Seeing Through Augmented Reality

Steven Feiner

Computer Graphics & User Interfaces Lab
Department of Computer Science
Columbia University
New York, NY 10027

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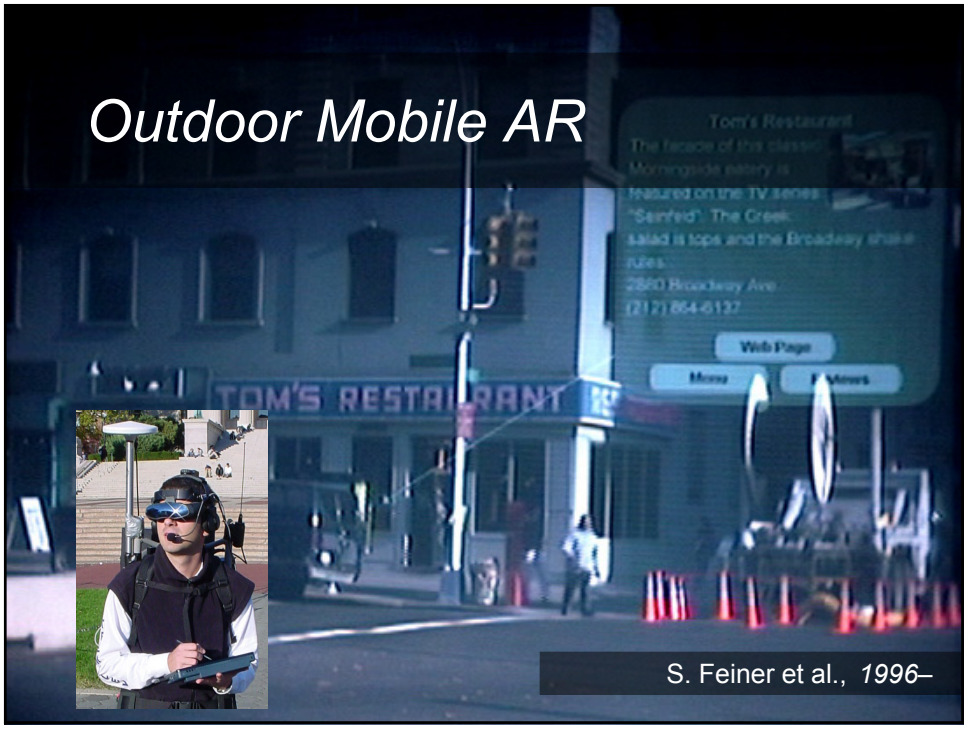
Qualcomm Augmented Reality Lecture Series
TU Wien, Vienna, Austria, August 22, 2013

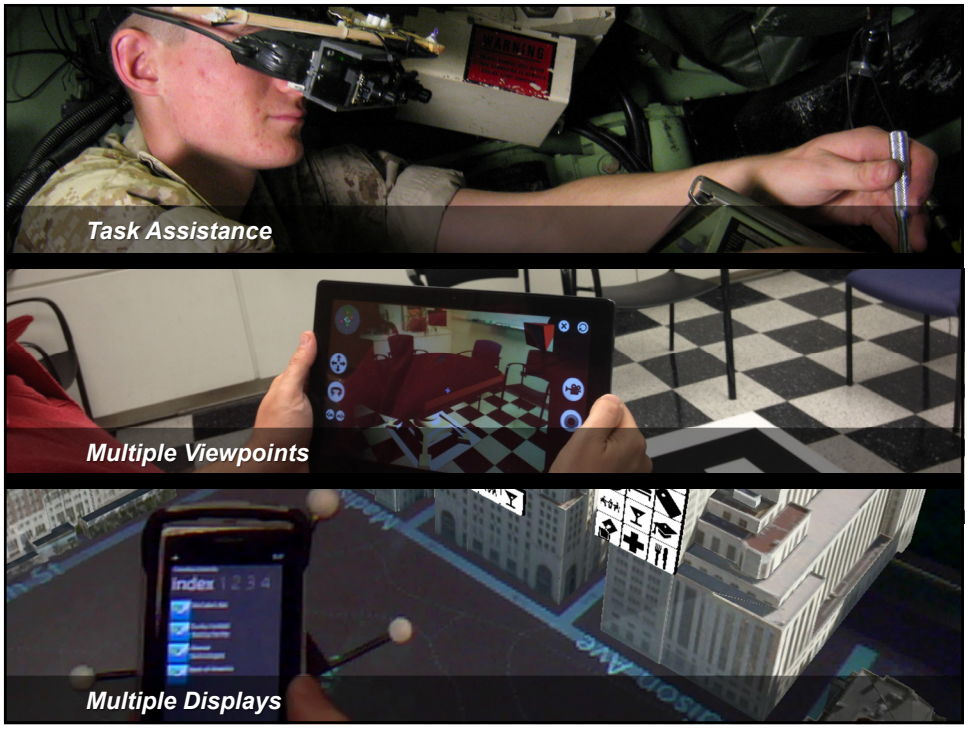
Outdoor Mobile AR




Outdoor Mobile AR
Dodge
Earl
S. Feiner et al., 1996–

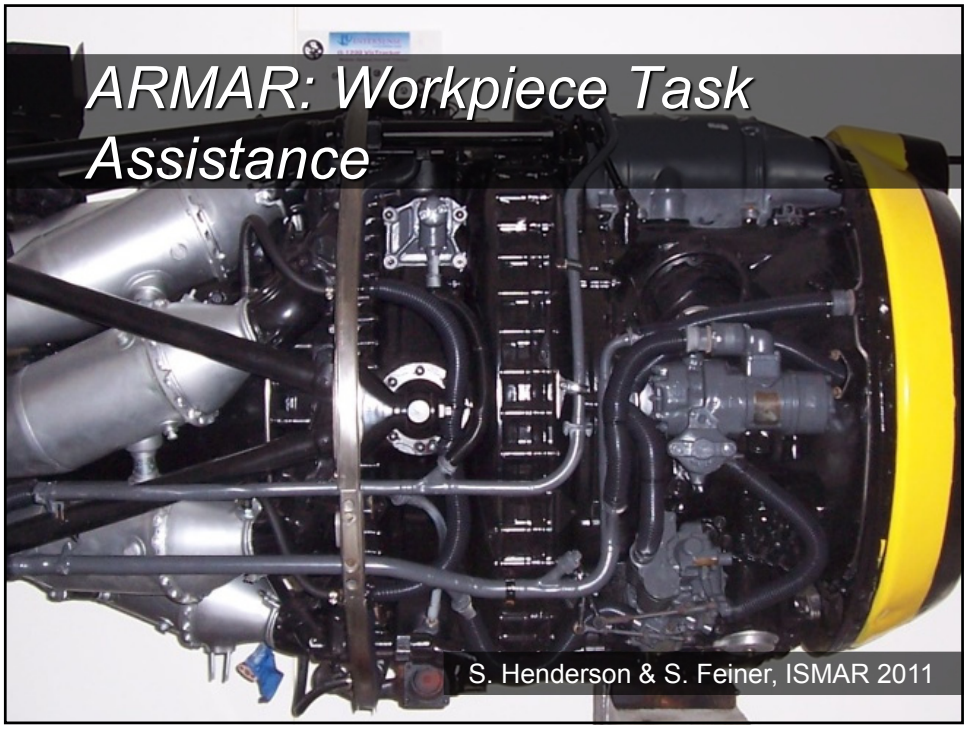

Situated Visualization
VAIO
SONY
S. White & S. Feiner, CHI 2009


Games: FarmAR
0
100
10/50
O. Oda & M. Sukan, 2011


Task Assistance
Multiple Viewpoints
Multiple Displays


Task Assistance
1991–1993
Install strut 11. Then scan it.
1996–1997
TASK: INSPECT OIL PRESSURE SENSOR
RECORD SENSOR CONDITION USING BUTTON PANEL
TOUCH NEXT TO CONFIRM AND CONTINUE
OIL PRESSURE SENSOR
SERVICEABLE
LEAKING
DAMAGED
MISSING
2007–2008
2008–2009


ARMAR (Augmented Reality for Maintenance and Repair)
WARNING
S. Henderson & S. Feiner, ISMAR 2009



ARMAR: Workpiece Task Assistance

S. Henderson & S. Feiner, *IEEE ISMAR 2011*

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ARMAR: Workpiece Task Assistance

S. Henderson & S. Feiner, *IEEE ISMAR 2011*

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ARMAR: Workpiece Task Assistance Study

- Is AR better than conventional (computer) documentation?
  - Assemble aircraft engine combustion chamber
  - Select bottom and top, align correctly, pin

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ARMAR: Workpiece Task Assistance Study

- Within-subject
- Counterbalanced start condition: AR, LCD
- Randomized chamber bottom/top, pairs of holes

AR Condition

LCD Condition

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ARMAR: Workpiece Task Assistance Study: AR Condition

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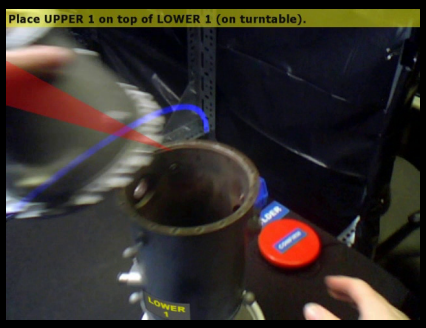
ARMAR: Workpiece Task Assistance Study: AR Condition

- Source/destination bin highlights
- Motion paths



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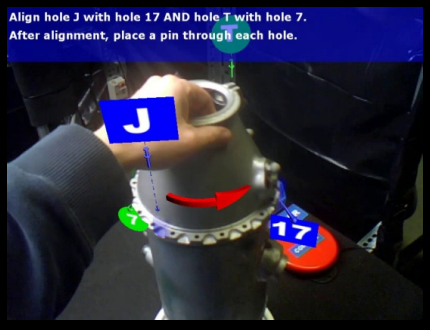
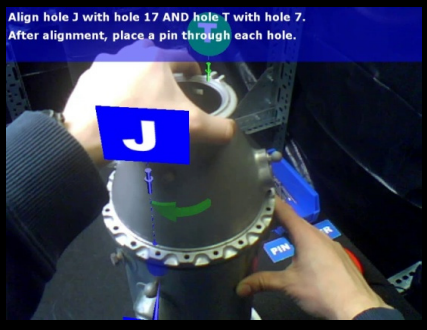
ARMAR: Workpiece Task Assistance Study: AR Condition

- Prescriptive 3D arrows
- Billboarded labels





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ARMAR: Workpiece Task Assistance Study: AR Condition

- Alignment highlights

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ARMAR: Workpiece Task Assistance Study: AR Condition

Optical See-Through HWD

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ARMAR: Workpiece Task Assistance Study: LCD Condition

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ARMAR: Workpiece Task Assistance Study: Experiment Design

- Formal study (22 participants, 6 female, ages 18–44 [avg 26.3], CU affiliates)
- Introduction + stereo vision test + 2 conditions × (instructional video + practice block + 14 trials) + post hoc questionnaire

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ARMAR: Workpiece Task Assistance Study: Results (α = .05)

- H1: AR faster for alignment/pinning (24.2s vs. 45.5s)
- H2: AR more accurate [aligned within .5 hole width] (95% vs. 62%)
- H3: AR preferred [ranked higher in questionnaire] (20 of 22)
- H4: AR more intuitive [ranked higher in questionnaire] (19 of 22)

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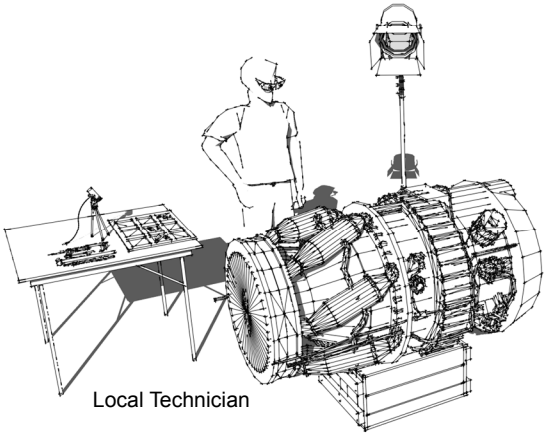
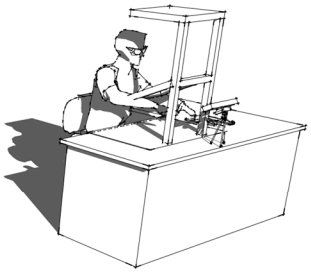
Remote Localization and Referencing in Collaborative AR



Local Technician

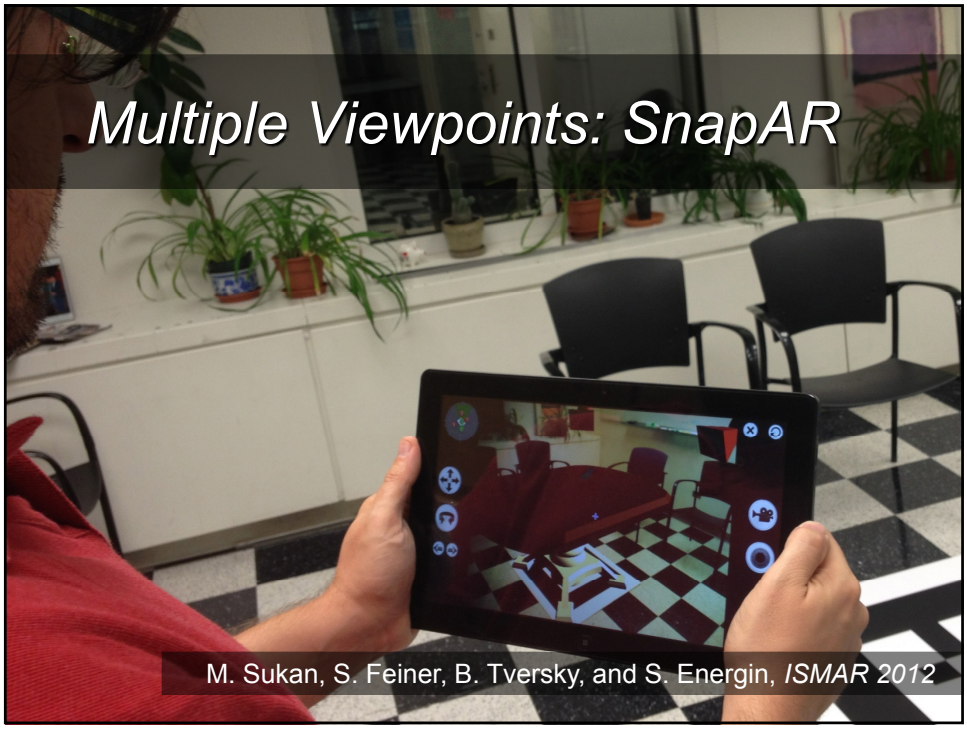


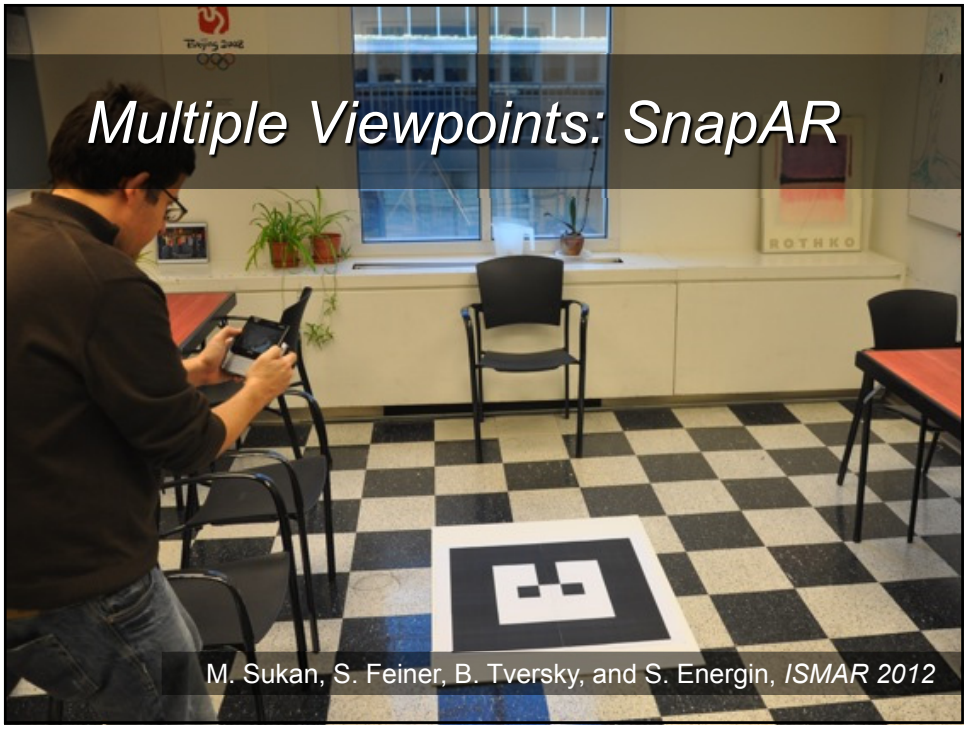
Remote SME

O. Oda, M. Sukan, S. Feiner, and B. Tversky, *3DUI 2013*


Remote Localization and Referencing in Collaborative AR
Remote SME View
CONFIRM
Local Technician View
O. Oda, M. Sukan, S. Feiner, and B. Tversky, 3DUI 2013


Remote Localization and Referencing in Collaborative AR


Multiple Viewpoints: SnapAR
M. Sukan, S. Feiner, B. Tversky, and S. Energin, *ISMAR 2012*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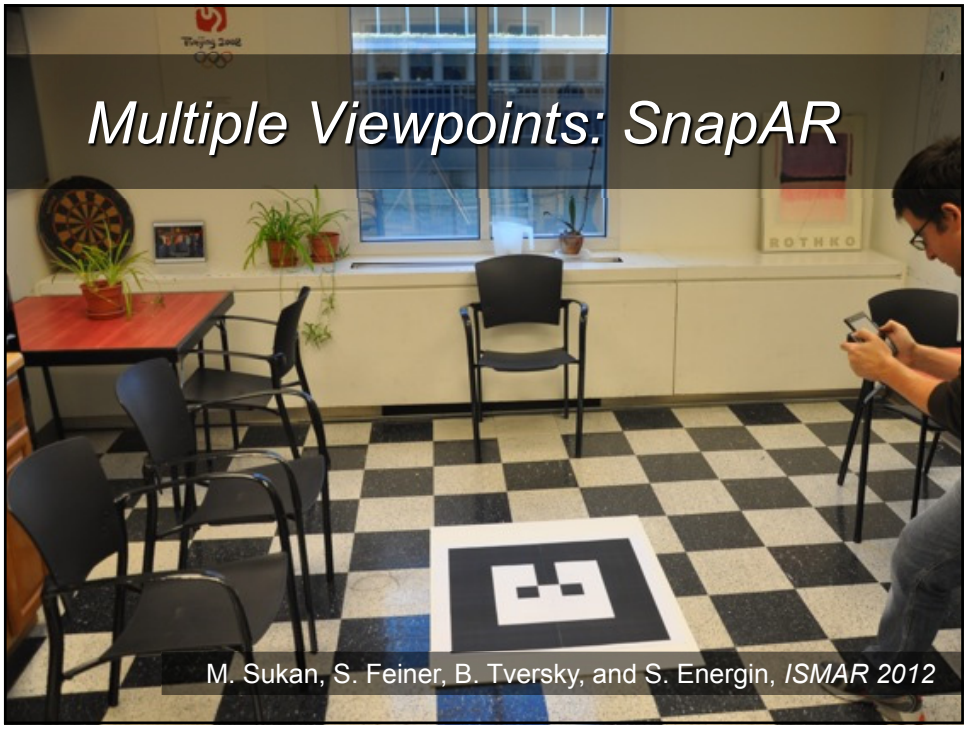
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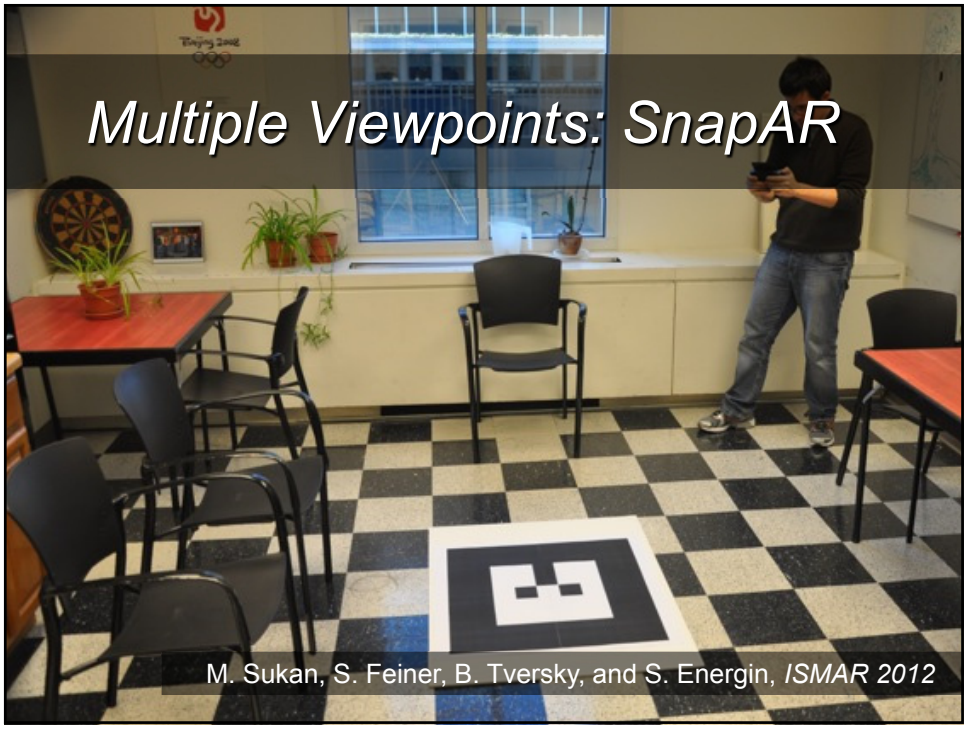
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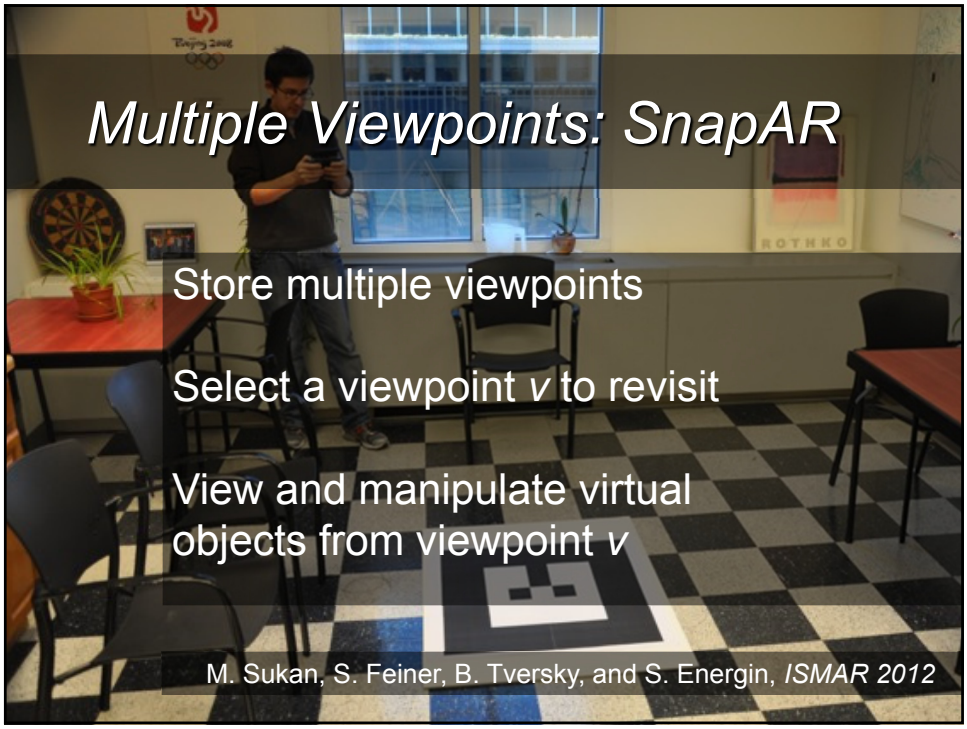

User Study Backstory

User Study Backstory

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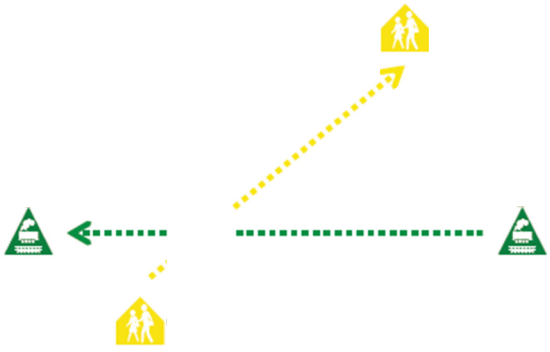
User Study Backstory



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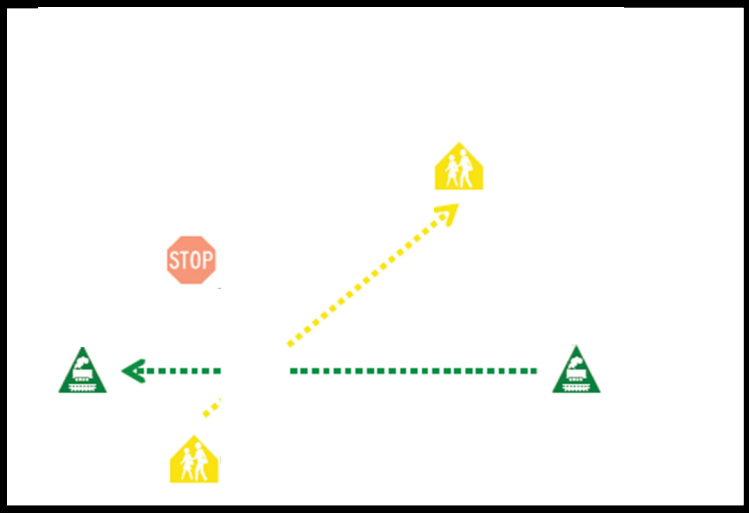
User Study Backstory



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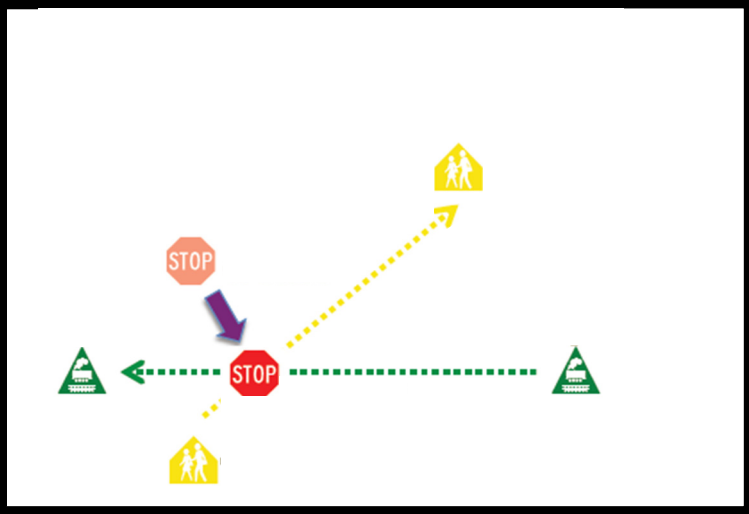
User Study Backstory



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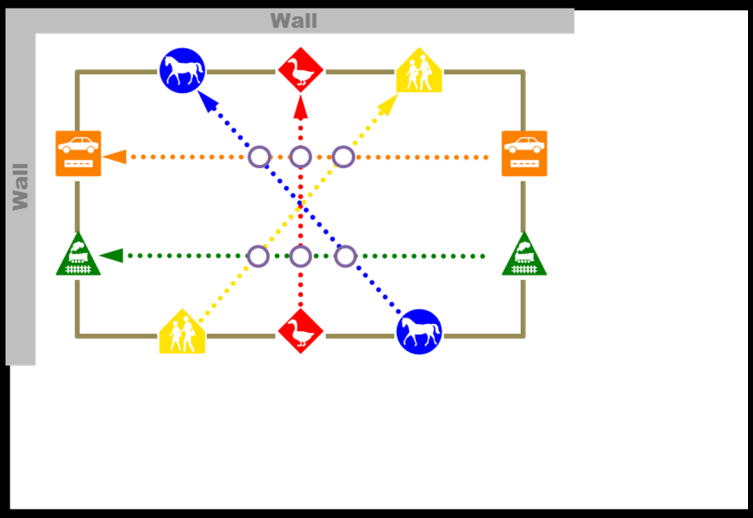
User Study Setup



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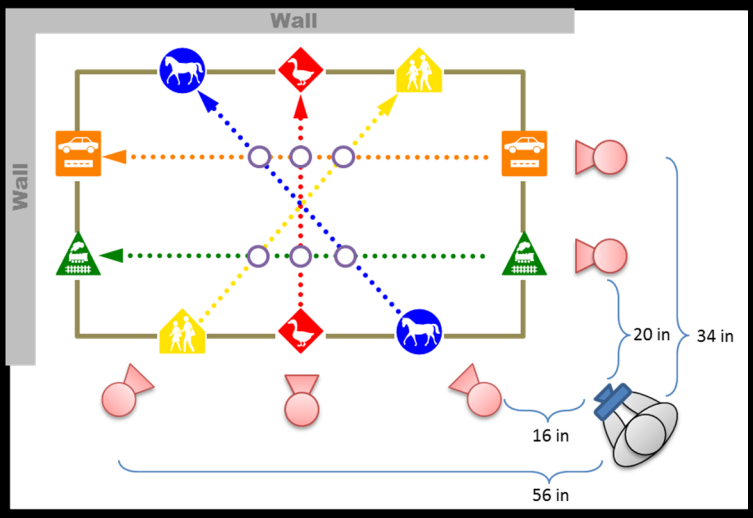
User Study Setup



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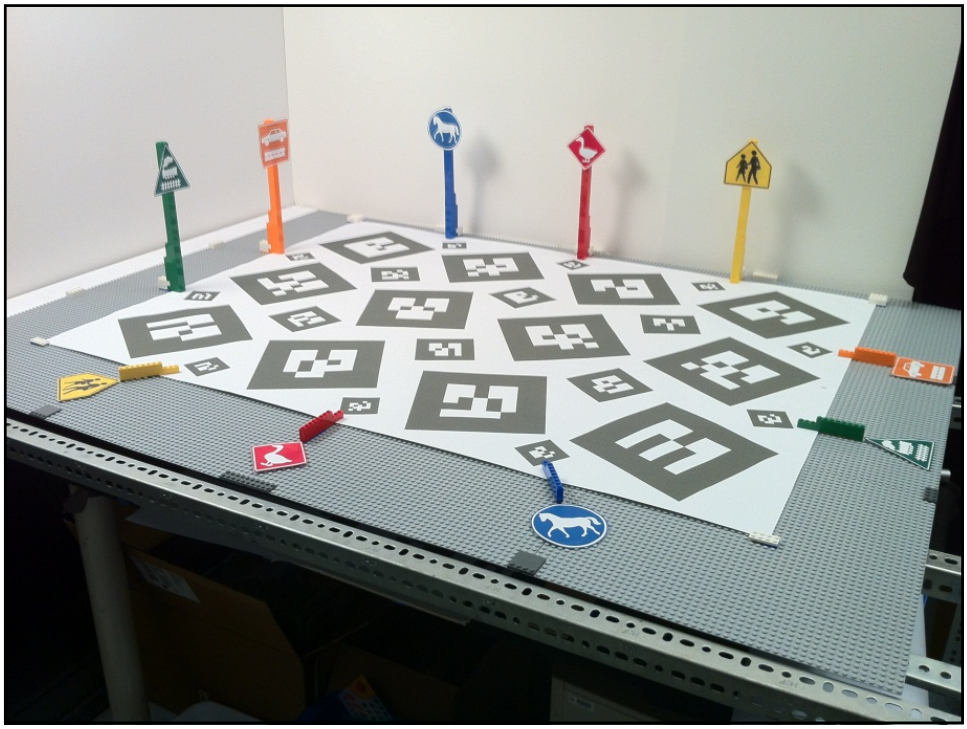
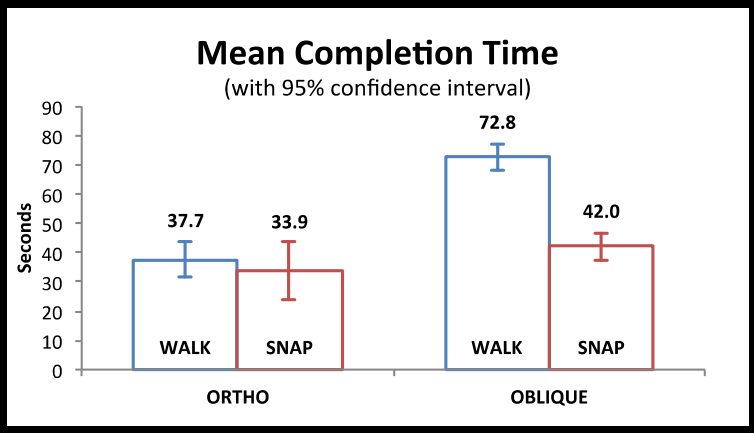


User Study Design

- Travel condition: SNAP, WALK
- Task difficulty: ORTHO, OBLIQUE
- 21 participants (CU affiliates, 8 female, age 19–40, $\bar{X}$ = 23.6)
- Within-subject

User Study Results



- SNAP significantly faster overall, esp. for OBLIQUE (# revisits higher)

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User Study Results

$$t_{Capture} < \underbrace{(t_{Walk} - t_{Switch})}_{\text{Saved time}} \times n_{revisits}$$

$$n_{revisits} > \frac{t_{Capture}}{t_{Walk} - t_{Switch}}$$ → Time saved overall

- $t_{Capture} \approx$ 54 secs for 5 snapshots
- $t_{Walk} - t_{Switch} \approx$ 30 secs for OBLIQUE, so faster after second OBLIQUE trial
- Time savings scale with usage/walking time

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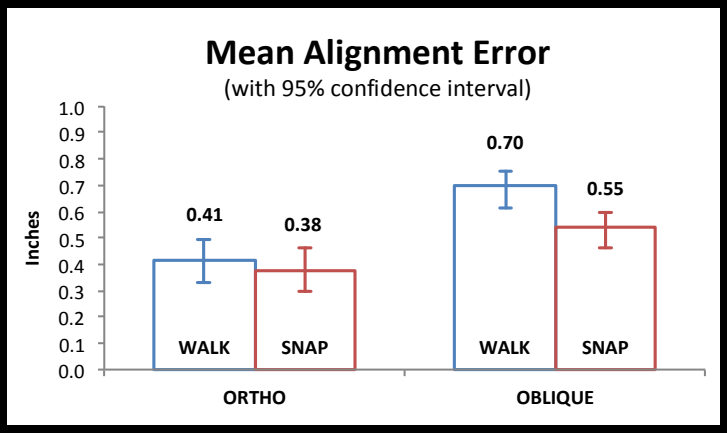
User Study Results



- SNAP significantly more accurate overall, esp. for OBLIQUE (more difficult)

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User Study Results

- Questionnaire
  - 19 of 21 preferred SNAP over WALK
  - 17 of 21 rated SNAP less demanding than WALK

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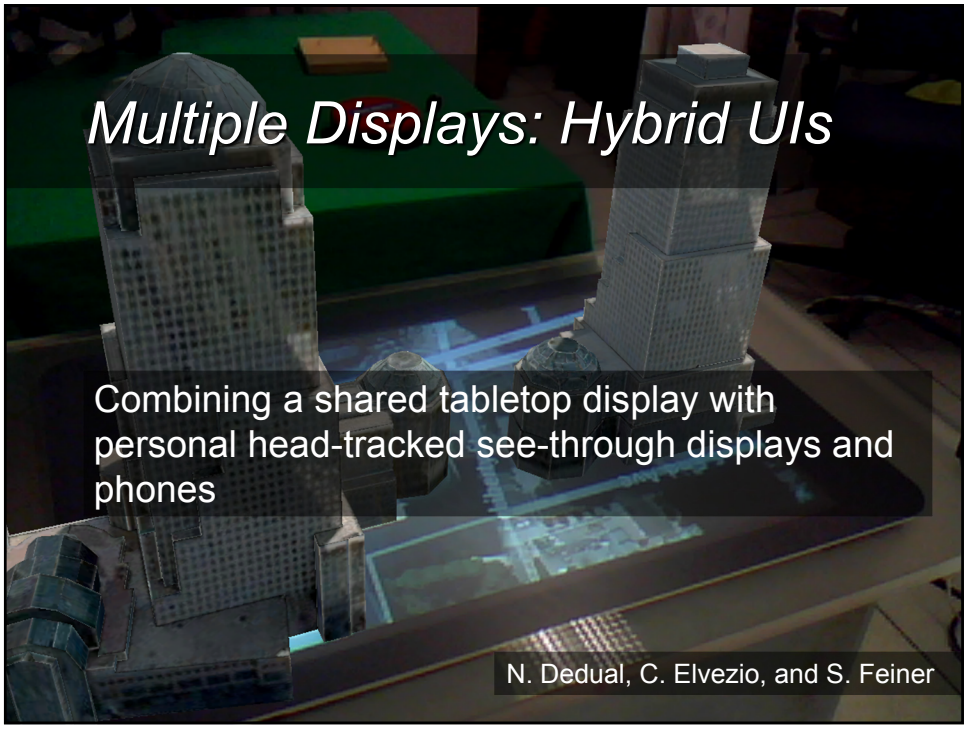
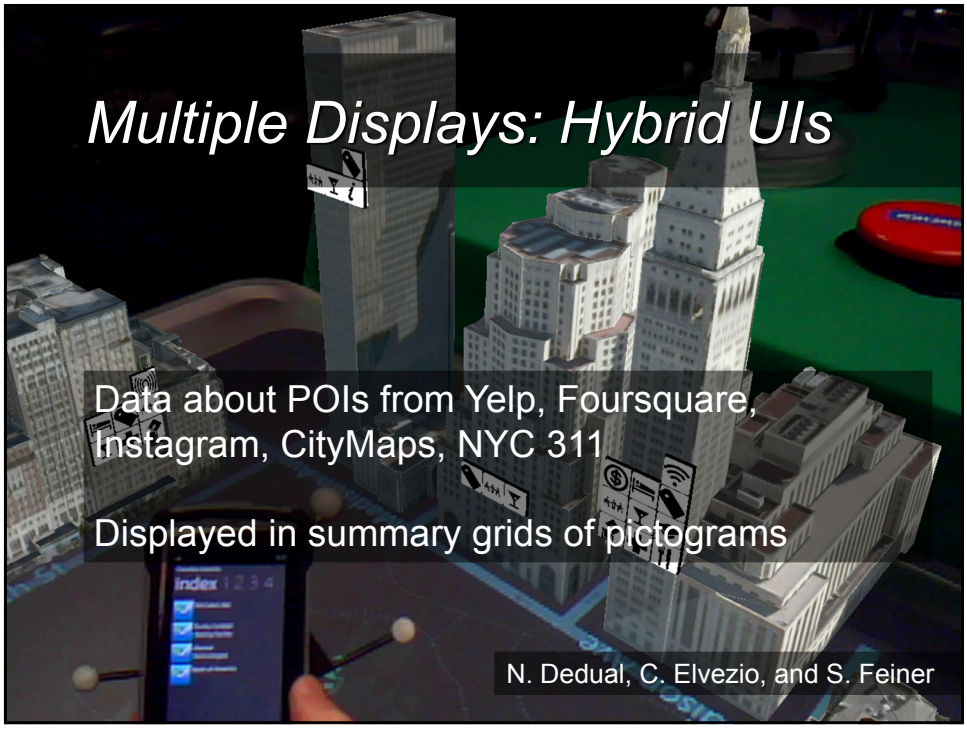
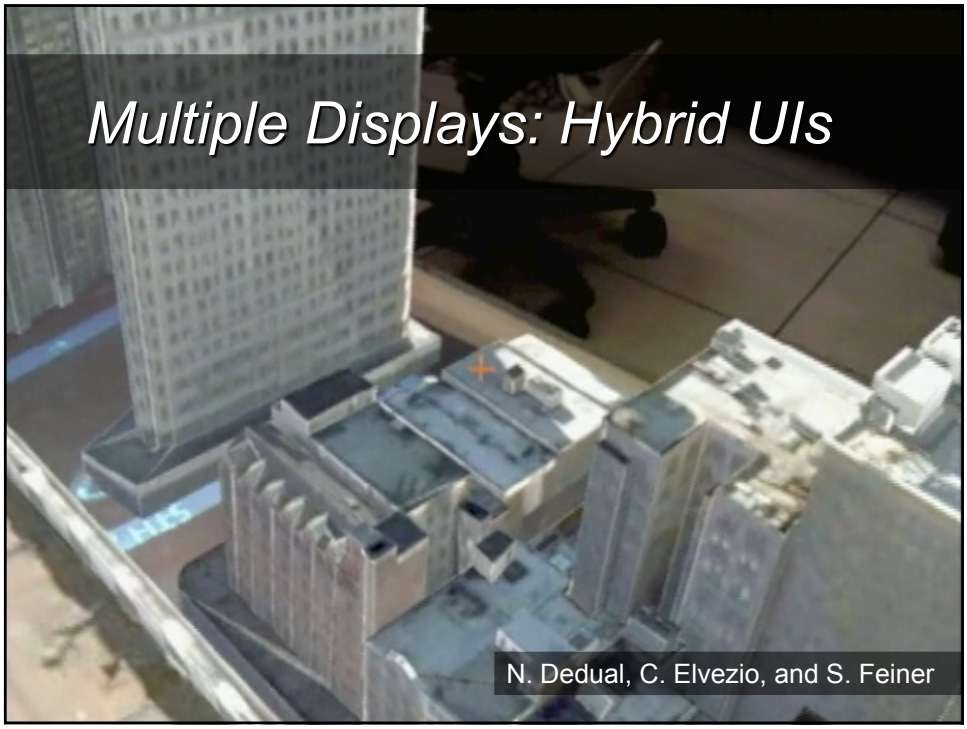

Multiple Displays: Hybrid UIs
Combining a shared tabletop display with personal head-tracked see-through displays and phones
N. Dedual, C. Elvezio, and S. Feiner


Multiple Displays: Hybrid UIs
Data about POIs from Yelp, Foursquare, Instagram, CityMaps, NYC 311
Displayed in summary grids of pictograms
N. Dedual, C. Elvezio, and S. Feiner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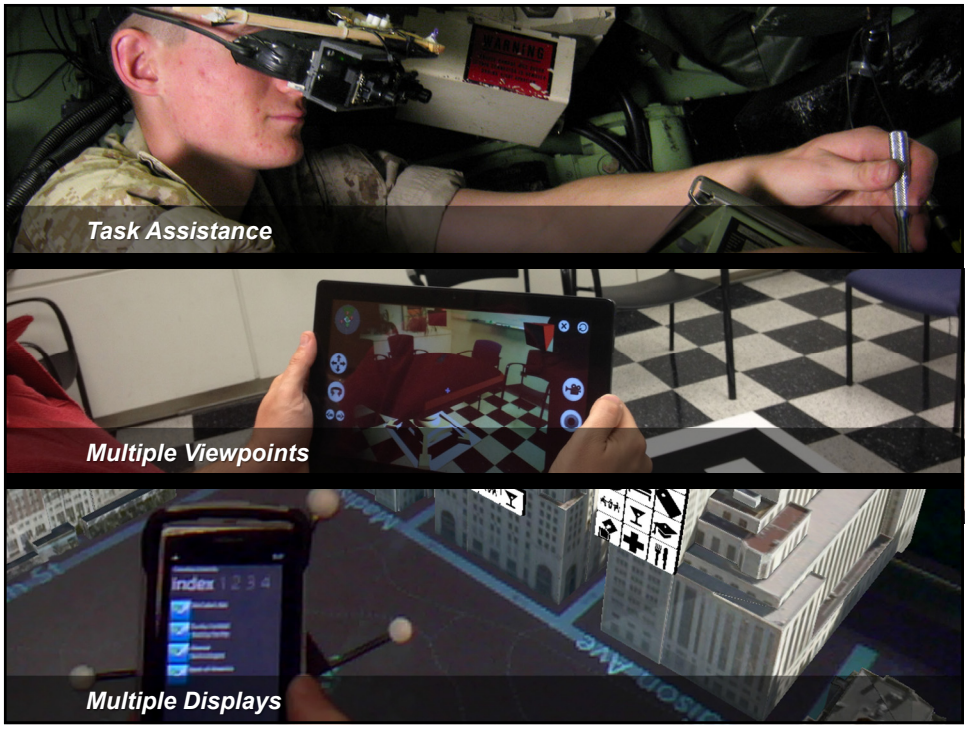
Task Assistance
Multiple Viewpoints
Multiple Displays

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- Mengu Sukan
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