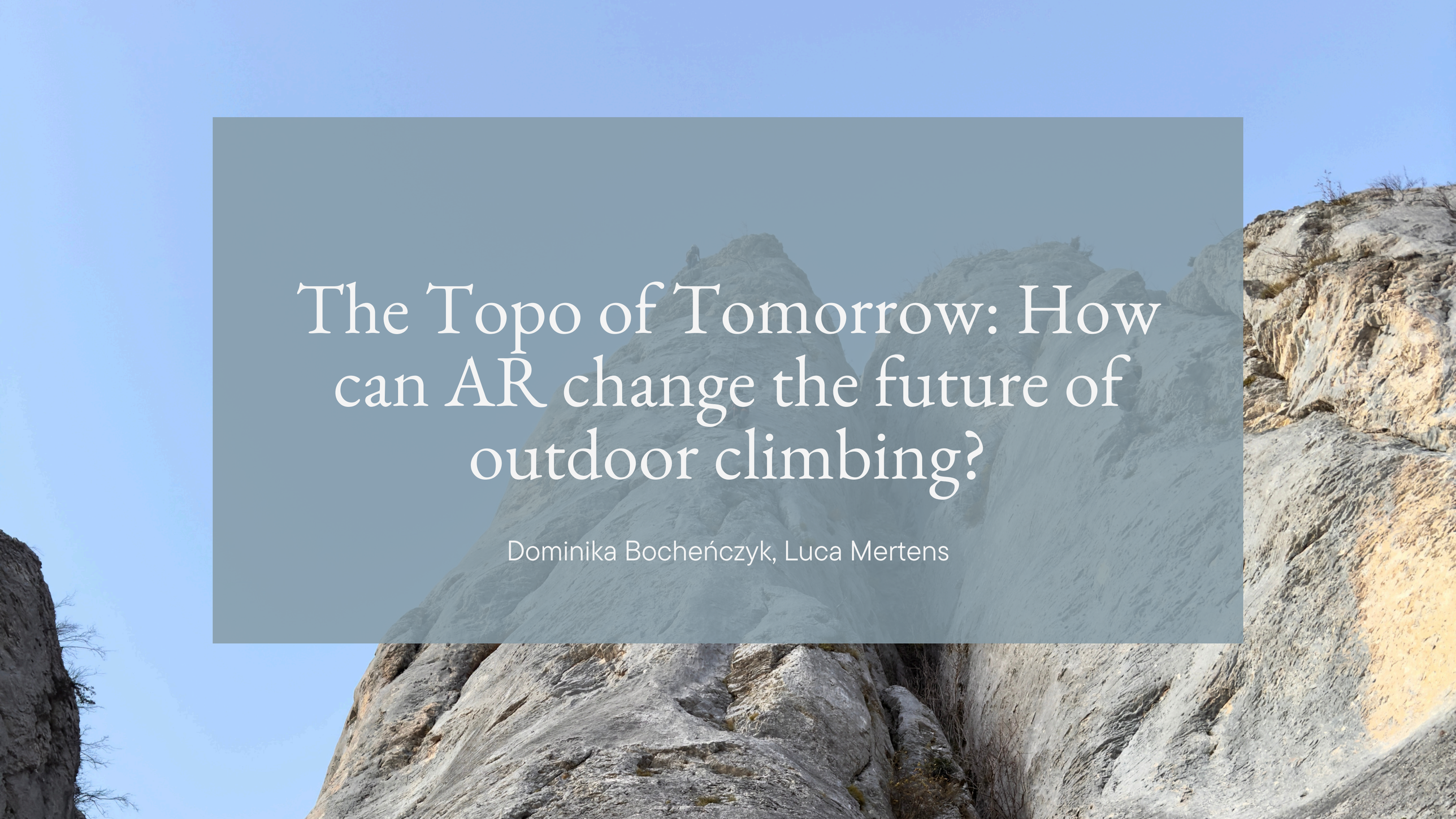
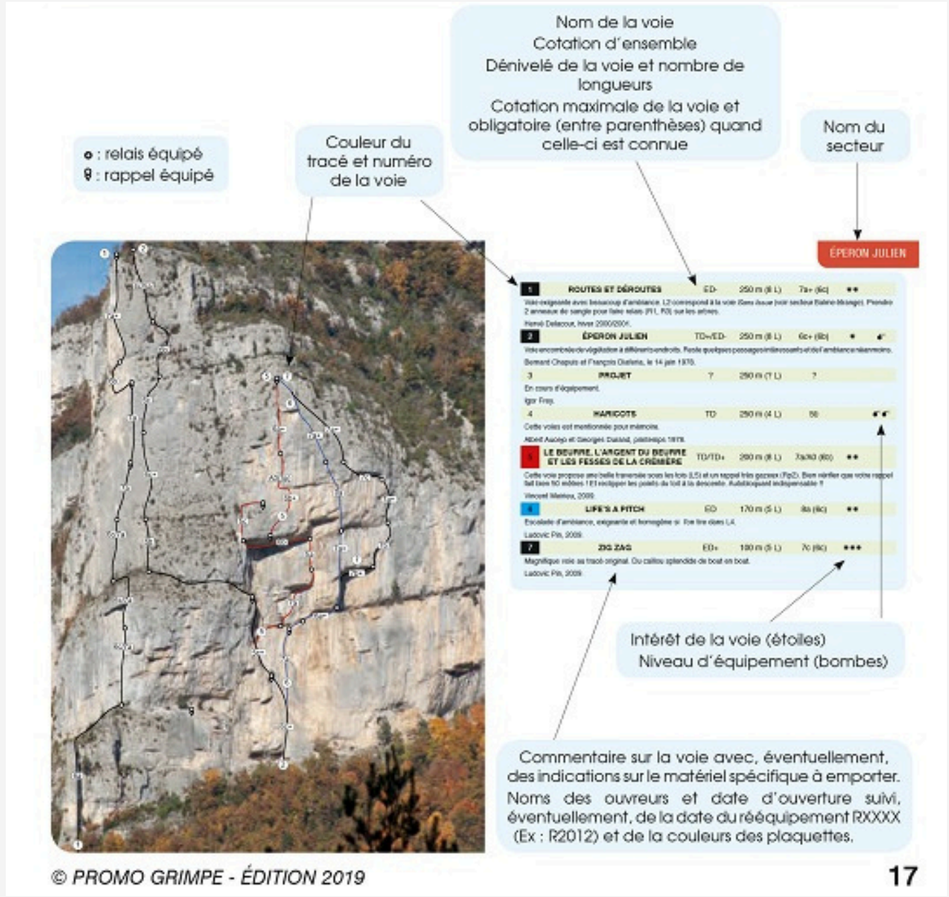


The Topo of Tomorrow: How can AR change the future of outdoor climbing?

Dominika Bocheńczyk, Luca Mertens

Motivation



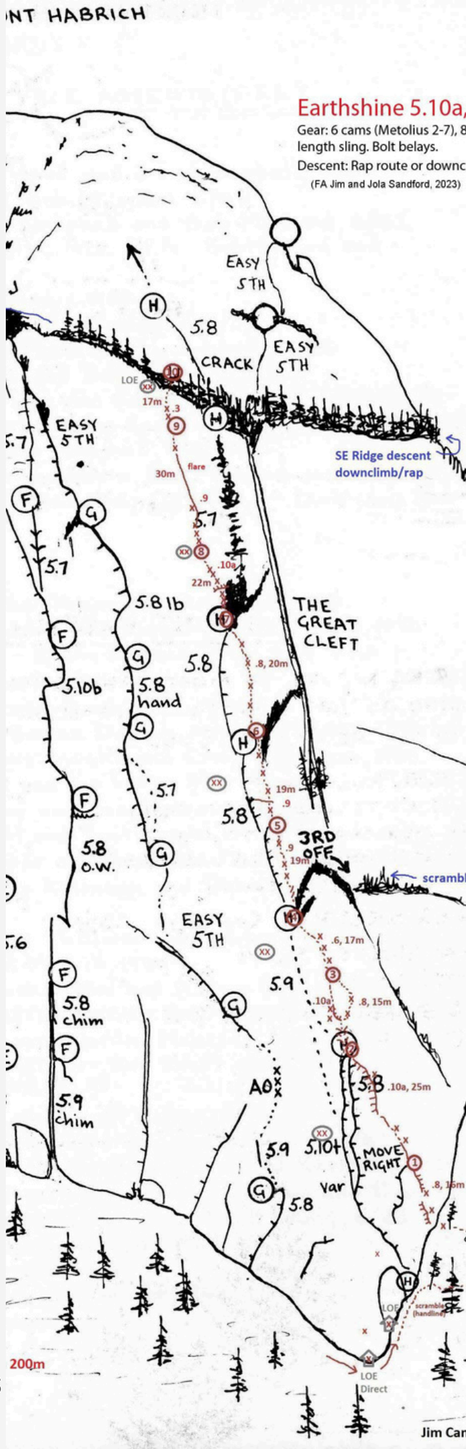
Example topo with photos

https://pizbube.ch/en/shop/escalades-a-presles/

Sport climbing is a very popular sport especially in mountain regions. The climbing routes are marked by metal rings set vertically every few meters on the rock. In order to determine the levels and locations of routes, special topographies (*topos*) are used.

With the current form of topos, finding a particular route can often be difficult and time-consuming.

How could using an AR application impact the sport climbing route localization speed and accuracy compared to a regular topography?



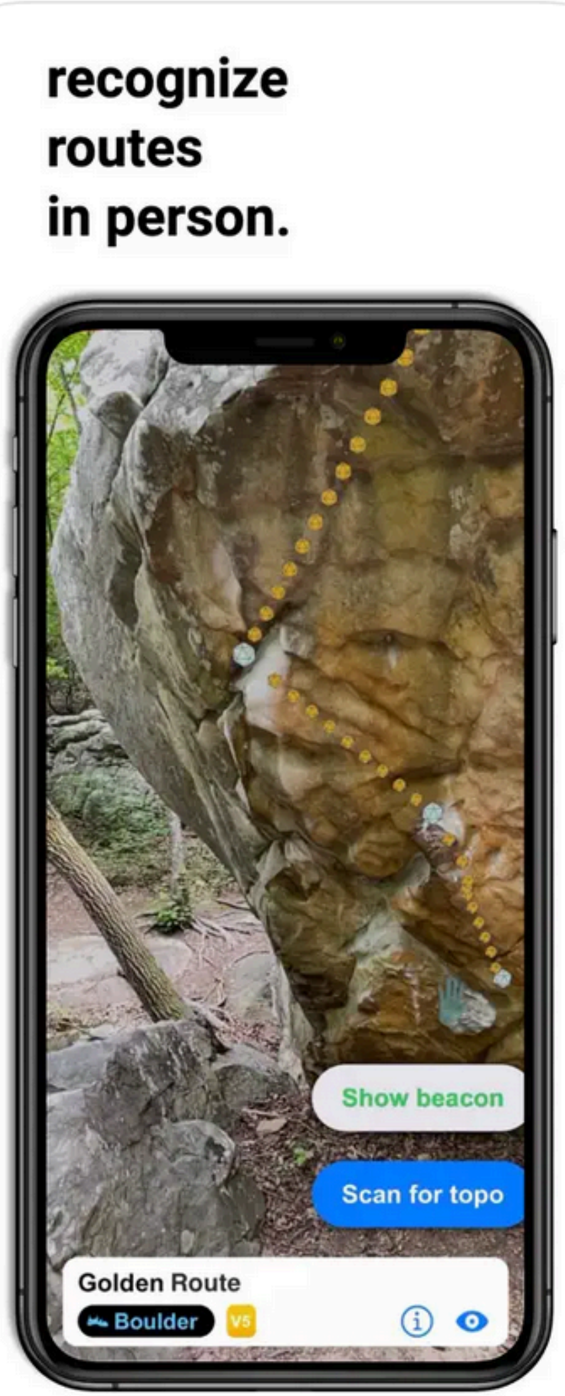
Example topo with drawings

https://quickdrawpublications.com/free-topos/

Related work

2D PDF TOPOS	3D MODEL TOPOS	AR-BOULDERING
Change of only the document format - from paper to electronic one.	3D scans of the rocks instead of photos on smartphone.	Two apps: theclimbingguide and ClimbAR. Using AR to show the scanned rock or for bouldering.

The novelty of our idea includes the use of AR technology to show the sport climbing routes according to the placement of the rings.

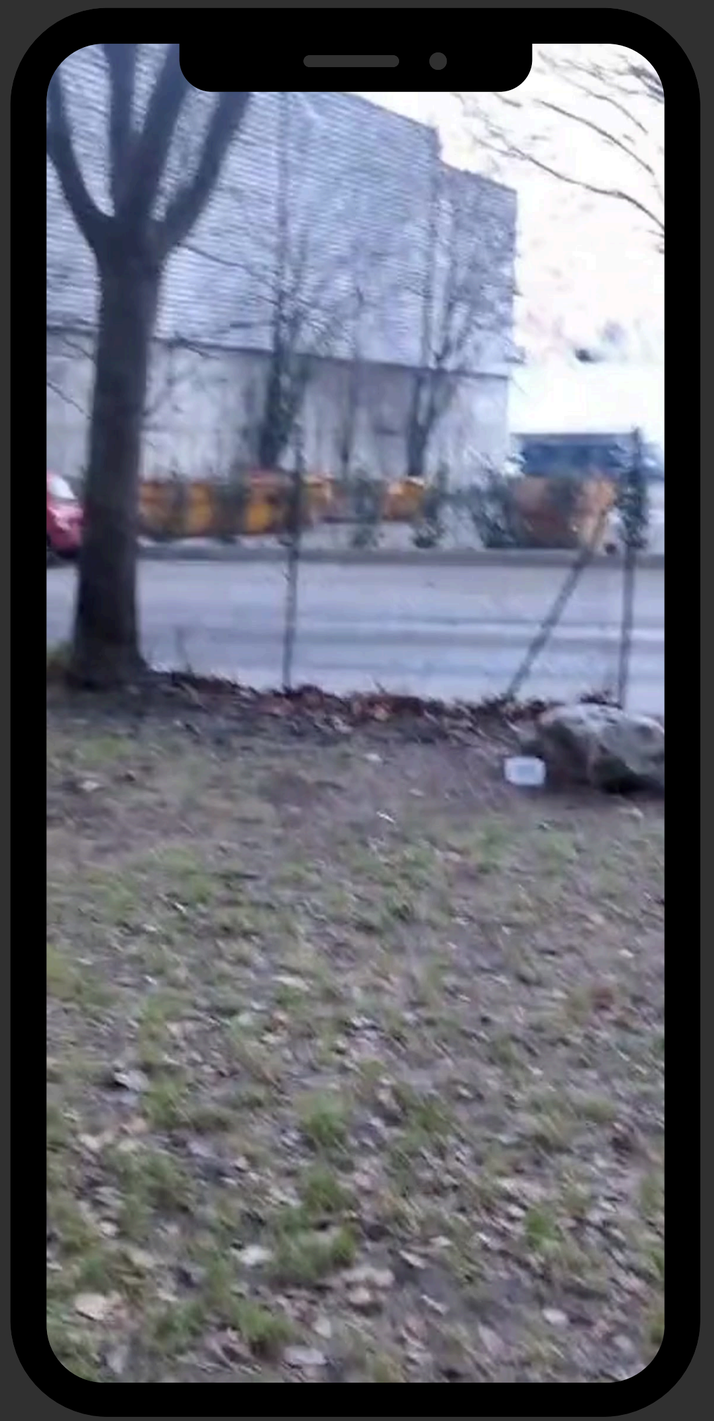


https://apps.apple.com/us/app/the-climbing-guide-3d-topos/id1567299645

Solution

OUR PROTOTYPE APP

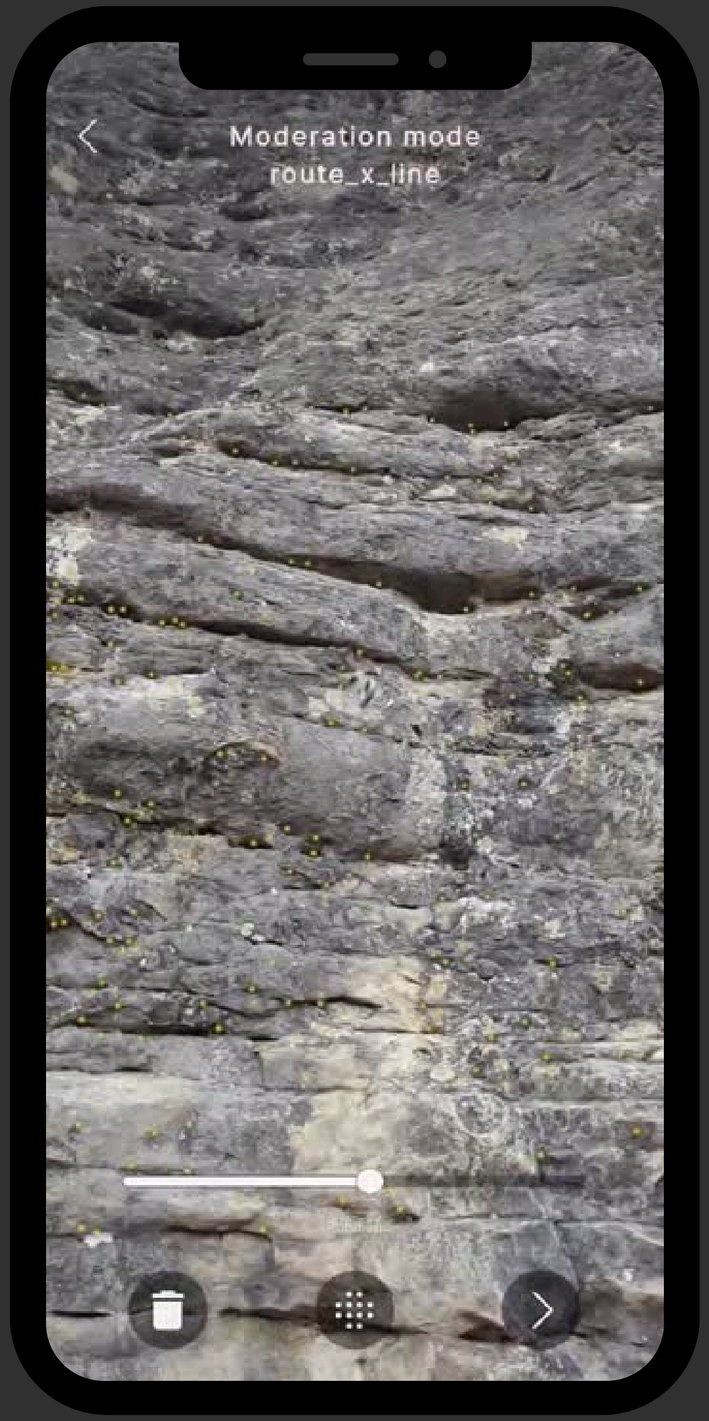
- Written in Unity (with AR-Foundations)
- User mode displays routes overlaid on the rock, but no UI



Moderator Mode

Used to set-up the experiment

- Manual placement of routes using AR-anchors
- Persistent anchors were not feasible



3D Rock Scanning

- **Challenge**: Get 3D-Models of climbing rock to model climbing-routes

- Attempt 1: Revopoint Pop 2 3D-Scanner (**Unsuccessful**)
- Attempt 2: Using Photogrammetry app (Polycam)

Experiments

1

PAPER TOPO

Find a particular route on the rock with a specially prepared topo.

2

AR APP

Find a similar route using our prototype.

3

SURVEY

Every participant was asked to fill in a short survey after the experiment.

4

VERBAL INTERVIEW

The participants also answered a few additional open questions.

Part 1: Time Measurements

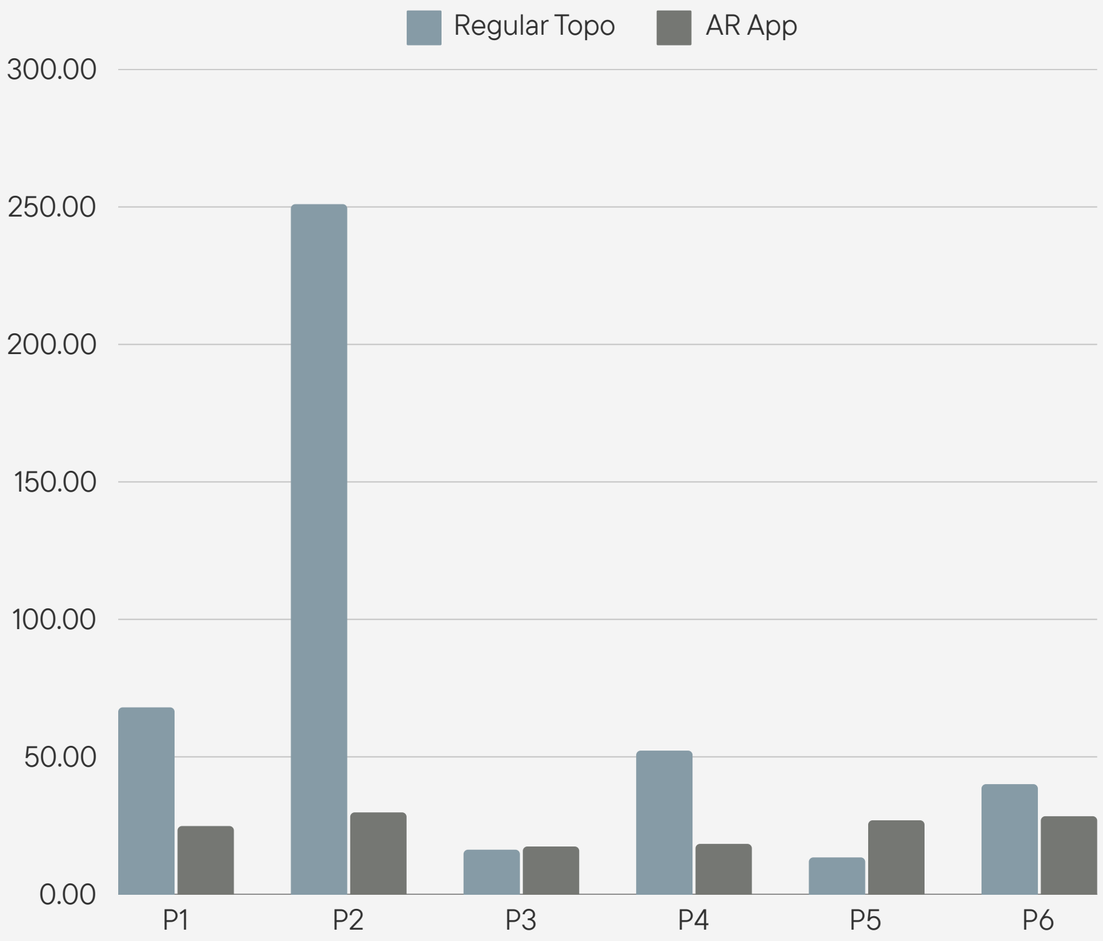
1st mode	2nd mode	1st route	2nd route
App	Regular Topo	Route B	Route A
App	Regular Topo	Route A	Route B
App	Regular Topo	Route B	Route A
Regular Topo	App	Route A	Route B
Regular Topo	App	Route B	Route A
Regular Topo	App	Route A	Route B

Time measurement scheme

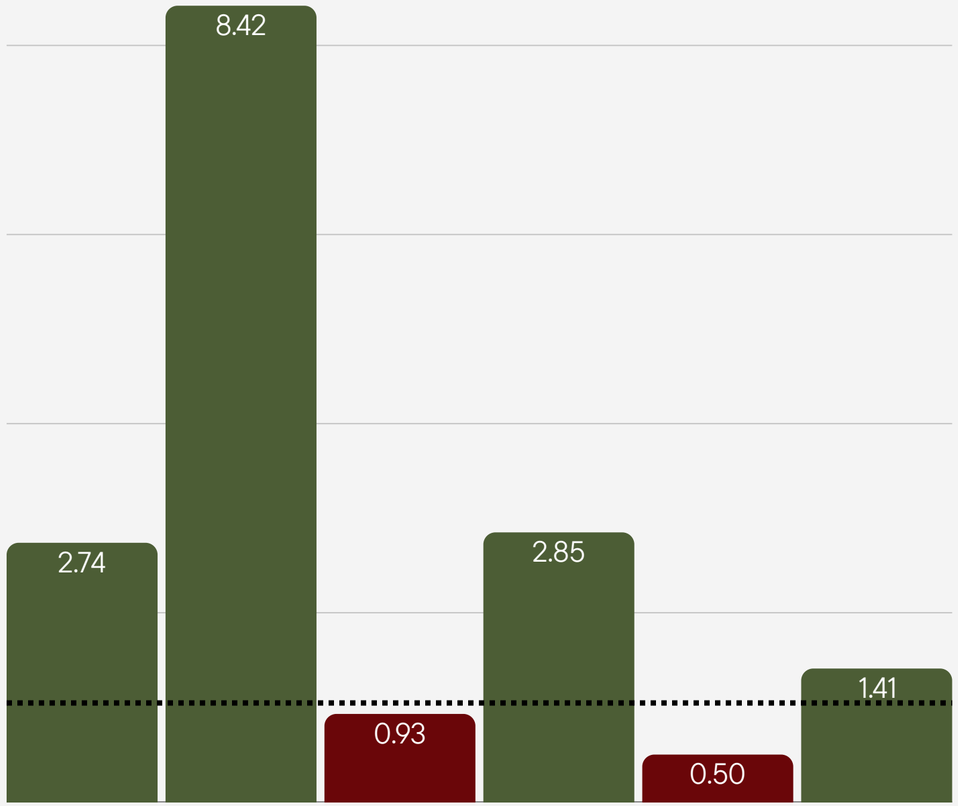
One of the topos prepared for the experiments

Part 1: Results

TIME MEASUREMENTS



SPEEDUP (TOPO SPEED / APP SPEED)



Part 2: Users’ feedback

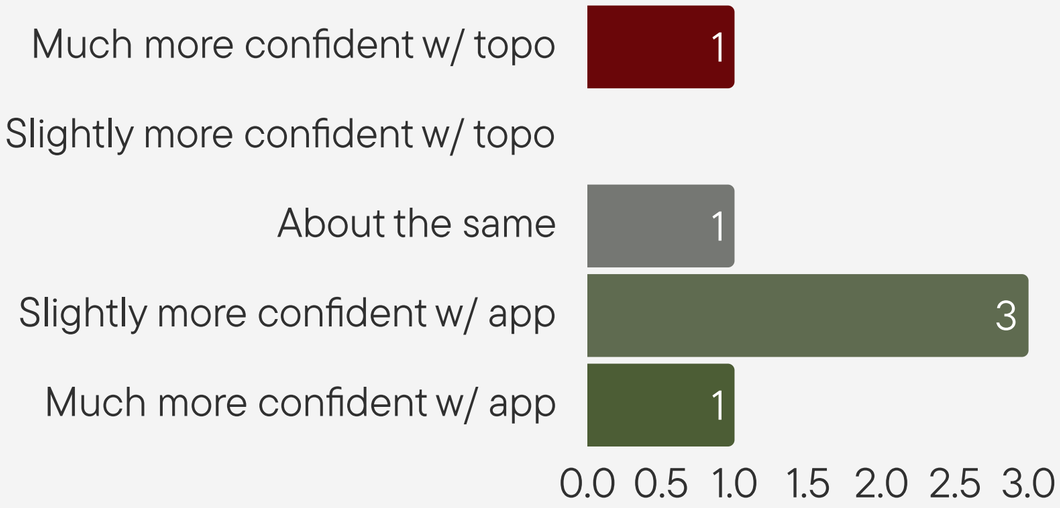
Survey:

- Demography
- Used a topo before?
- Perceived time and confidence (app vs. topo)
- Usability: Umux Lite [Lewis et al., 2015]

Verbal Interview:

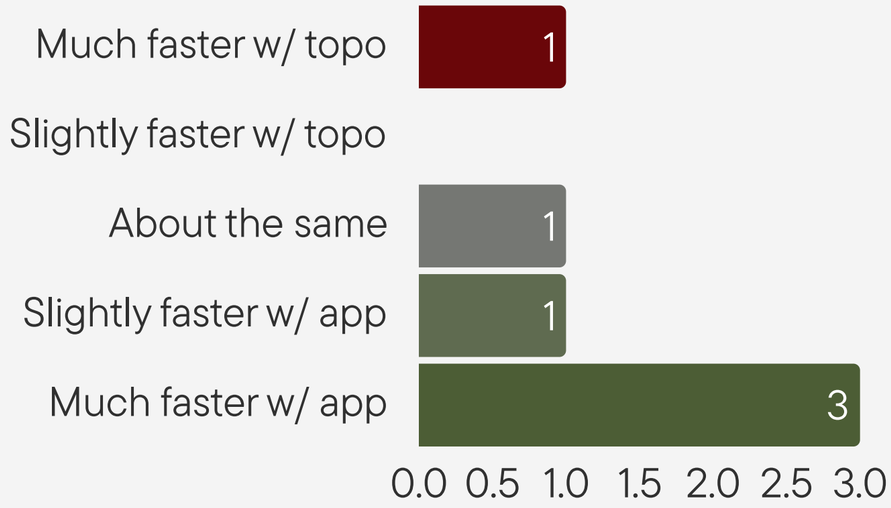
- Difficulties w/ each approach
- Strategies used to find routes
- What to improve about the app

Part 2: Results



CONFIDENCE IN ROUTE IDENTIFICATION

How confident were you about the identified route with each method?



PERCEIVED IDENTIFICATION TIME

Using which method you felt finding the route faster?

Survey Results

77.06

AVERAGE SUS-SCORE
(FROM UMUX-LITE)

What would you bring to the rock climbing site the next time you went there - a regular topo or the AR app?

1/6

BRING BOTH BUT MORE LIKELY TO USE A REGULAR TOPO

5/6

BRING BOTH BUT MORE LIKELY TO USE THE APP

Conclusions

Moving the regular climbing topo to the AR with a high probability could be a solution to time-consuming and often nonefficient classic route finding.

We developed a prototype of an app that enables the user to see the route explicitly on the rock and conducted experiments.

However, for that solution to be widely accessible and used it would need to be extremely large-scaled.

References

John Dallas Cast, Alejandro Martin-Gomez, and Mathias Unberath. ClimbAR: Collaborative Augmented Reality for Climbing Applications. 2024 IEEE Conference on Virtual Reality and 3D User Interfaces Abstracts and Workshops (VRW), pages 795–796, 2024. URL: https://api.semanticscholar.org/CorpusID:270097032.

Lewis, James R., Brian Utesch and Deborah E. Maher. “Measuring Perceived Usability: The SUS, UMUX-LITE, and AltUsability.” International Journal of Human-Computer Interaction 31 (2015): 496 - 505.

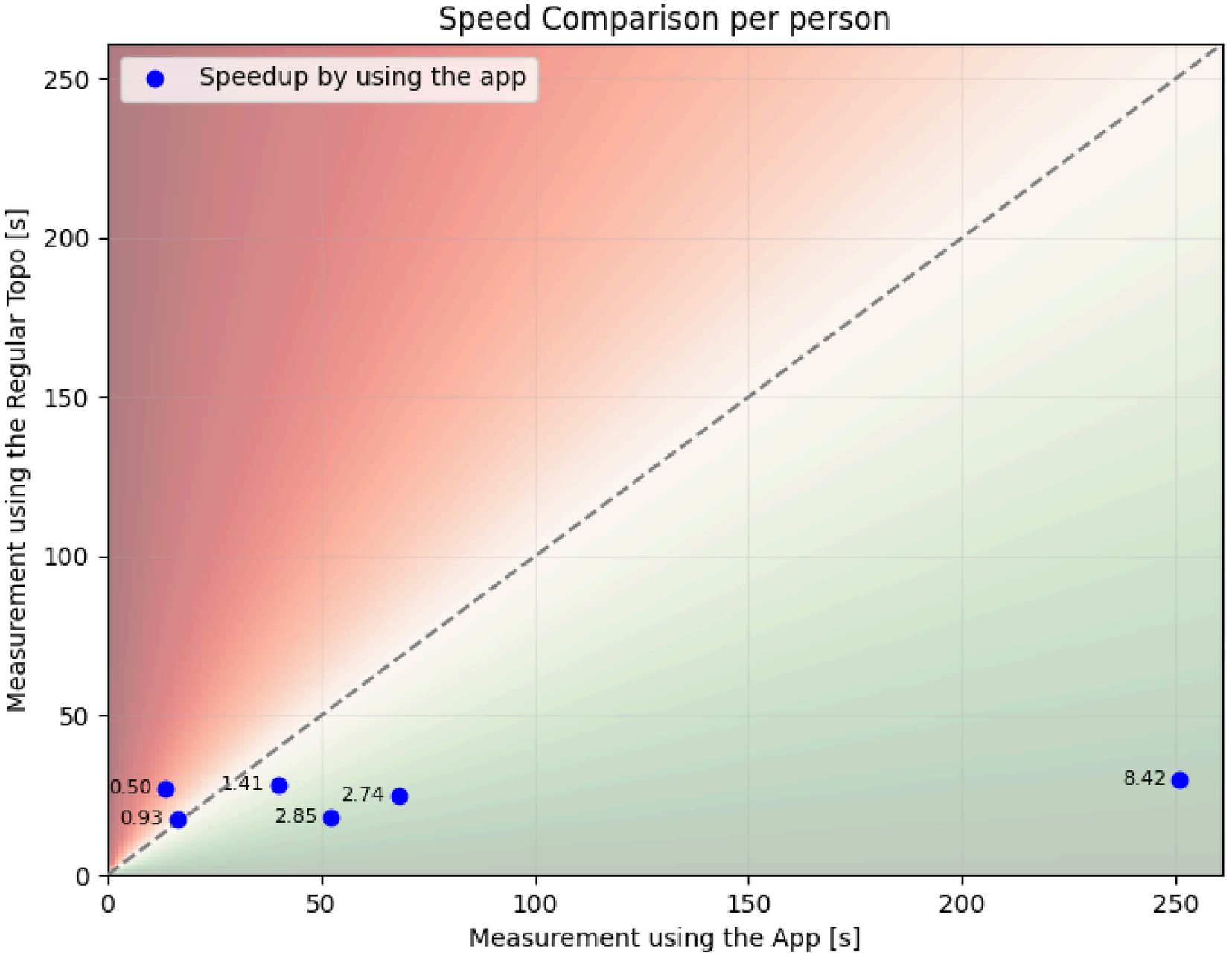
Thank you for your attention

Extra Slides 🐳

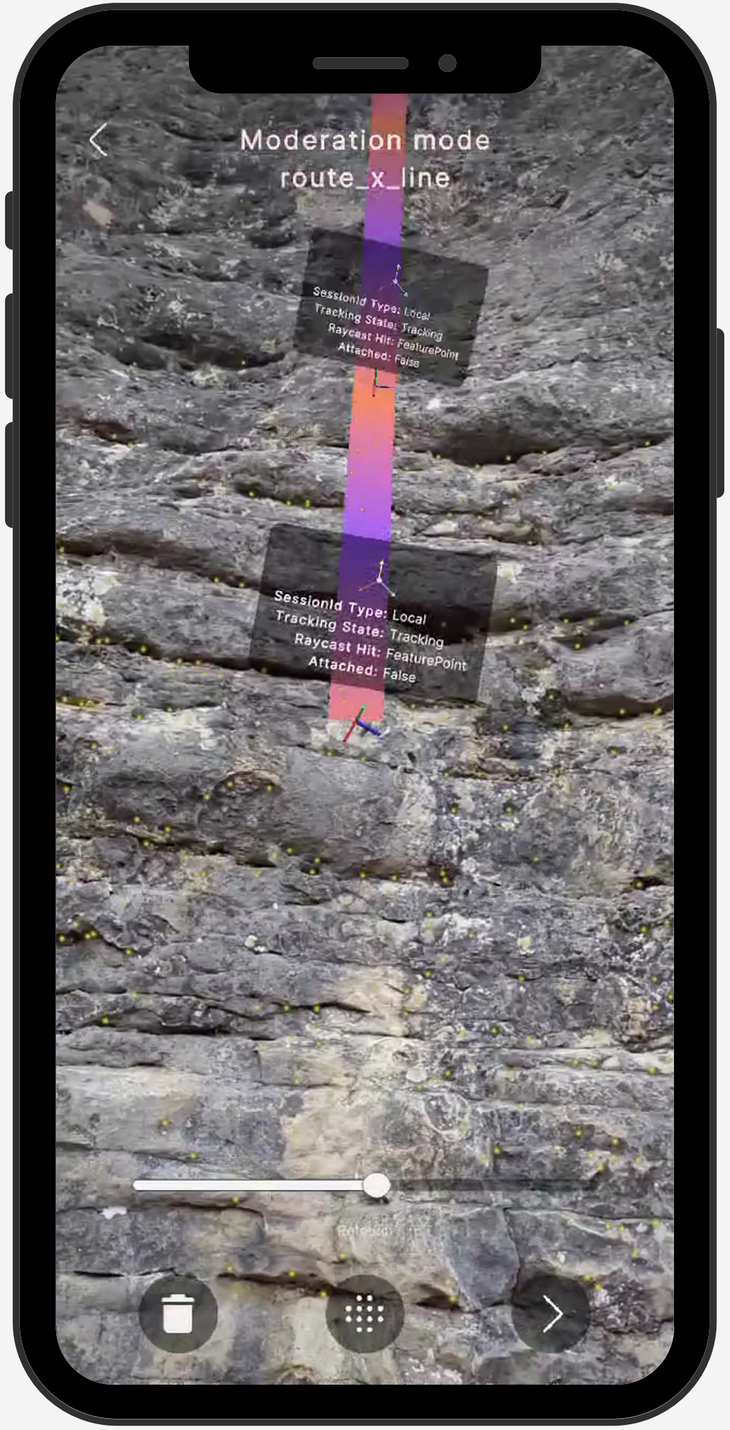
To compare **measured speedup** (continouus) with **perceived speedup** (categorical), we categorized the measured speedup by binning:

$[-\infty, 0.5]$ --> Much faster using the topo
$(0.5, 0.85]$--> A bit faster using the topo
$(0.85, 1.25]$ --> About the same time
$(1.25, 2]$ --> A bit faster using the topo
$[2, \infty]$ --> Much faster using the topo


Comparison of Measured vs Perceived Speedup
Much faster using the app
A bit faster using the app
About the same time
A bit faster using the topo
Much faster using the topo
Speedup Category
2.74
8.42
0.93
2.85
1.41
0.50
Perceived Speedup
Measured Speedup
P1
P2
P3
P4
P5
P6
Participants


Speed Comparison per person
Speedup by using the app
Measurement using the Regular Topo [s]
Measurement using the App [s]
0
50
100
150
200
250
0.50
0.93
1.41
2.85
2.74
8.42

Tracking accuracy



https://docs.google.com/spreadsheets/d/13TTglUlgiahB0xxcfLQAWCUwBigNIB7ArSNU8OWfHoU/edit?usp=sharing