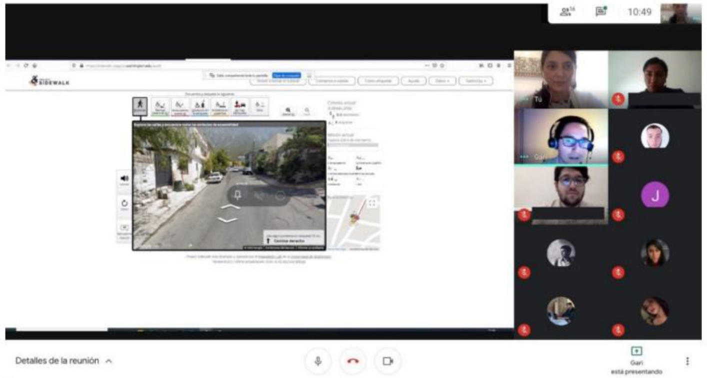
>>
Fotografía 2. Mapa de etiquetas en Project Sidewalk

Fuente: Liga Peatonal (2021).

La vinculación fue posible gracias a que ya había un historial de activismo peatonal en la metrópoli y el acercamiento no fue solo con la Liga Peatonal como ONG, sino de la mano de Makeability Lab, un actor técnico-académico que mostró disposición a contextualizar su plataforma a las necesidades de las calles mexicanas. Aunado a este proceso, la situación por la COVID-19 detonó una serie de intervenciones en el espacio público por parte del municipio de San Pedro Garza García, enfocadas en promover la movilidad sostenible, destacando las ciclovías emergentes y la aceleración de otros proyectos en el espacio público que estaban en puerta. Todo esto generó un escenario adecuado para la colaboración de EvaluANDO SPGG, en la que todos los actores involucrados estaban conscientes de la importancia de contar con información precisa sobre las condiciones de las calles en el municipio.

Recientemente, en mayo de 2021, tras 9 meses de trabajo y con la participación de 1099 personas se lograron cubrir los 570.2 km de vialidades que tiene el municipio de SPGG y se generaron 105 117 etiquetas (Makeability Lab, 2021) en un ejercicio inédito a nivel nacional de participación ciudadana para ubicar los obstáculos de movilidad peatonal.

El caso de EvaluANDO SPGG destaca no solo por haber completado el mapeo del municipio y ser resultado de una colaboración multisectorial entre gobierno local, sociedad civil y academia, sino porque los resultados son ahora insumos valiosos del municipio para la creación de nuevos planes y proyectos. Los planes en proceso de elaboración, tanto de movilidad activa como de seguridad vial, con los resultados de EvaluANDO, ayudarán a identificar estrategias aterrizadas a la realidad y fomentar una mayor participación ciudadana, al involucrar a la población desde su diagnóstico y permitir la descarga de los datos generados en formato editable.



>>
Fotografía 4. Mapatón San Pedro Garza García

Fuente: Liga Peatonal (2020).

En el proceso de levantamiento de información, Liga Peatonal trató de complementar el trabajo asincrónico e individual con cuatro eventos donde varias personas se conectaban de manera simultánea a probar la herramienta y resolver dudas sobre su funcionamiento. Se convocó a dos sesiones dirigidas a las personas ciudadanas del municipio, con el nombre de Mapatones, y otras dos orientadas a estudiantes universitarios, en formato de talleres en los que se les introducía al tema de movilidad peatonal y donde se generaron propuestas para atender los problemas principales.

Si bien este proceso ha permitido el involucramiento de adolescentes y jóvenes en el análisis crítico de su entorno urbano, todavía presenta oportunidades de mejora en la inclusión de personas que no tienen acceso a dispositivos de internet. Ante esta situación, sería conveniente explorar el ejercicio analógico del mapeo en sitio con herramientas impresas y más con el fin de fortalecer la convivencia vecinal y promover la organización, que con la precisión del levantamiento. En estos escenarios de atención a la población en condición de vulnerabilidad, tal vez destaquen otros elementos a mapear no tan relacionados con ser un obstáculo en las banquetas, sino ya más encaminados a una ausencia de infraestructura como la misma pavimentación de las calles, las banquetas o la falta de conectividad con otros sectores.

Además, en las reflexiones en torno al uso de la herramienta y las necesidades para el diagnóstico urbano incluyente, se identificó como área de oportunidad un mapeo con perspectiva de género, que pudiera incluir no solamente obstáculos en los trayectos identificados, sino también situaciones y elementos propios de la infraestructura que provocan una sensación de inseguridad, pero que no representan como tal un obstáculo, como sí lo hacen los muros ciegos, la falta de luminarias, los recovecos o terrenos baldíos.

City of Newberg

SIDEWALK REPAIR PROGRAM

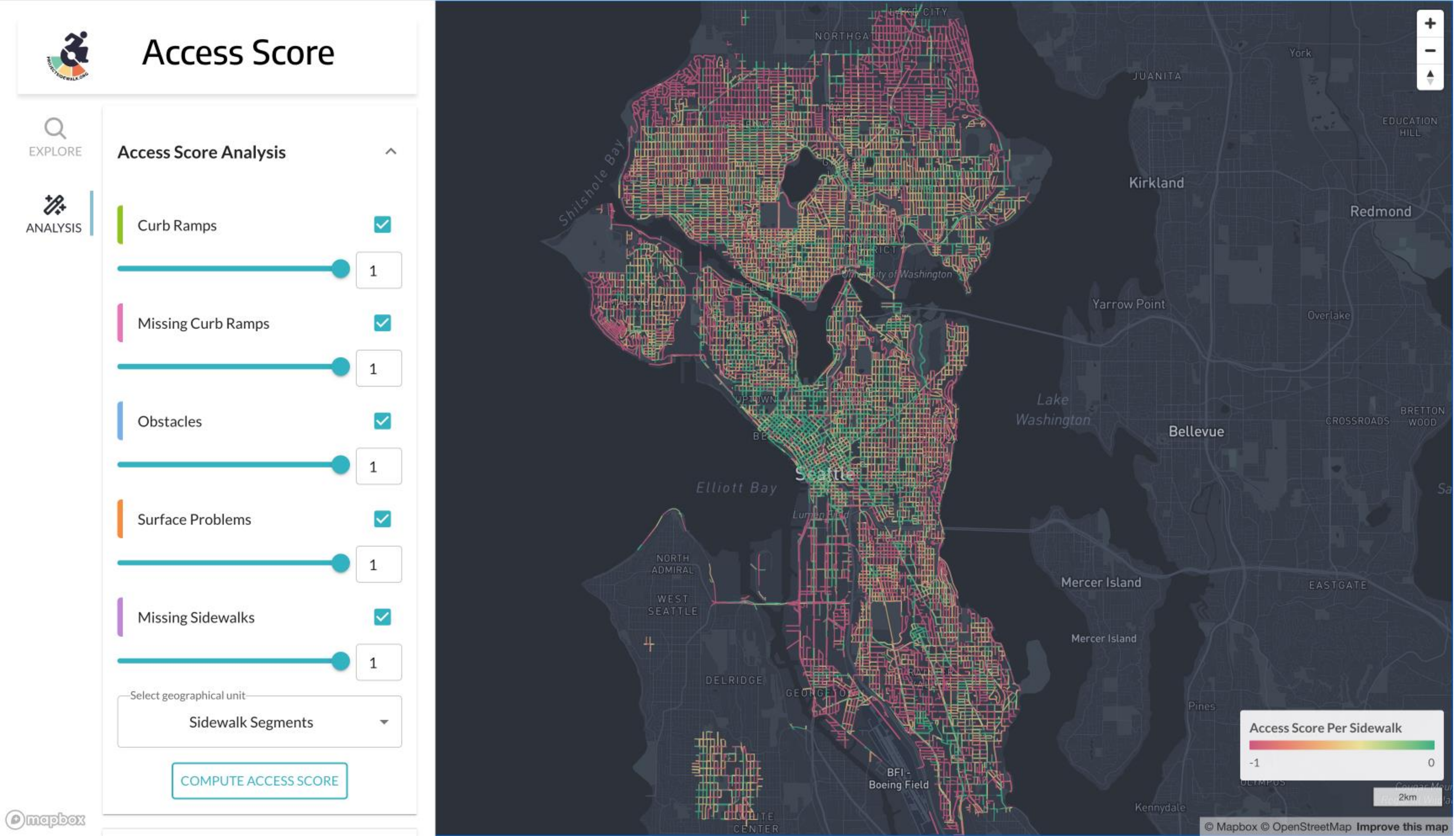
RESIDENTIAL GRANT AND LOAN APPLICATION PACKET

Sidewalks are for Everybody

Sidewalks make the entire community accessible,
are required under the Federal ADA regulations,
and enhance your home's value and curb appeal.

City Engineer's Office: Email: sidewalkrepairprogram@newbergoregon.gov | 503.537.1273 | PO Box 970

Newberg City Hall | 414 E. First Street | Newberg, OR 97132 | (503) 538-9421 | M-F 8:30-4:30PM


Access Score
EXPLORE
ANALYSIS
Access Score Analysis
Curb Ramps
1
Missing Curb Ramps
1
Obstacles
1
Surface Problems
1
Missing Sidewalks
1
Select geographical unit
Sidewalk Segments
COMPUTE ACCESS SCORE
mapbox
Shilshole Bay
University of Washington
Elliott Bay
Seattle
Lake Washington
Kirkland
Redmond
Yarrow Point
Overlake
Bellevue
Mercer Island
EASTGATE
NORTH ADMIRAL
WEST SEATTLE
DELRIDGE
BFI - Boeing Field
JUANITA
York
EDUCATION HILL
CROSSROADS
BRETTON WOOD
Kennydale
Pines
Access Score Per Sidewalk
-1
0
2km
© Mapbox © OpenStreetMap Improve this map

Deep Learning for Automatically Detecting Sidewalk Accessibility Problems Using Streetscape Imagery
Galen Weld[1], Esther Jang[1], Anthony Li[2], Aileen ... Kartis Heimerl[1], and Jon E. Froehlich[1]
ABSTRACT
Author Keywords
ACM Classification Keywords
INTRODUCTION
DOI: 10.1145/3308561.3353798
Towards Global-Scale Crowd+AI Techniques to Map and Assess Sidewalks for People with Disabilities
Maryam Hosseini[1,2], Mikey Saugstad[3], Fabio Miranda[4], Andres Sevtsuk[5], Claudio T. Silva[2], Jon E. Froehlich[3]
[2] NYU, [3] University of Washington, [4] University of Illinois at Chicago, [5] MIT
Abstract
Scaling Crowd+AI Sidewalk Accessibility Assessments: Initial Experiments Examining Label Quality and Cross-city Training on Performance
MICHAEL DUAN, Allen School of Computer Science, University of Washington, USA
SHOSUKE KIAMI, Allen School of Computer Science, University of Washington, USA
LOGAN MILANDIN, Allen School of Computer Science, University of Washington, USA
JOHNSON KUANG, Allen School of Computer Science, University of Washington, USA
MICHAEL SAUGSTAD, Allen School of Computer Science, University of Washington, USA
MARYAM HOSSEINI, Visualization Imaging and Data Analysis (VIDA) Center, New York University, USA
JON E. FROEHLICH, Allen School of Computer Science, University of Washington, USA
Increasingly, crowds plus machine learning techniques are being used to semi-automatically analyze the accessibility of built environments; however, open questions remain about how to effectively combine the two. We present two experiments examining the effect of crowdsourced data in automatically classifying sidewalk accessibility features in streetscape images. In Experiment 1, we investigate the effect of validated data—which has been voted correct by the crowd but is more expensive to collect—compared with a larger but noisier aggregate dataset. In Experiment 2, we examine whether crowdsourced labeled data gathered in one city can be used as effective training data for another. Together, these experiments contribute to the growing literature in Crowd+AI approaches for semi-automatic sidewalk assessment and help identify pertinent challenges.
ACM Reference Format:
Michael Duan, Shosuke Kiami, Logan Milandin, Johnson Kuang, Michael Saugstad, Maryam Hosseini, and Jon E. Froehlich. 2022. Scaling Crowd+AI Sidewalk Accessibility Assessments: Initial Experiments Examining Label Quality and Cross-city Training on Performance. In . ACM, New York, NY, USA, 7 pages. https://doi.org/XXXXXXX.XXXXXXX
1 INTRODUCTION
Despite broad policy measures and an increasing emphasis on the design of inclusive cities [13], urban streets and sidewalks remain largely inaccessible. The problem is not just a lack of accessibility but a lack of data on sidewalk location and their condition, which fundamentally impacts policy making, urban planning, and the design of accessibility features in tools like Apple or Google Maps [5, 15]. Traditionally, sidewalk data is gathered via in-person inspections administered by local governments; however, this approach is laborious, expensive, and infrequent [2, 5, 12]. Thus, emerging work has explored alternative methods using remote crowdsourcing [7, 16], computer vision [1, 9, 10, 19], or both [8, 11].
While vision-based solutions are more scalable, they require copious amounts of training data. Large-scale, standardized streetscape datasets like CityScapes [3] or Mapillary Vistas [14] exist and have dramatically accelerated research in autonomous navigation. However, these labeled datasets do not include sidewalk accessibility features. Furthermore, while automatic walkability [1] and surface condition assessment [10] have benefited from including streetscape imagery, these experiments used expensive, researcher-labeled datasets for training, which limits experimental scope and size (e.g., to only single neighborhoods or cities). To achieve larger training sets, others have explored crowdsourced
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Manuscript submitted to ACM
1
Towards Inferring 33 Classes of Sidewalk Accessibility Conditions using Deep Learning: Initial Benchmarks and an Open Dataset to Spur Future Research
ANONYMOUS AUTHOR(S)*
Curb Ramps
Missing tactile warning
Points into traffic
Surface problem
Narrow
Not enough landing space
Not level with street
Steep
Pooled water
Crosswalks
Paint fading
Bumpy
Broken surface
Brick/Cobblestone
Grass
Surface Problems
Height difference
Parked bike
Bumpy
Brick
Cracks
Height difference (uplifts)
Uneven/Slanted
Narrow
Very Broken
Sand/Gravel
Utility Panel
Obstacles
Vegetation
Parked car
Trash can
Construction
Sign
Tree
Litter/Garbage
Narrow
Pole
Fig. 1. We examine whether deep learning models can classify sidewalk accessibility conditions from pre-cropped 640x640 streetscape images. For example, whether a curb ramp is too steep, too narrow, or missing a tactile indicator or if a sidewalk panel is uneven, bumpy, or composed of brick/cobblestone. Above are examples of sidewalk accessibility conditions we attempt to infer.
We examine the feasibility of using deep learning to infer 33 separate classes of sidewalk accessibility conditions in pre-cropped streetscape images, including bumpy, brick/cobblestone, cracks, height difference (uplifts), narrow, uneven/slanted, pole, and sign. We present two experiments: first, a comparison between two state-of-the-art computer vision models, Meta's DINOv2 and OpenAI's CLIP-ViT, on a cleaned dataset of ~24k images; second, an examination of a larger but noisier crowdsourced dataset (~88k images) on the best performing model from Experiment 1. Though preliminary, Experiment 1 findings show that certain sidewalk conditions can be identified with high precision and recall, such as missing tactile warnings on curb ramps and grass grown on sidewalks, while Experiment 2 demonstrates that larger but noisier training data can have a detrimental effect on performance. We contribute an open dataset and foundational classification benchmarks to advance this important area.
ACM Reference Format:
Anonymous Author(s). 2018. Towards Inferring 33 Classes of Sidewalk Accessibility Conditions using Deep Learning: Initial Benchmarks and an Open Dataset to Spur Future Research. In Proceedings of Make sure to enter the correct conference title from your rights confirmation email (Conference acronym 'XX). ACM, New York, NY, USA, 15 pages. https://doi.org/XXXXXXX.XXXXXXX

But the focus of this talk is on **AI-powered AR accessibility**.

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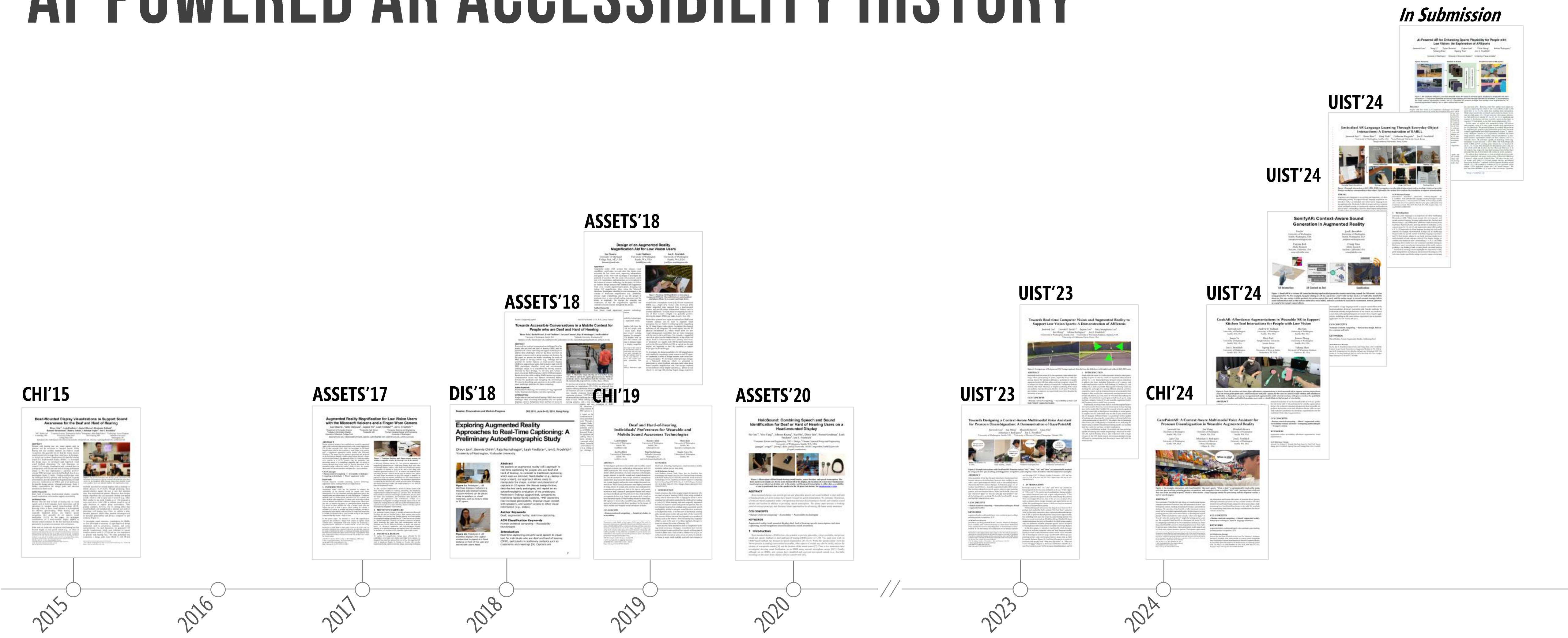
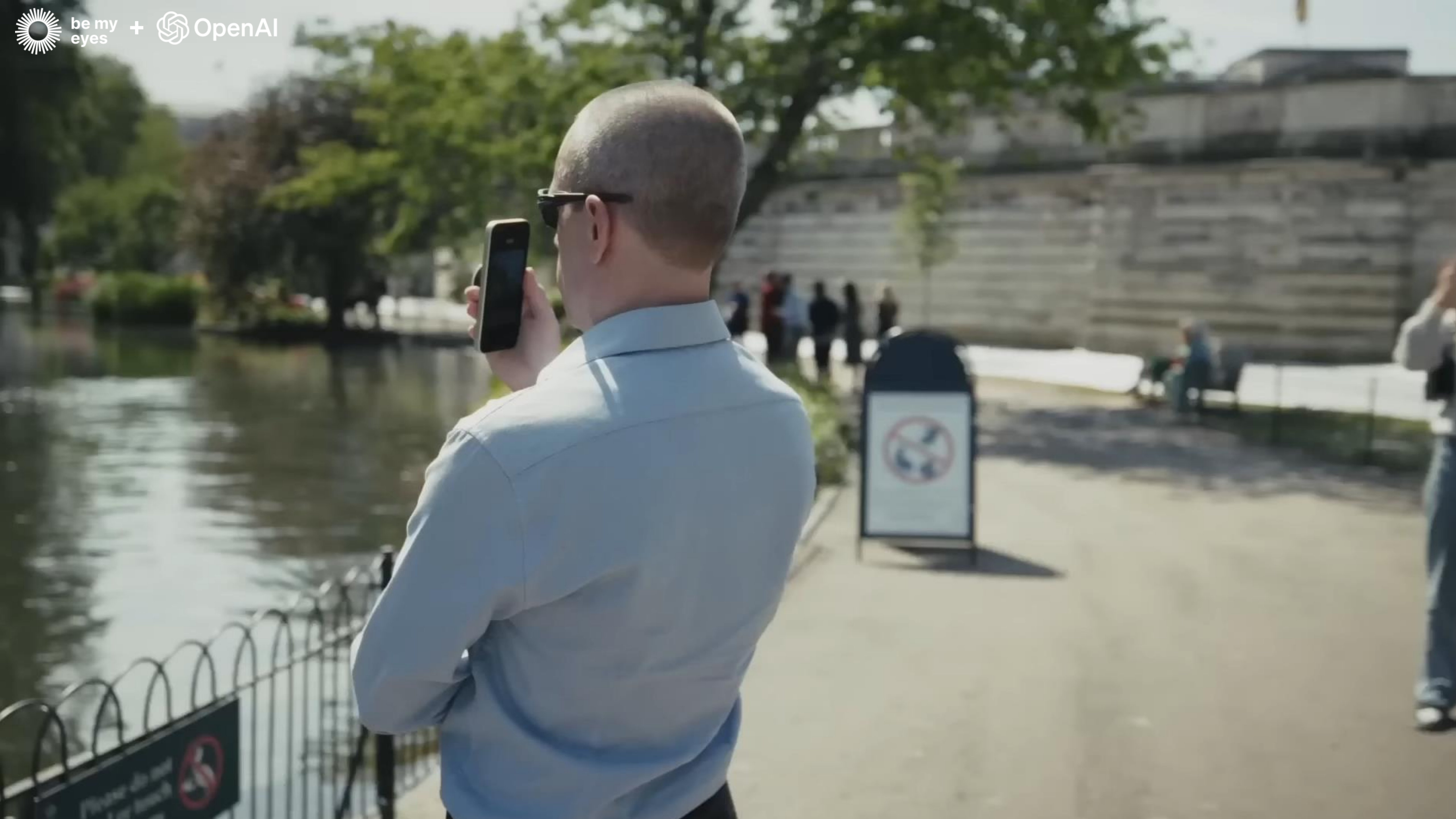
AI-POWERED AR ACCESSIBILITY HISTORY



AI foundation models + advances in **AR hardware**


be my eyes + OpenAI

WHAT DID YOU OBSERVE IN THIS VIDEO?

Brilliant Labs

Vision Pro

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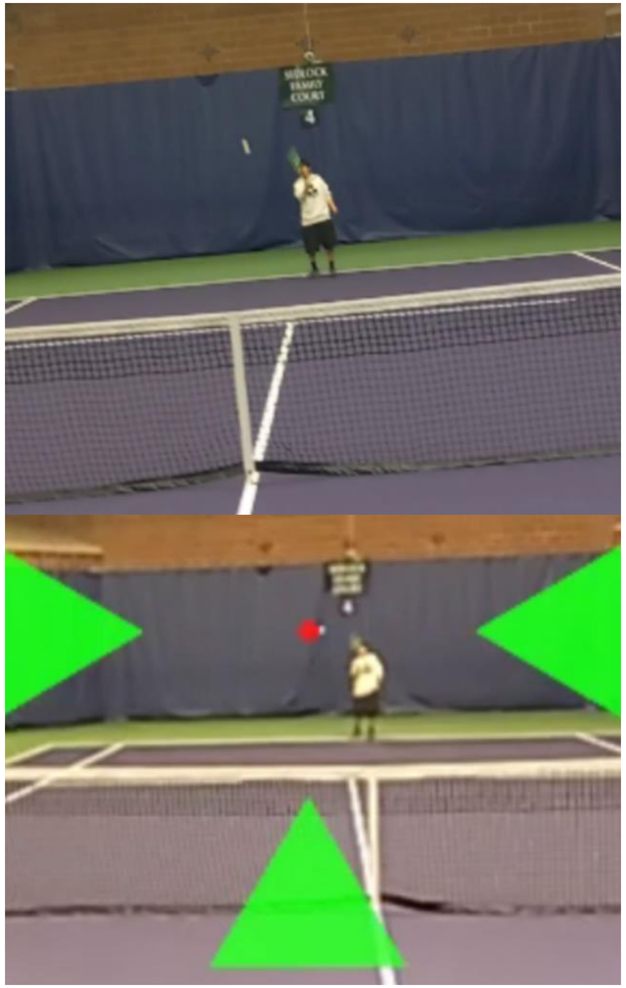
AI-POWERED AR ACCESSIBILITY

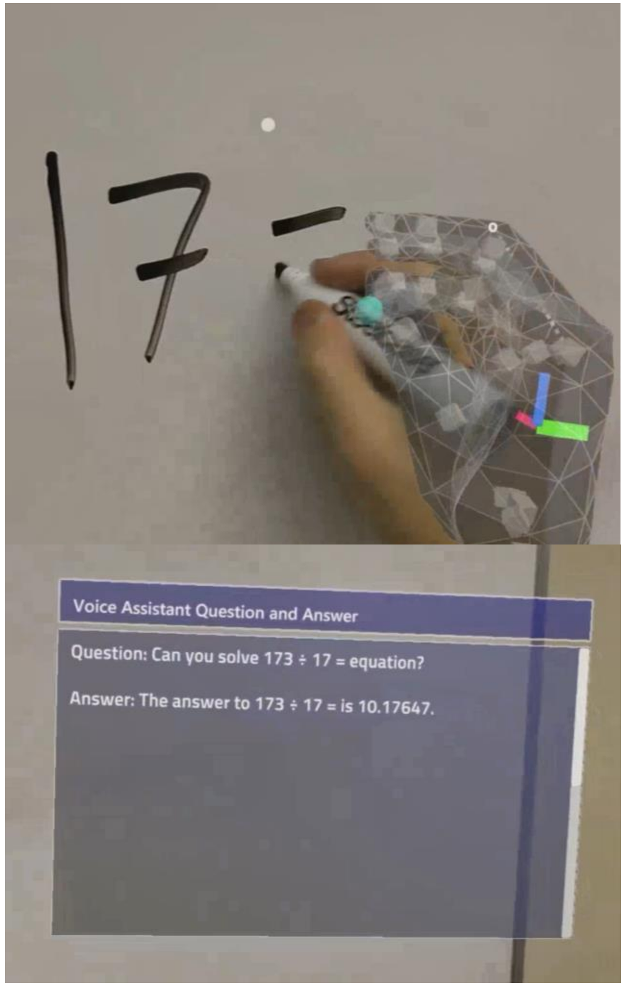


ARSports

UIST'23 Demo; *In Submission*

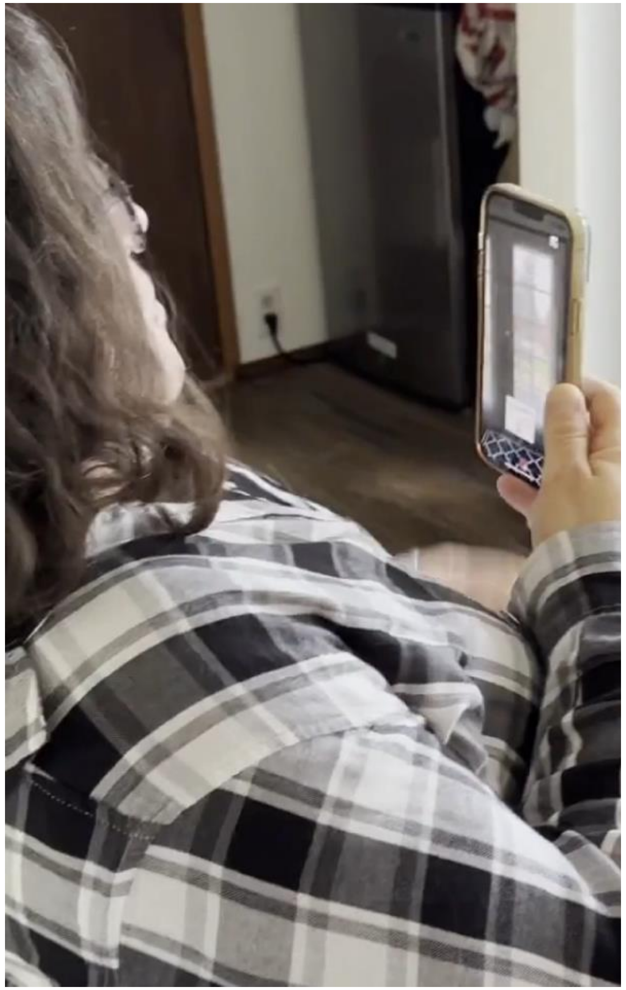
CookAR

UIST'24



GazePointAR

CHI'24

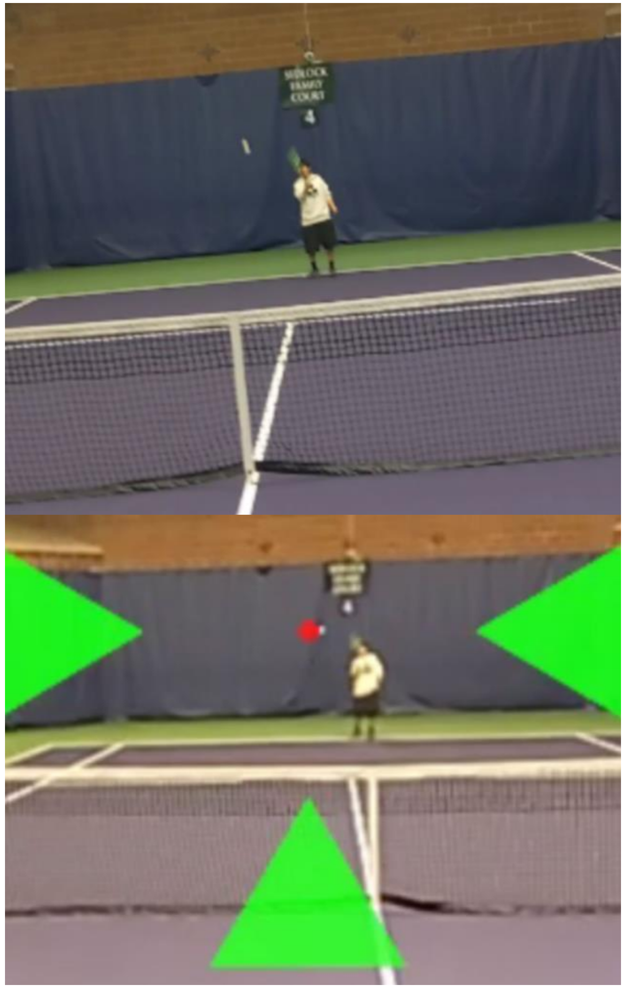


RASSAR

ASSETS'23 Demo, CHI'24

MAKEABILITY LAB

ARSPORTS



ARSports

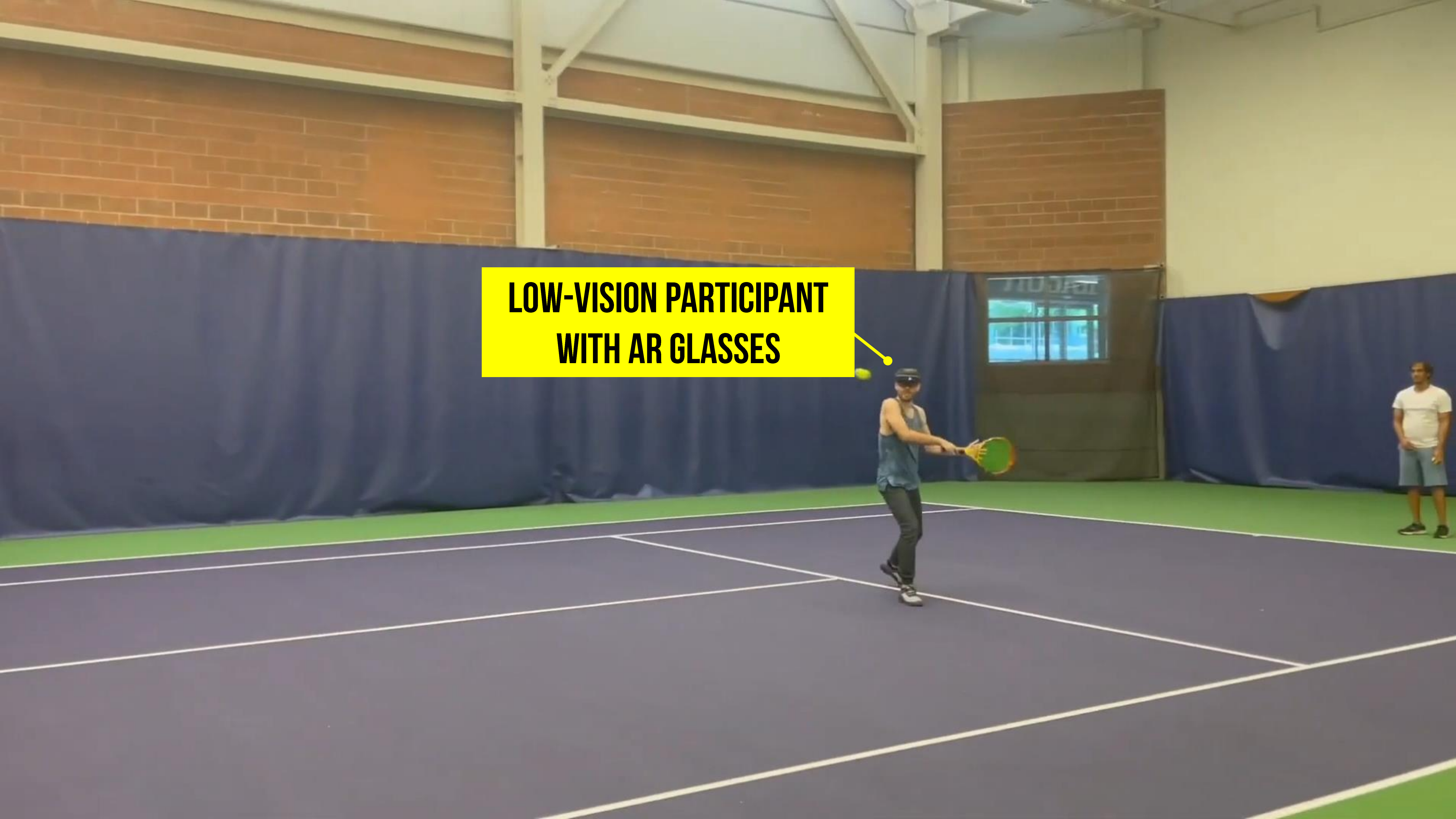
UIST'23 Demo; *In Submission*

Jaewook Lee

PhD Student

How can we…

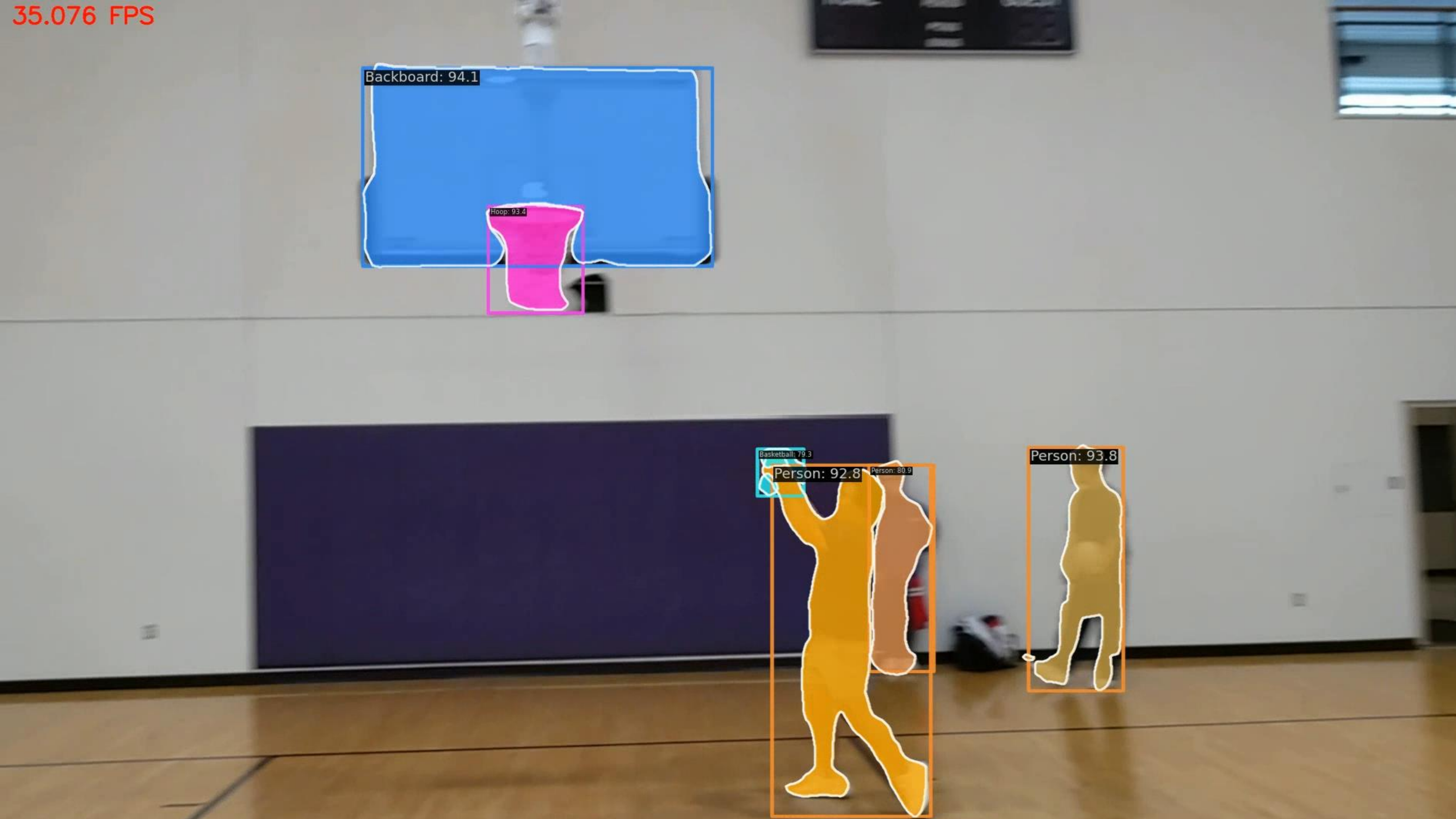
use real-time computer vision & visual augmentations to **support people with low-vision** in **playing sports**?


LOW-VISION PARTICIPANT
WITH AR GLASSES


HUSKIES
GUEST
COURT 4
EDLOCK
FAMILY
COURT
4


GROUNDSTROKE
424 X 240 @ 25 FPS


31.459 FPS
HUSKIES
GUEST
COURT 2
GO HUSKIES!
Rackets: 38.2
Person: 80.1
Net: 96.8


35.076 FPS
Backboard: 94.1
Hoop: 93.4
Basketball: 79.3
Person: 92.8
Person: 80.9
Person: 93.8

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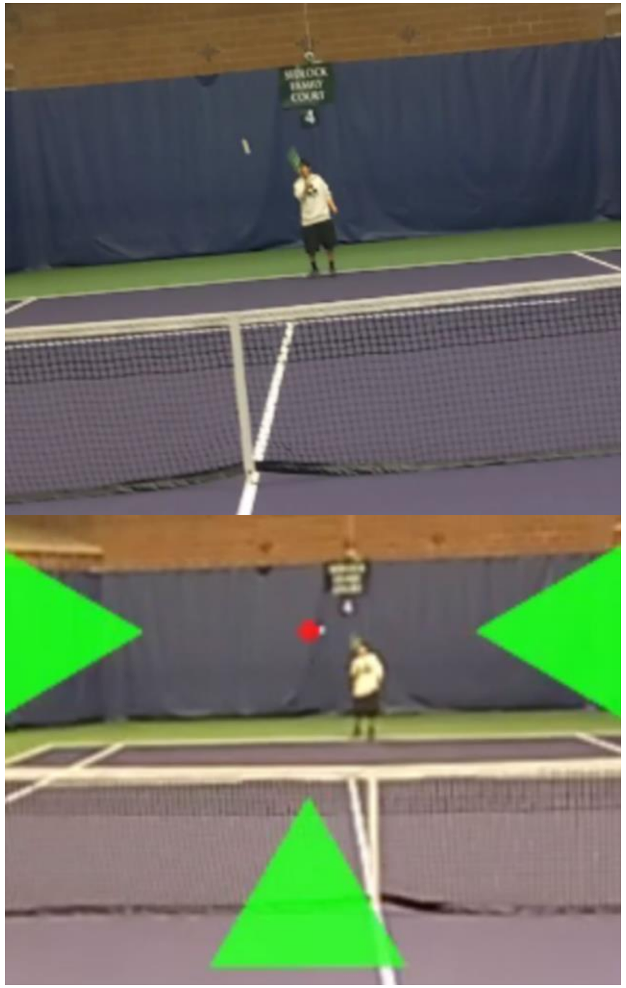
AI-POWERED AR ACCESSIBILITY

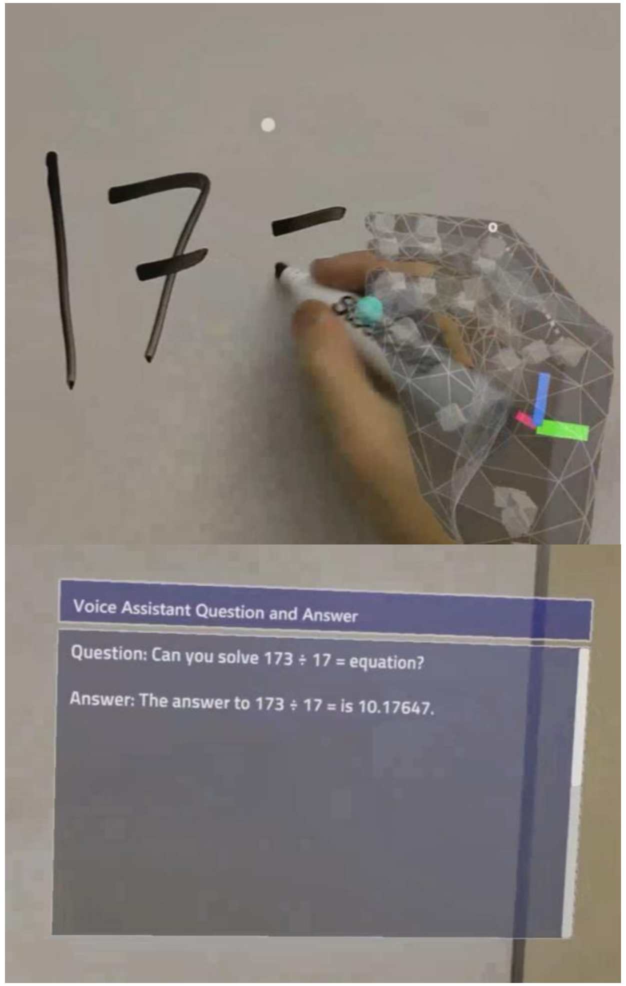


ARSports

UIST'23 Demo; *In Submission*

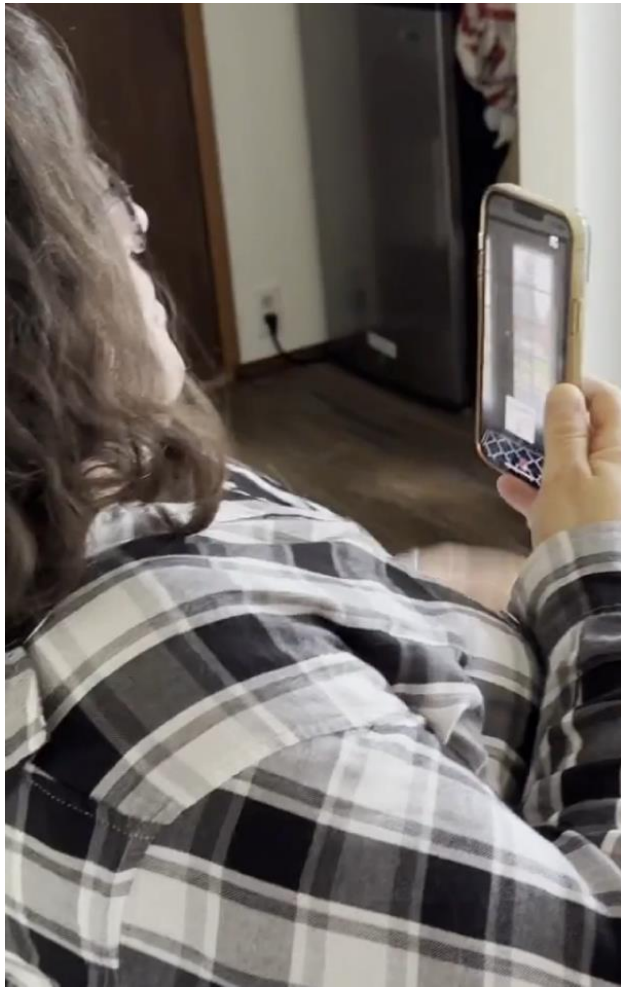
CookAR

UIST'24



GazePointAR

CHI'24



RASSAR

ASSETS'23 Demo, CHI'24

MAKEABILITY LAB

COOKAR



Jaewook Lee
PhD Student

Yapeng Tian
Assistant Professor
UT Dallas

Yuhang Zhao
Assistant Professor
UWisc

CookAR
UIST'24

How can we…

support **low-vision cooking** through real-time object affordance augmentations?

Article
Food Experiences and Eating P
Blind People
Authors: Marie Claire Bilyk, MSc, Jessica M. Sontrop, PhD, Gwen E. C
& AFFILIATIONS
Publication: Canadian Journal of Dietetic Practice and Research • 17
46

Abstract
Purpose: The number of visually impaire
population ages, and yet little is known ab
eating. In this qualitative study, the food e
blind people were examined. Influencing
Methods: In 2000, nine blind or severely
blindness-related organizations in Britis
semistructured, in-depth interviews. Th
explicate participants' experiences.
Results: Participants experienced blin
food, and eating in restaurants. Inacce
lacking in variety and limited access t
obese, a finding thatmay be related to
use.
Conclusions: This is the first study i
perspective of visually impaired Ca
together to reduce the food-related
Professionals must address both individual skill developme

Non-Visual Cooking: Exploring Practices
Preparation by People with Visu

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ABSTRACT
The reliance on vision for tasks related to cooking and eating healthy can present barriers to cooking for oneself and achieving proper nutrition. There has been little research exploring cooking practices and challenges faced by people with visual impairments. We present a content analysis of 122 YouTube videos to highlight the cooking practices of visually impaired people, and we describe detailed practices for 12 different cooking activities (e.g., cutting and chopping, measuring, testing food for doneness). Based on the cooking practices, we also conducted semi-structured interviews with 12 visually impaired people who have cooking experience and show existing challenges, concerns, and risks in cooking (e.g., tracking the status of tasks in progress, verifying whether things are peeled or cleaned thoroughly). We further discuss opportunities to support the current practices and improve the independence of people with visual impairments in cooking (e.g., zero-touch interactions for cooking). Overall, our findings provide guidance for future research exploring various assistive technologies to help people cook without relying on vision.

CCS CONCEPTS
• Human-centered computing → Empirical studies in accessibility.

KEYWORDS
accessibility, cooking, people with visual impairments, blind, activity of daily living, assistive technology

ACM Reference Format:
Franklin Mingzhe Li, Jamie Dorst, Peter Cederberg, and Patrick Carrington. 2021. Non-Visual Cooking: Exploring Practices and Challenges of Meal Preparation by People with Visual Impairments. In The 23rd International ACM SIGACCESS Conference on Computers and Accessibility (ASSETS '21), October 18–22, 2021, Virtual Event, USA. ACM, New York, NY, USA, 11 pages. https://doi.org/10.1145/3441852.3471215

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ASSETS '21, October 18–22, 2021, Virtual Event, USA
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ACM ISBN 978-1-4503-8306-6/21/10.
https://doi.org/10.1145/3441852.3471215

1 INT
Vision is
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difficult
ple with
which i
ing he
aversi
and cu
peopl
at res
Acco
nine
of th

A Contextual Inquiry of People with Vi
Cooking

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Shaun K. Kane
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ABSTRACT
Individuals with vision impairments employ a variety of strategies for object identification, such as pans or soy sauce, in the culinary process. In addition, they often rely on contextual details about objects, such as location, orientation, and current status, to autonomously execute cooking activities. To understand how people with vision impairments collect and use the contextual information of objects while cooking, we conducted a contextual inquiry study with 12 participants in their own kitchens. This research aims to analyze object interaction dynamics in culinary practices to enhance assistive vision technologies for visually impaired cooks. We outline eight different types of contextual information and the strategies that blind cooks currently use to access the information while preparing meals. Further, we discuss preferences for communicating contextual information about kitchen objects as well as considerations for the deployment of AI-powered assistive technologies.

CCS CONCEPTS
• Human-centered computing → Empirical studies in accessibility.

KEYWORDS
Cooking, Contextual Inquiry, Blind, People with Vision Impairments, Accessibility, Assistive technology

ACM Reference Format:
Franklin Mingzhe Li, Michael Xieyang Liu, Shaun K. Kane, and Patrick Carrington. 2024. A Contextual Inquiry of People with Vision Impairments in Cooking. In Proceedings of the CHI Conference on Human Factors in Computing Systems (CHI '24), May 11–16, 2024, Honolulu, HI, USA. ACM, New York, NY, USA, 14 pages. https://doi.org/10.1145/3613904.3642233

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CHI '24, May 11–16, 2024, Honolulu, HI, USA
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https://doi.org/10.1145/3613904.3642233

Practices and Barriers of Cooking Training for Blind and Low Vision People

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ABSTRACT
Cooking is a vital yet challenging activity for blind and low vision (BLV) people, which involves many visual tasks that can be difficult and dangerous. BLV training services, such as vision rehabilitation, can effectively improve BLV people's independence and quality of life in daily tasks, such as cooking. However, there is a lack of understanding on the practices employed by the training professionals and the barriers faced by BLV people in such training. To fill the gap, we interviewed six professionals to explore their training strategies and technology recommendations for BLV clients in cooking activities. Our findings revealed the fundamental principles, practices, and barriers in current BLV training services, identifying the gaps between training and reality.

CCS CONCEPTS
• Human-centered computing → Empirical studies in accessibility.

KEYWORDS
blind and low vision, rehabilitation training, cooking, kitchen

ACM Reference Format:
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1 INTRODUCTION
Cooking is a vital but challenging daily activity for blind and low vision (BLV) people as it involves various vision-related tasks, such as locating items, pouring, and measuring ingredients [2, 15]. Some cooking tasks can even pose safety risks, for example, handling sharp tools and hot appliances [13]. While several low-tech assistive tools are available, such as liquid level indicators and talking

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https://doi.org/10.1145/3597638.3614494

thermometers [7], they are limited to supporting very specific tasks and cannot fulfill BLV people's full range of needs in the dynamic and busy cooking process. Prior research has investigated BLV people's cooking experiences via interviews and observations [13, 16] and identified various challenges they face, such as getting burned during cooking and not being able to track the status of cooking tasks.

To overcome these challenges, BLV training services become a primary source where BLV people learn about assistive technologies and skills for daily activities [19], such as reading [24, 28, 29], socializing [22], and cooking [9, 20]. Many BLV organizations and rehabilitation clinics offer services to train BLV people in the kitchen. K-12 schools also offer individualized education plans (IEP) for BLV students to learn necessary living skills, including skills in the kitchen [10]. Prior research has shown that rehabilitation training can effectively improve BLV people's independence and performance in daily activities [12, 17, 29].

Despite the usefulness, current training services present barriers. For example, not all BLV people are able to access such a service [14], and some may drop out during the training [3]. Even completing the full training, not all BLV people can fully adopt the skills and technologies recommended by the professionals [26]. It is important to deeply look into this training and learning process, thus exploring how it shapes BLV people's cooking strategies and technology choices and identifying potential issues.

To achieve this goal, we conduct an interview study with six training professionals to investigate the training practices, technology recommendations, and challenges in the current training process. We find that while most professionals customize their training plans and technology recommendations according to BLV clients' abilities and needs to optimize the training efficacy, they point out that current training process cannot fully address all cooking challenges faced by BLV people. Our research identifies the training barriers and derives implications for technologies and research directions that would better support BLV training in the kitchen.

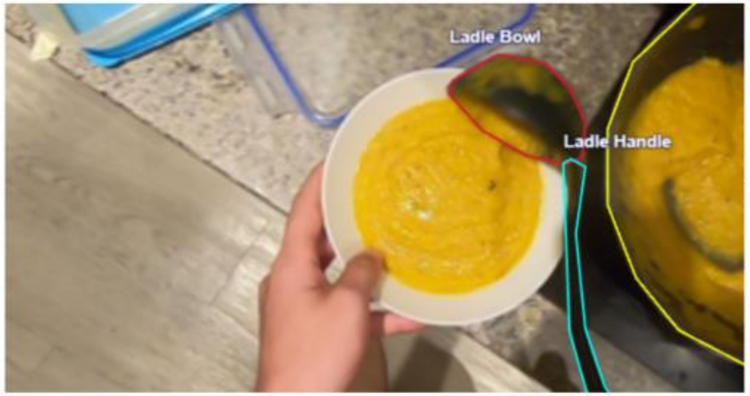
2 METHOD
Participants. We recruited six professionals who trained BLV people to cook, with training experience ranging from 7 to 25 years. Participants were recruited from BLV organizations as well as the local hospital and clinics. Table ?? detailed participants' information.

Knife Blade & Handle

Spoon Bowl & Handle

Fork Tines & Handle

Scissor Blade & Handle



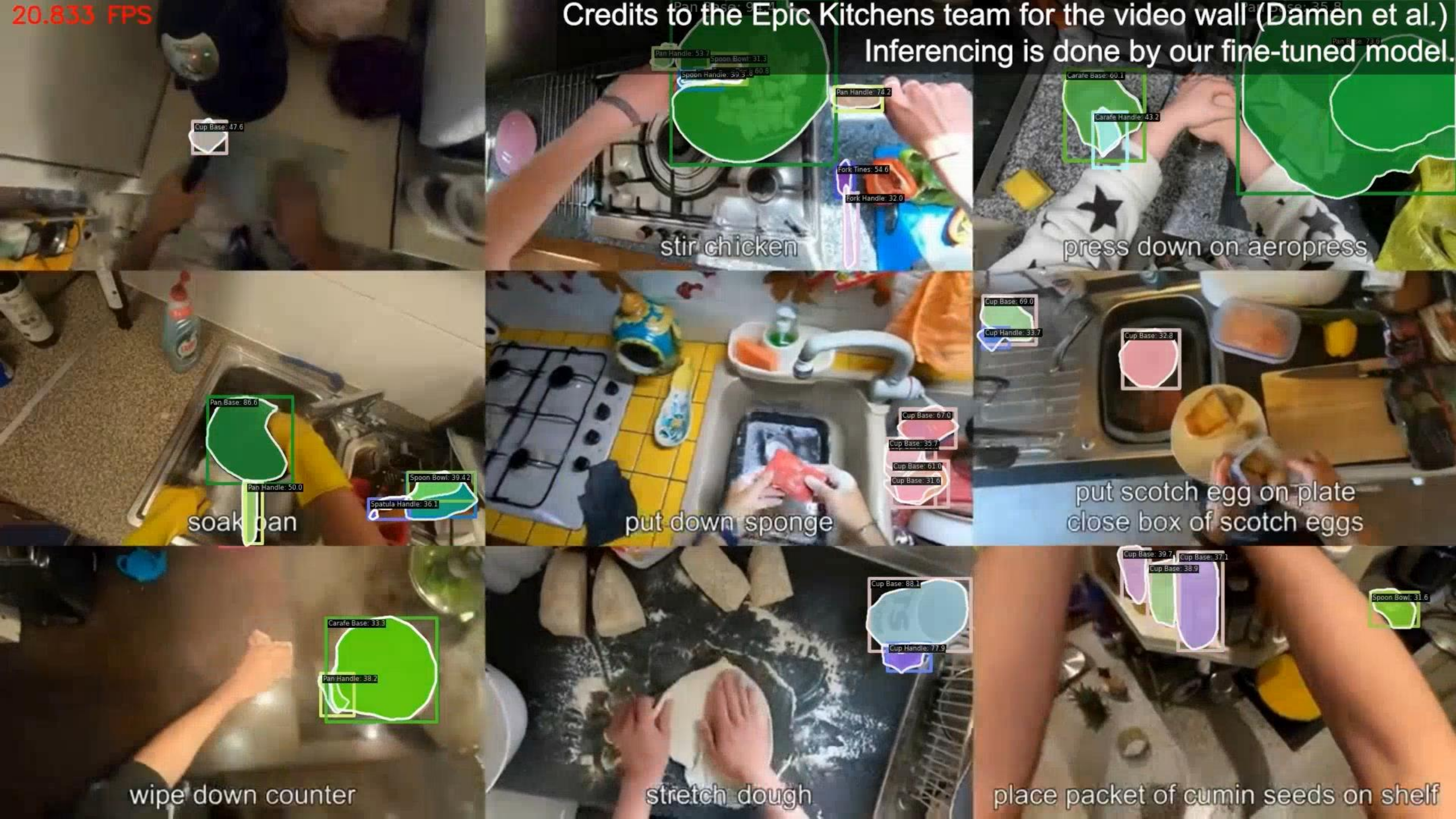
Ladle Bowl & Handle

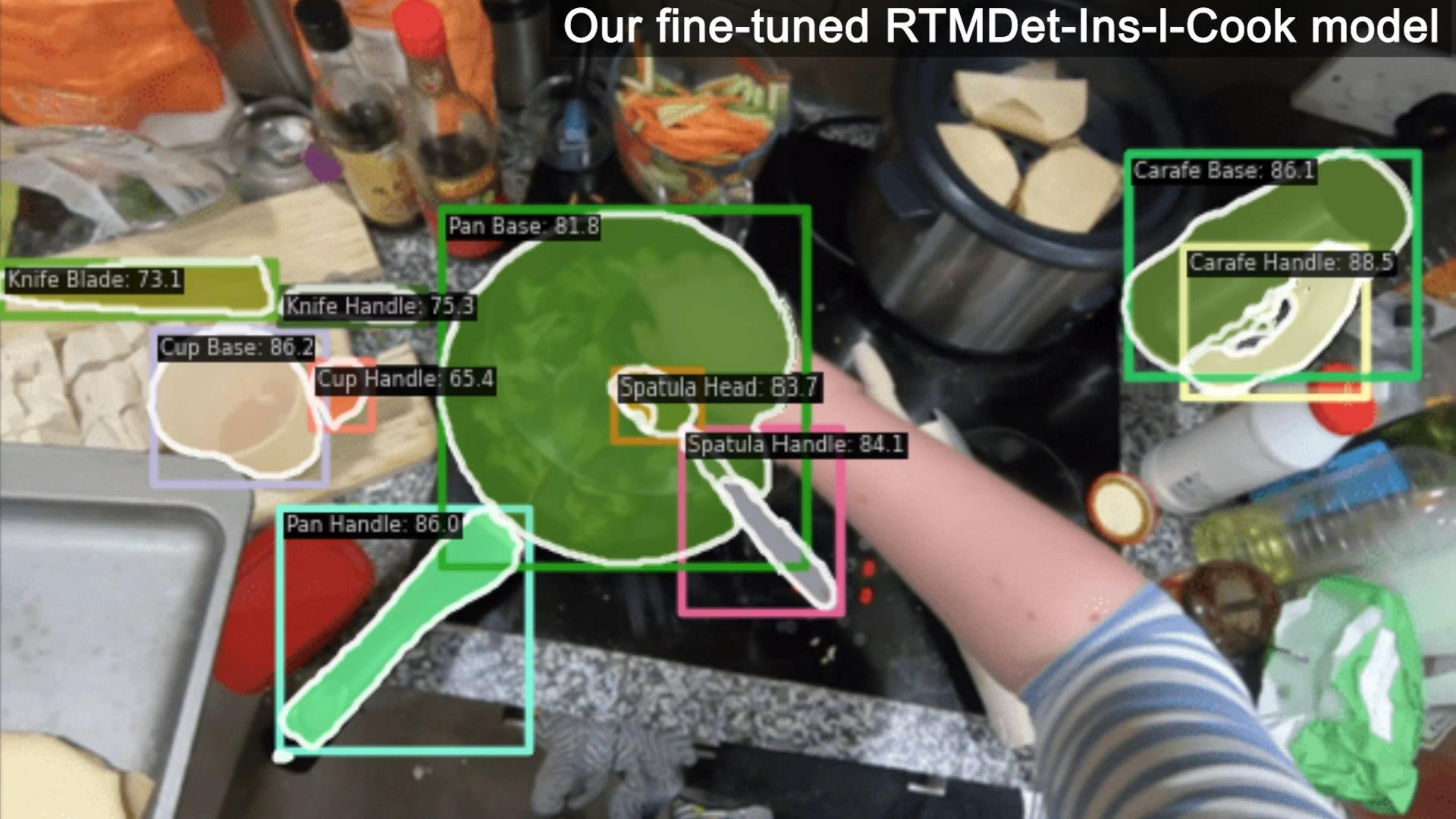
Spatula Head & Handle

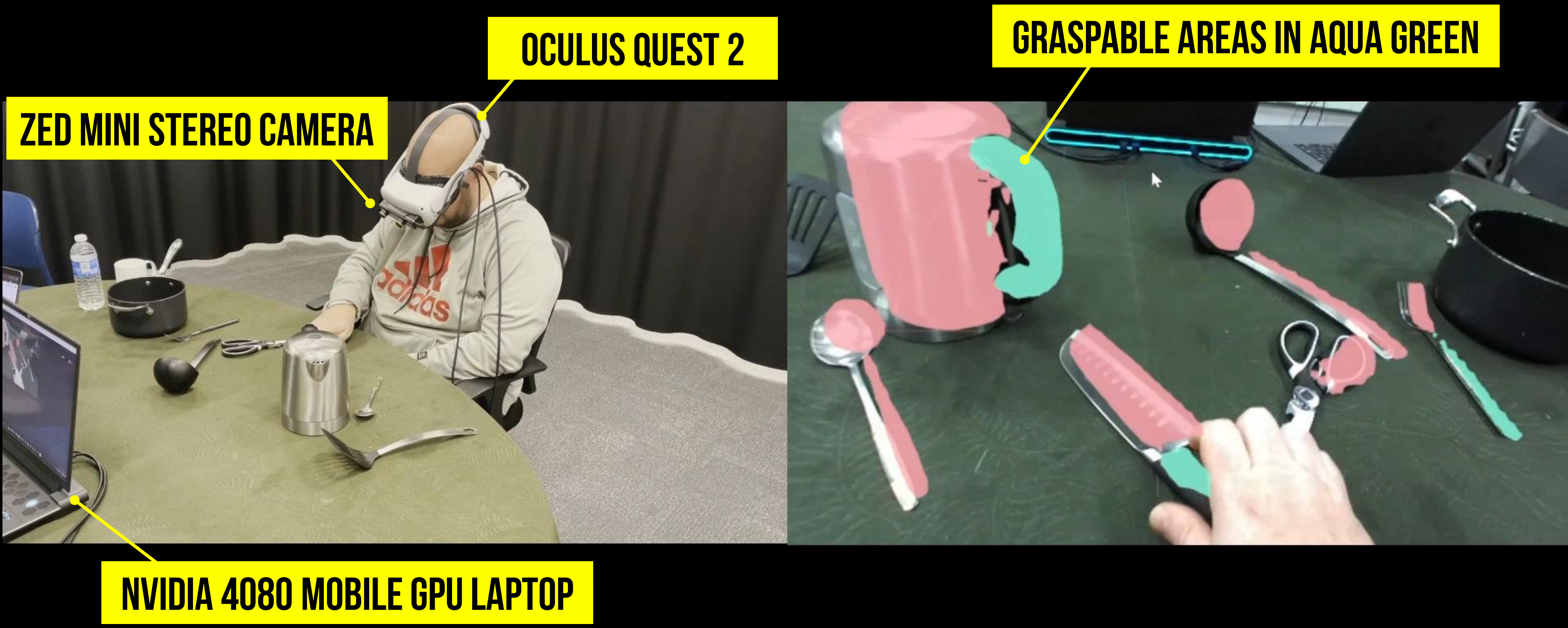
Pan Base & Handle

Cup Base & Handle

Carafe Base & Handle


20.833 FPS
Credits to the Epic Kitchens team for the video wall (Damen et al.)
Inferencing is done by our fine-tuned model.
stir chicken
press down on aeropress
soak pan
put down sponge
put scotch egg on plate
close box of scotch eggs
wipe down counter
stretch dough
place packet of cumin seeds on shelf

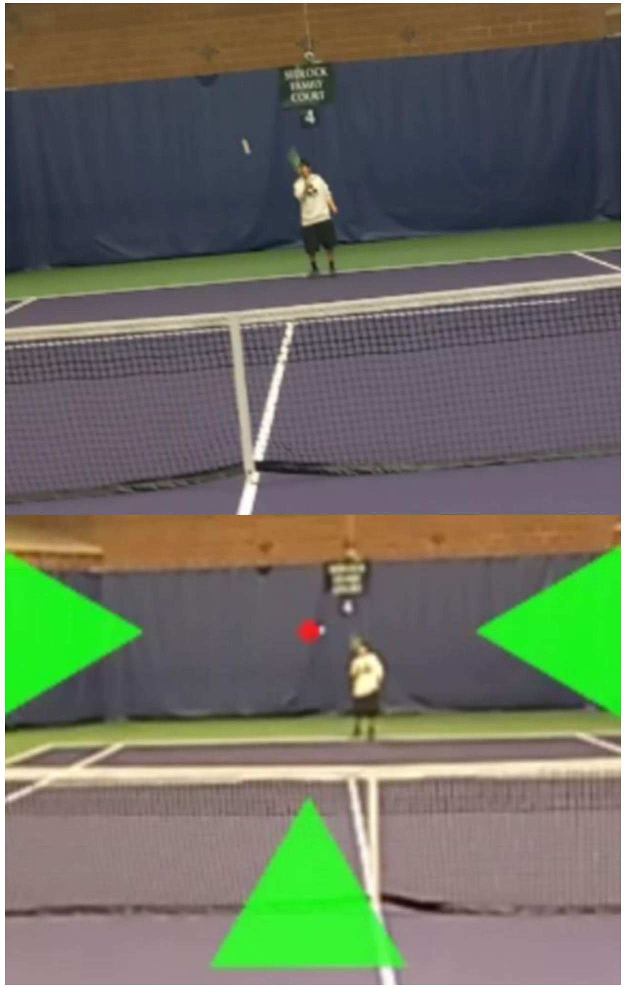

Our fine-tuned RTMDet-Ins-l-Cook model
Carafe Base: 86.1
Pan Base: 81.8
Carafe Handle: 88.5
Knife Blade: 73.1
Knife Handle: 75.3
Cup Base: 86.2
Cup Handle: 65.4
Spatula Head: 83.7
Spatula Handle: 84.1
Pan Handle: 86.0



OCULUS QUEST 2
ZED MINI STEREO CAMERA
NVIDIA 4080 MOBILE GPU LAPTOP
GRASPABLE AREAS IN AQUA GREEN


adidas

AI-POWERED AR ACCESSIBILITY

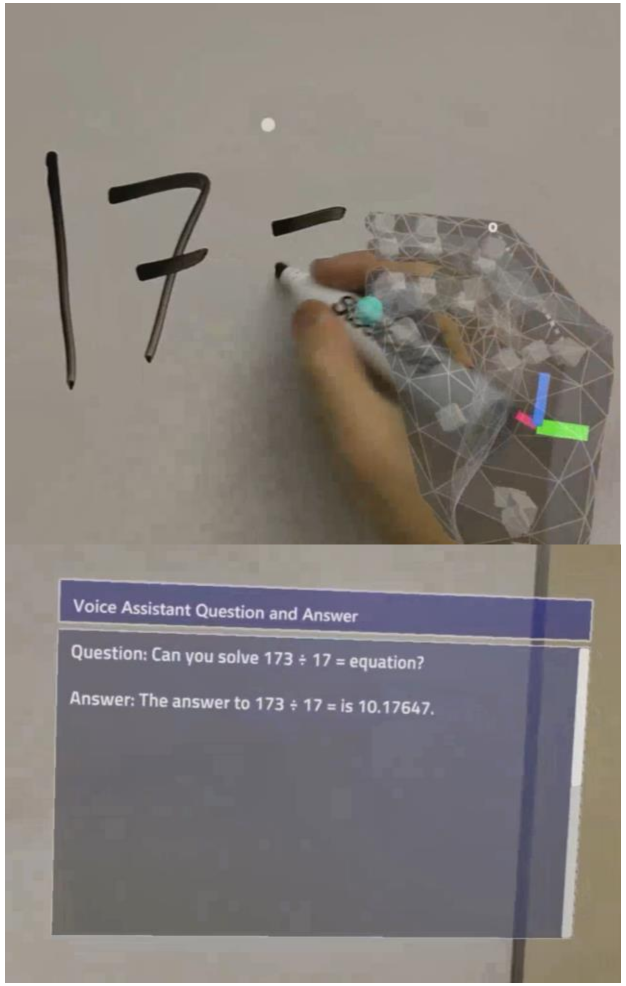


ARSports

UIST'23 Demo; *In Submission*

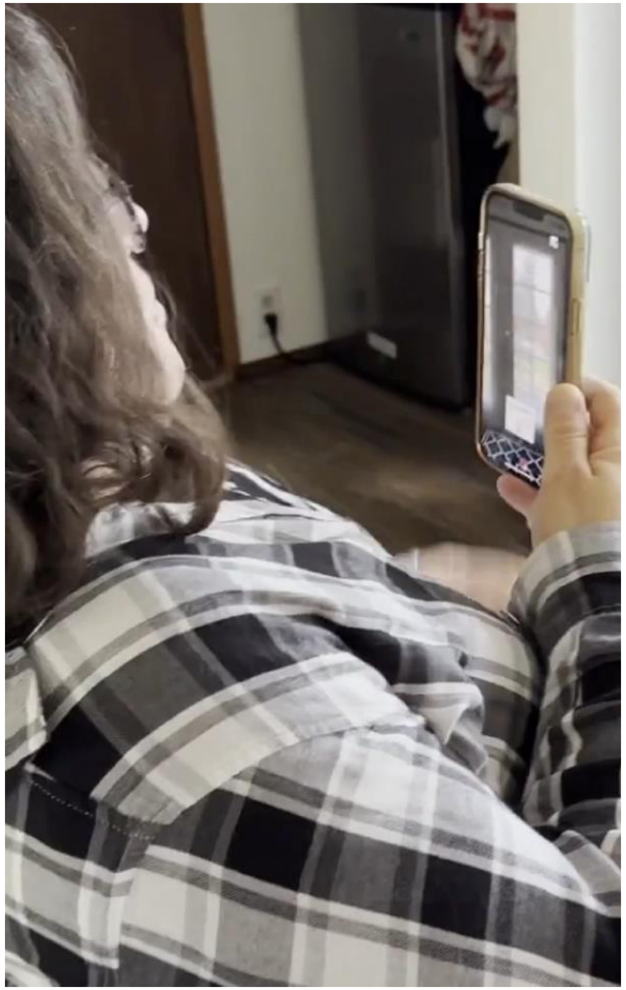
CookAR

UIST'24



GazePointAR

CHI'24



RASSAR

ASSETS'23 Demo, CHI'24

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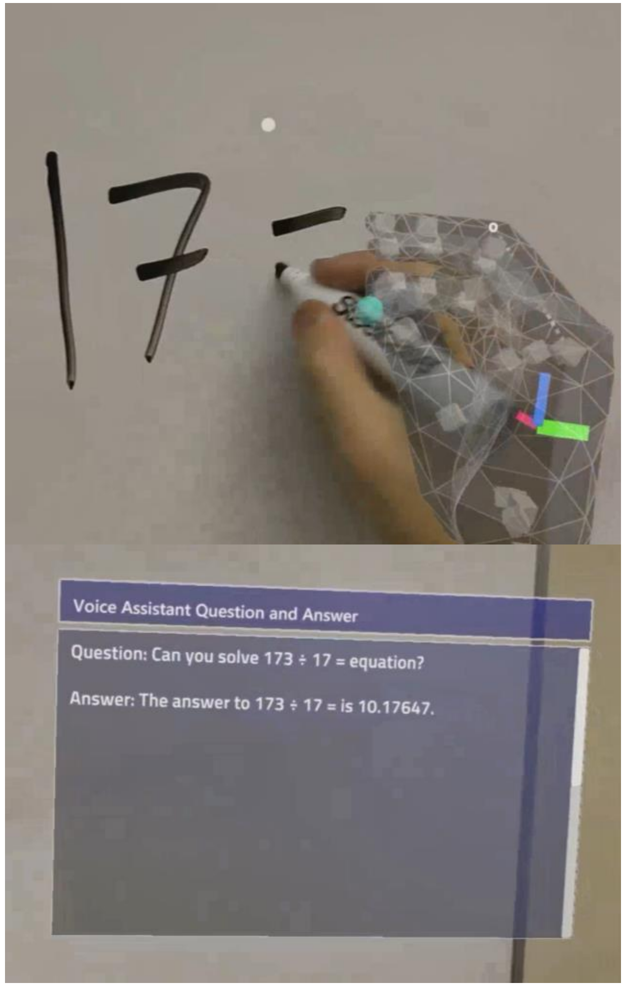
GAZEPOINTAR



GazePointAR

CHI'24

Jaewook Lee

PhD Student

How can we…

create an always-available, **context-aware AI agent** for AR glasses?

GazePointAR: A Context-Aware Multimodal Voice Assistant for Pronoun Disambiguation in Wearable Augmented Reality

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Elizabeth Brown
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Urbana-Champaign
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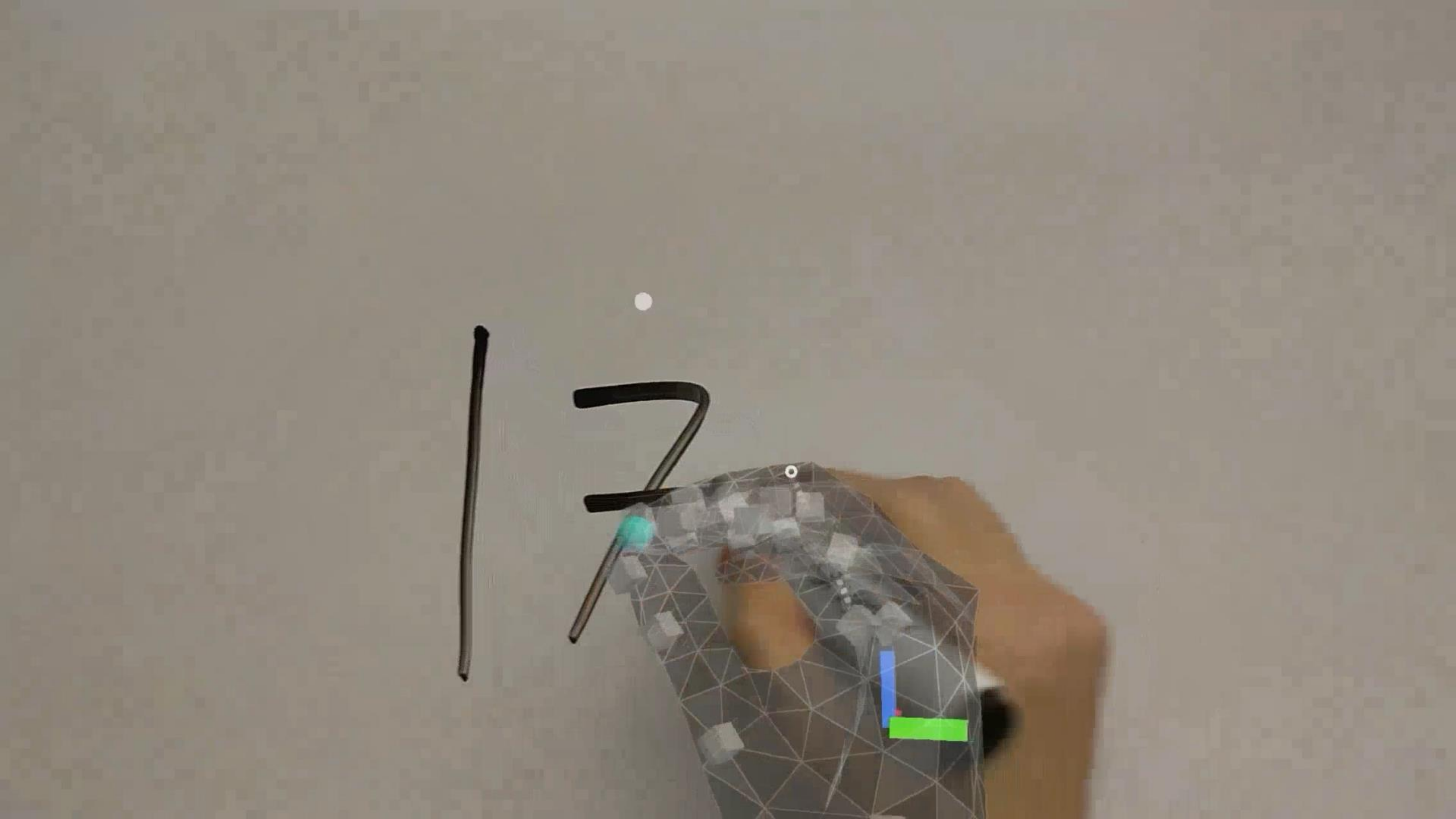
Figure 1: An example interaction with GazePointAR. The user's query *"What is this?"* is automatically resolved by using real-time gaze tracking, pointing gesture recognition, and computer vision to replace "*this*" with "*packaged item with text that says orion pocachip original,*" which is then sent to a large language model for processing and the response read by a text-to-speech engine.

ABSTRACT

Voice assistants (VAs) like Siri and Alexa are transforming human-computer interaction; however, they lack awareness of users' spatiotemporal context, resulting in limited performance and unnatural

the naturalness and human-like nature of pronoun-driven queries, although sometimes pronoun use was counter-intuitive. We then iterated on GazePointAR and conducted a first-person diary study examining how GazePointAR performs in-the-wild. We conclude


17

Rain Season

Testing the 3D-printed joint that connects the pad and the ... of the Dynamics of Rain.

To facilitate hiding the electronics under the tiles, ... testing if the water sensor could detect water through ... connected to the sensor.

→ Testing how the devices work when connecting the strings to the servos and the disks.

different ... hit different ... song of rain ... and varied.

To ... understanding ... the journey of ... I got inspired by ... hit tin roofs ... gardens, and ... roads. For ... places highlight ... dynamics, and ... so I made an ... of them.

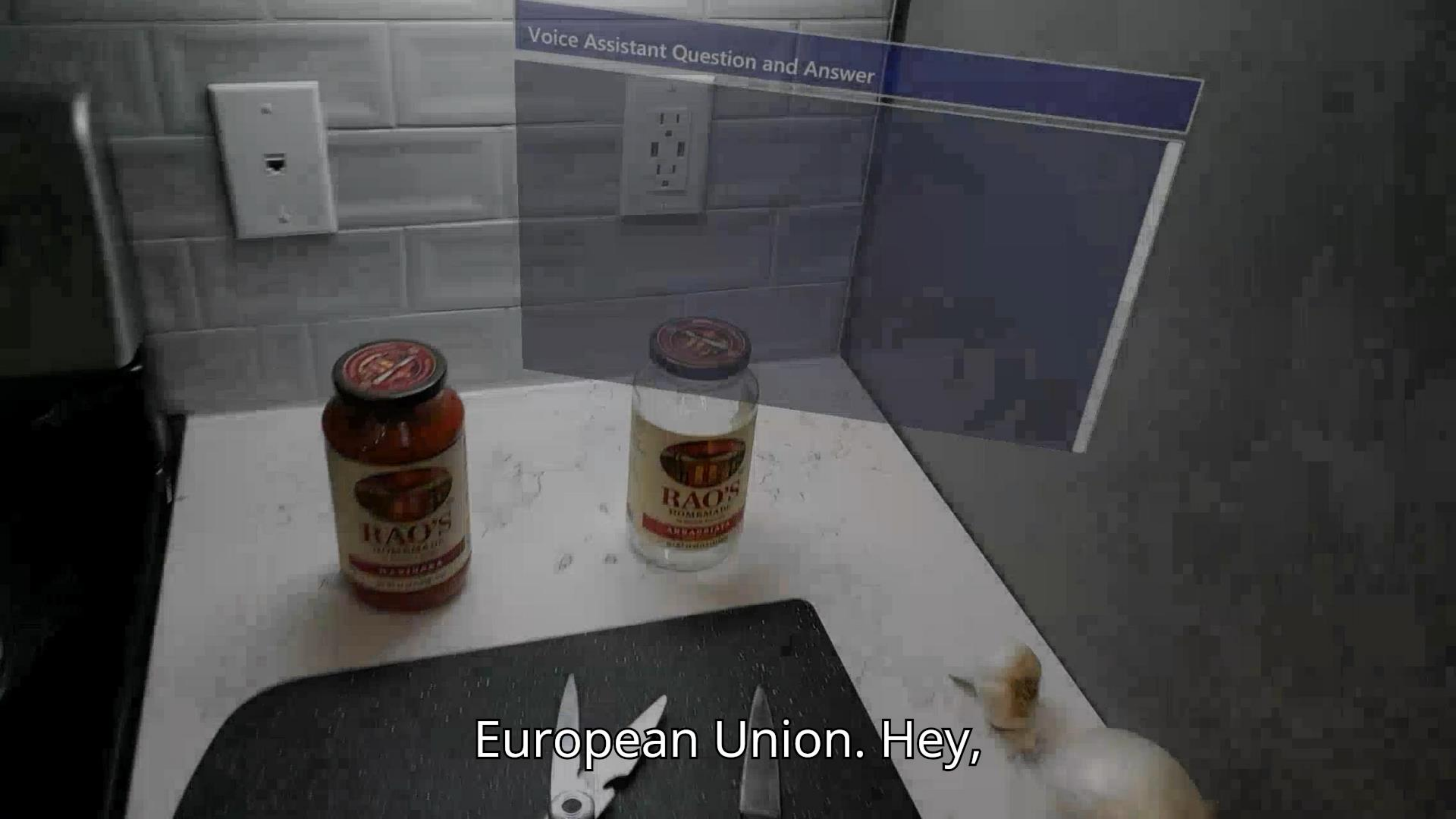
Was this a collab... process, and if so, ... involved? To ... melody for the ... I invited Lydia ... friend with a ... background ... professional ...

... for her work ethic and

... by the question: "Who do I call ... widely attributed (probably ... of state Henry Kissinger, ... many leaders, but no voice on

... at the end of the phone line: ... of the European ... most powerful woman in the

... air raid shelter, before ... president, Volodymyr Zelenskiy. ... at the White House, in an ... subsidies. This week she is ... to meet Xi Jinping in ... relations.


Voice Assistant Question and Answer
RAO'S
RAO'S
HOMEMADE
European Union. Hey,

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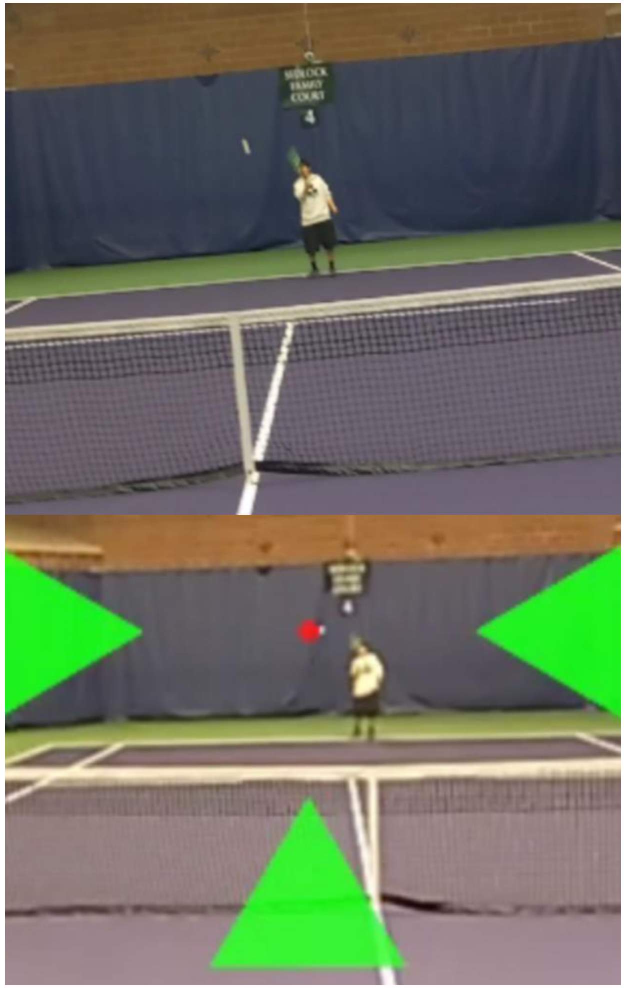

ARSports

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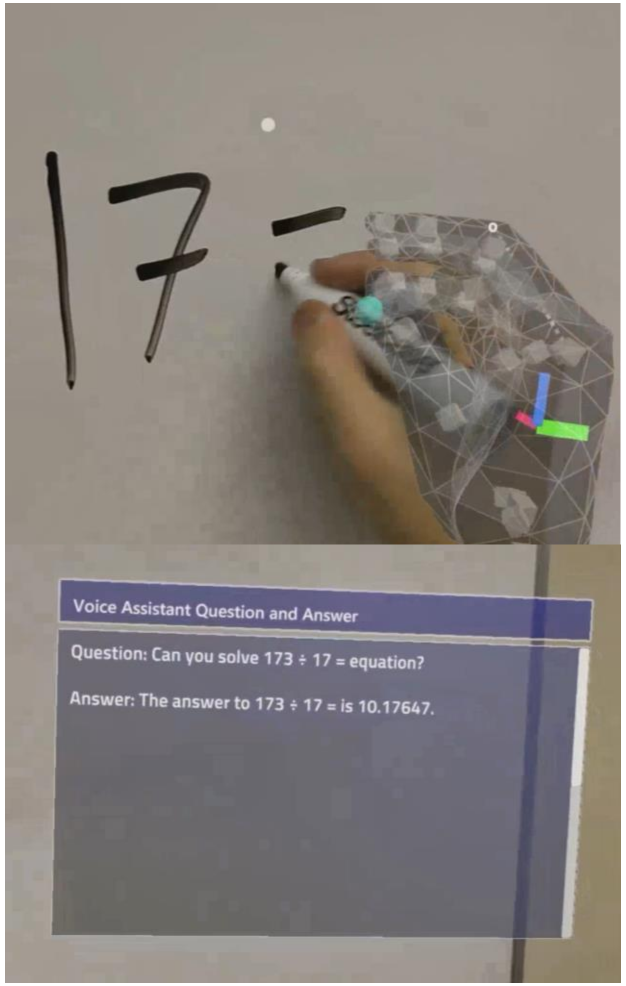
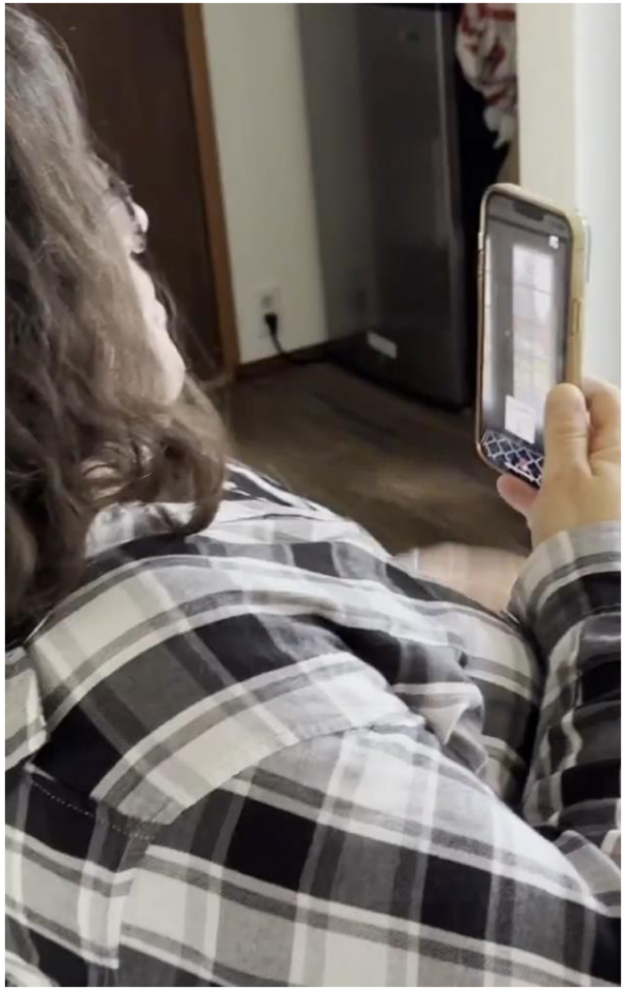


GazePointAR

CHI'24



RASSAR

ASSETS'23 Demo, CHI'24

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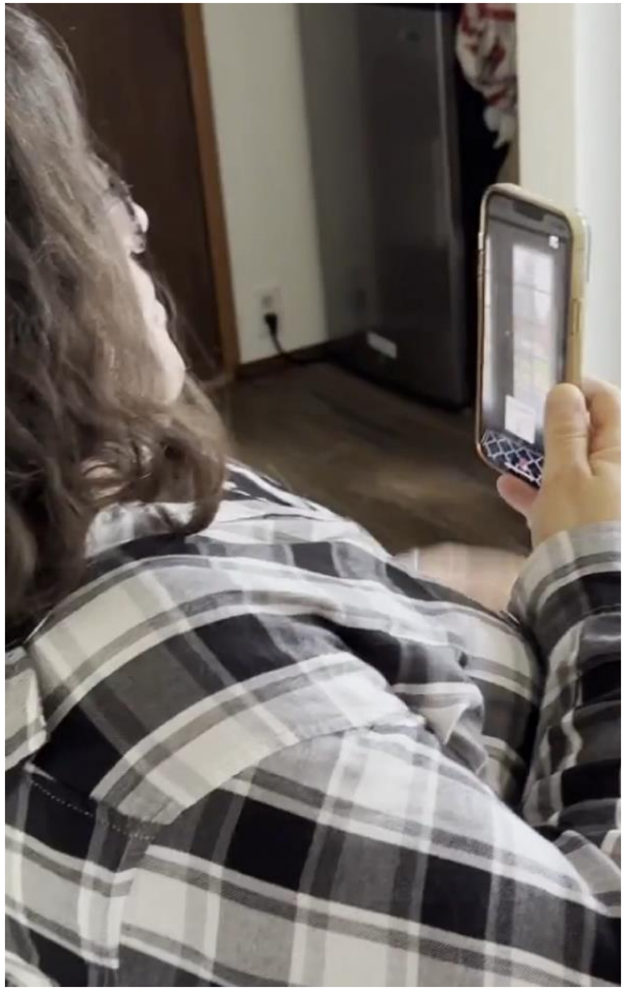
RASSAR



Xia Su
PhD Student

How can we...
create customized **indoor accessibility maps** using smartphones and drones?

RASSAR
ASSETS'23 Demo, CHI'24

RASSAR: Room Accessibility and Safety Scanning in Augmented Reality

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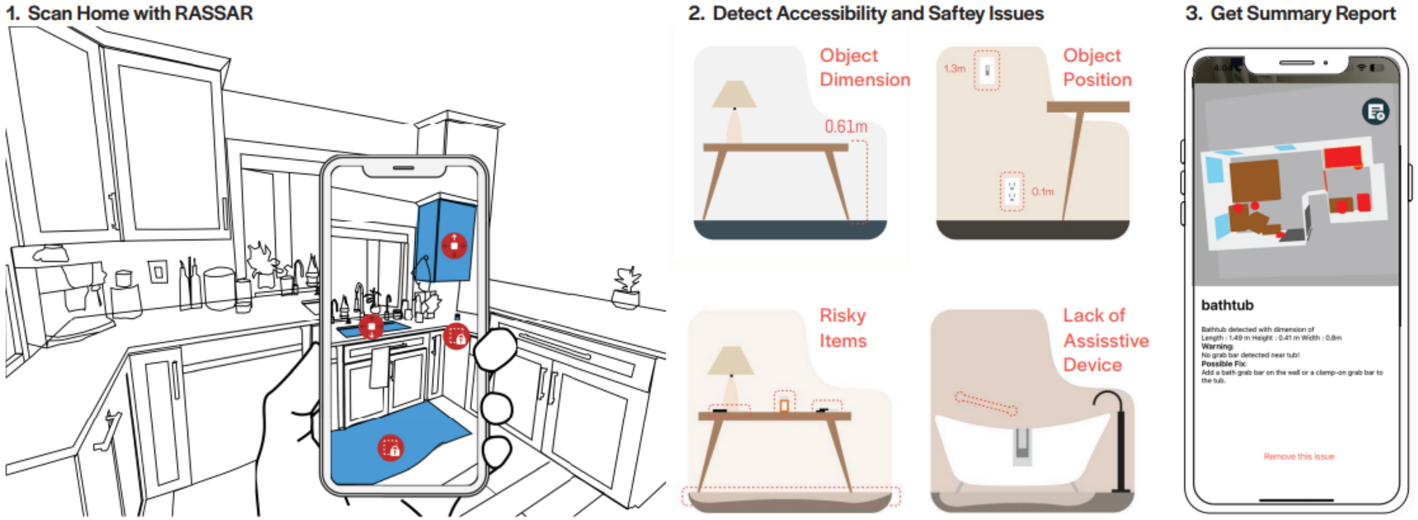
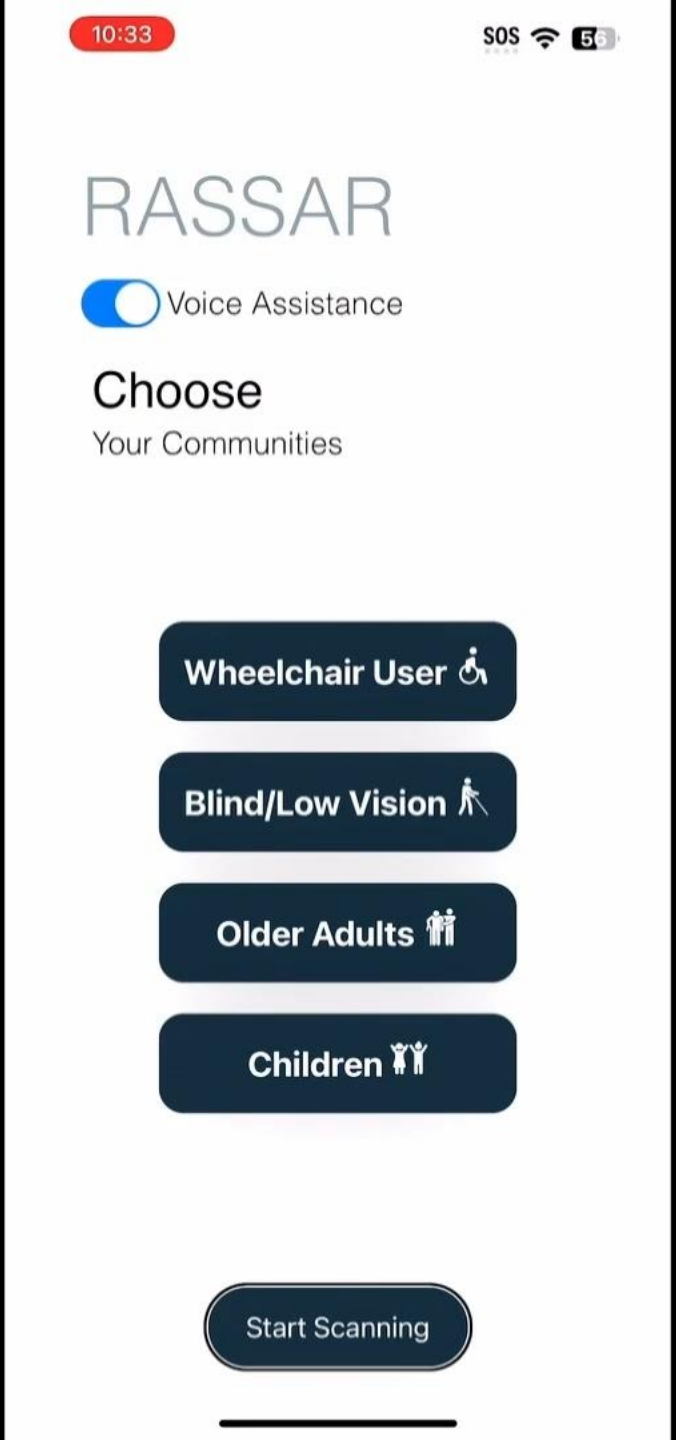
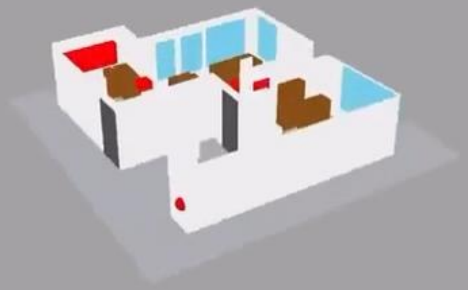


Figure 1: RASSAR is a mobile AR application for semi-automatically *identifying*, *localizing*, and *visualizing* indoor accessibility and safety issues. (1) RASSAR scans home spaces and detects potential issues in real time using LiDAR and computer vision. (2) RASSAR currently supports four classes of issues, including inaccessible *object dimensions* such as a high/low table top or the presence of risky/dangerous items such as scissors. (3) After a scan, RASSAR generates an interactive summary of identified problems with a 3D reconstructed model.


10:33
SOS
RASSAR
Voice Assistance
Choose
Your Communities
Wheelchair User
Blind/Low Vision
Older Adults
Children
Start Scanning

10:41



Item Category

Please tap any object or issues in 3D view to see details. The information will include object category and dimension.

DIAM: Drone-based Indoor Accessibility Mapping

Xia Su, Ruiqi Chen, Weiye Zhang, Jingwei Ma, Jon E. Froehlich
University of Washington

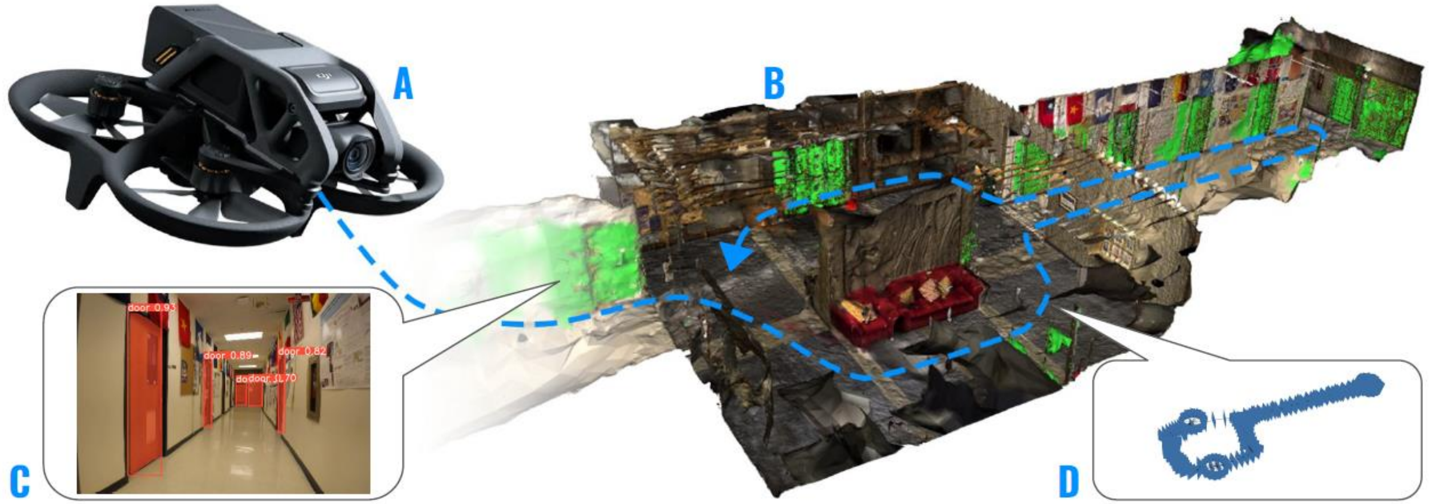


Figure 1: DIAM system overview. (A) The DJI Avata drone used to scan indoor spaces. (B) Indoor accessibility mapping result, green part shows detected doors. (C) DIAM use a few-shot fine-tuned instance segmentation model to detect accessibility related facilities. (D) DIAM also estimates camera position and fly trajectory to help locate detected facilities.

ABSTRACT

Indoor mapping data is crucial for navigation and accessibility, yet such data are widely lacking due to the high manual labor of data collection, especially for larger indoor spaces. In this demo paper, we introduce *Drone-based Indoor Accessibility Mapping* (DIAM), a drone-based indoor scanning system that efficiently produces 3D reconstructions of indoor spaces with key accessibility facilities recognized and located in the model. With DIAM, users can scan

1 INTRODUCTION

Indoor accessibility mapping data, which helps disabled people navigate [4] and assess [10] remote spaces, are widely lacking [2], especially in terms of data quality and accessibility information [1, 9]. Traditional indoor mapping methods are either high-cost and time-consuming [7] or lack accessibility information [1]. In this case, low-cost and efficient indoor accessibility mapping systems are widely needed.

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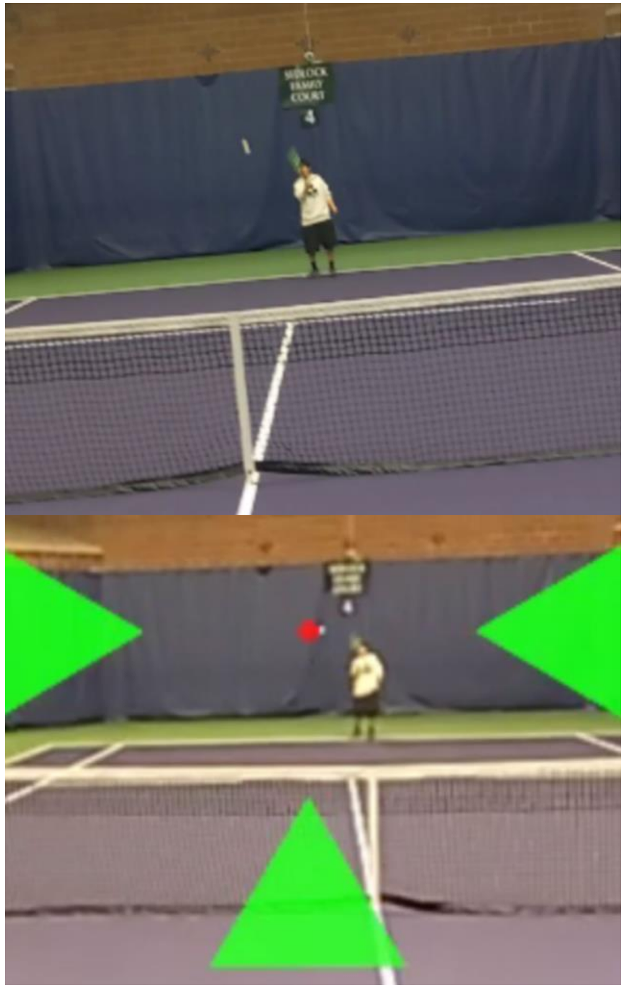
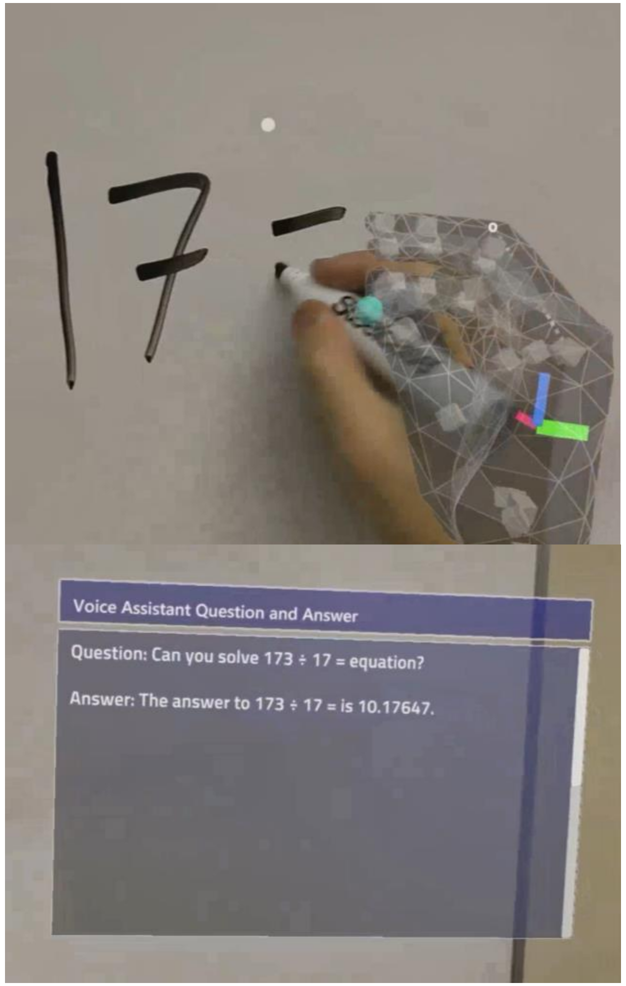


ARSports

UIST'23 Demo; *In Submission*

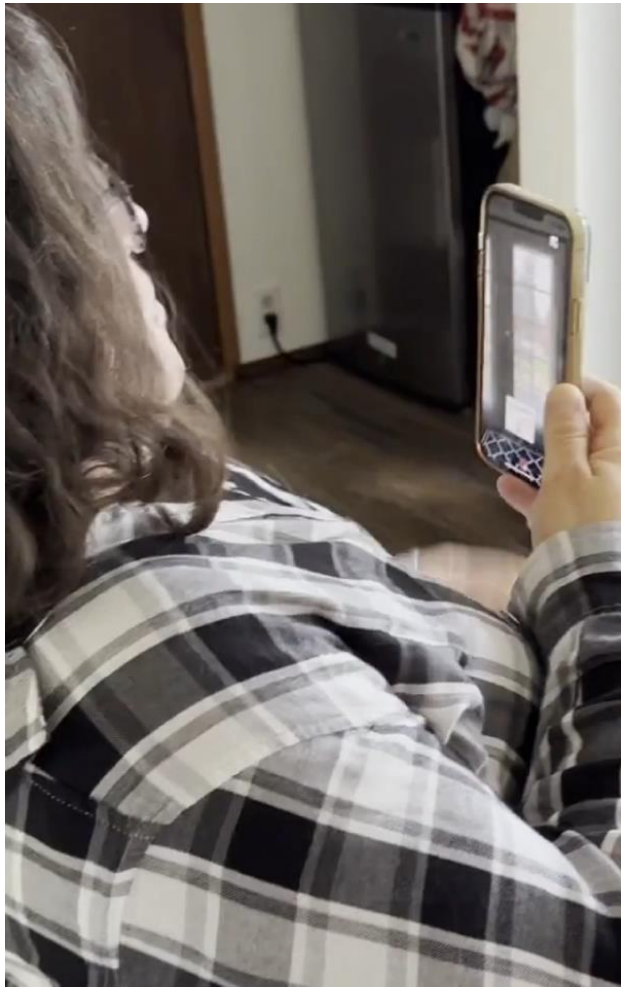
CookAR

UIST'24



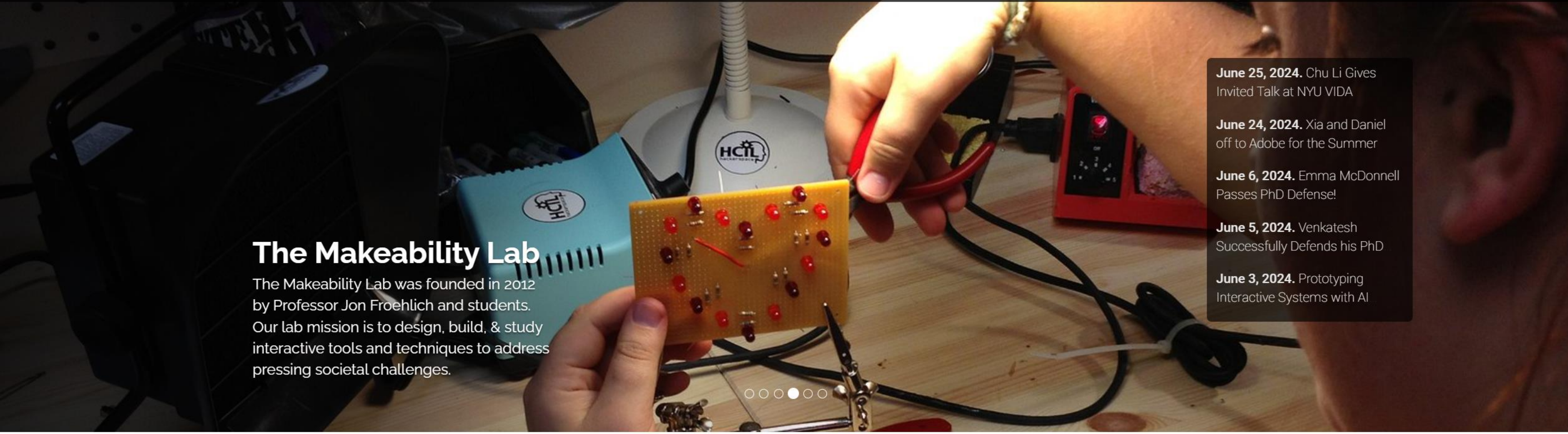
GazePointAR

CHI'24



RASSAR

ASSETS'23 Demo, CHI'24



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The Makeability Lab was founded in 2012 by Professor Jon Froehlich and students. Our lab mission is to design, build, & study interactive tools and techniques to address pressing societal challenges.

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June 24, 2024. Xia and Daniel off to Adobe for the Summer

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June 5, 2024. Venkatesh Successfully Defends his PhD

June 3, 2024. Prototyping Interactive Systems with AI

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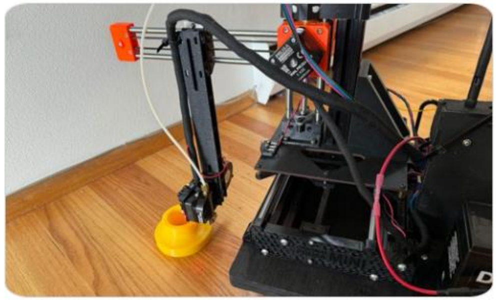
2023 – Present

CookAR
2023 – Present



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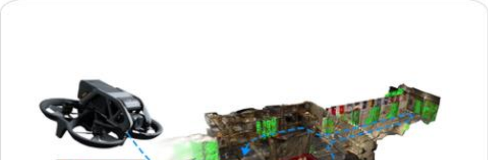

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AI-POWERED AR ACCESSIBILITY

JON E. FROEHLICH
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Human-Centered ML Workshop, Apple, Aug 8, 2024

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