



# Seeing Through AR (AR Longa, VR Brevis)

Steve Feiner  
Columbia University

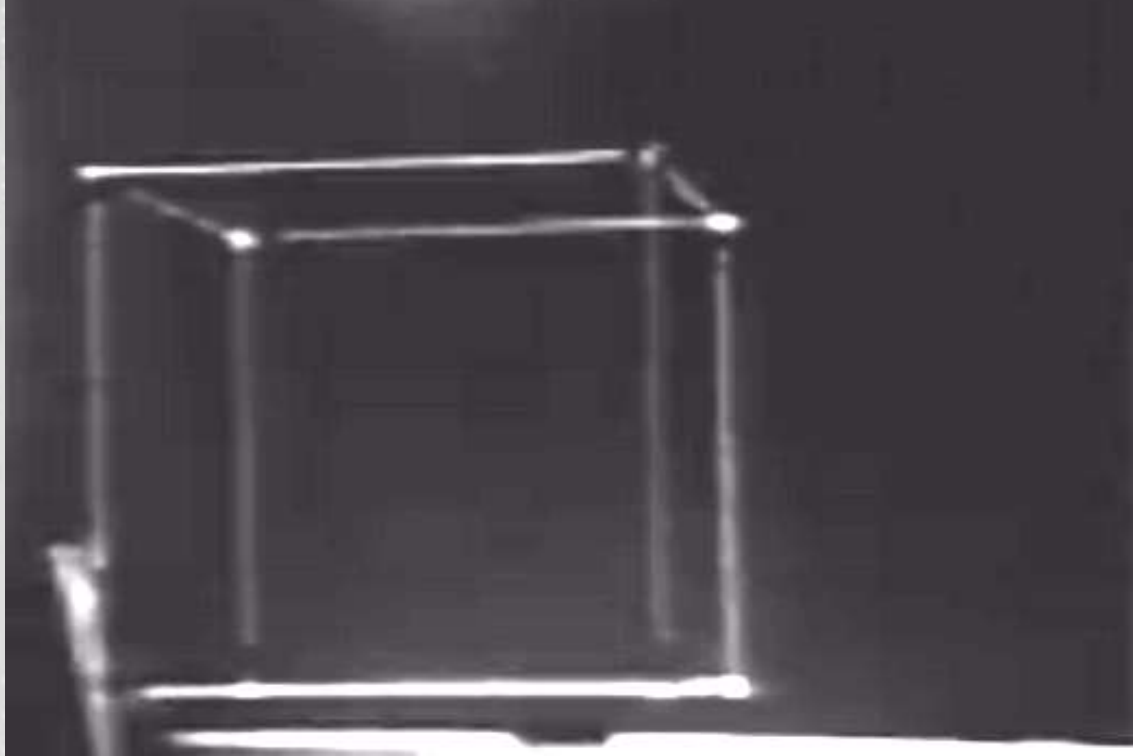


July 16, 2012

Supported in part by NSF, ONR, USMC, Raytheon,  
Institute for Information Industry, and gifts from Google,  
Microsoft, Nokia, VTT, Vuzix



# *45 Years of AR Research*



## Ivan Sutherland, Head-tracked VR/AR (Late 60s–early 70s)

- Stereo, head-tracked, optical see-through, head-worn display
- Graphics overlaid on real world

# 16 Years of Mobile AR Research



Columbia *Touring Machine* Backpack, 1996–

# 16 Years of Mobile AR Research

Dodge

Earl



Columbia *Touring Machine* Backpack, 1996–

Closest Object: SunDial

Tracking Mode: Accurate

# 16 Years of Mobile AR Research



Columbia *Touring Machine* Backpack, 1996–

# *Situated Visualization*



S. White and S. Feiner, *CHI 2009*

*Games*



O. Oda and M. Sukan, 2009–

# *Task Assistance*

A soldier in a camouflage uniform is shown in profile, wearing night vision goggles. He is focused on a piece of equipment, possibly a night vision device or a sensor, which is mounted on a larger piece of machinery. The scene is dimly lit, with some red lights visible in the background. The soldier's hands are visible, holding a tool or part of the equipment. The overall atmosphere is one of concentration and technical work in a dark environment.

S. Henderson and S. Feiner, 2009–



## STEP 2: Loosen #3 Fuel Line Clamp with the screwdriver

Once clamp is loose, disconnect the #3 Combustion Chamber Fuel Line

*ARMAR: AR for Maintenance and Repair*

**FUEL LINE 3**

**CLAMP  
SCREW**

# 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

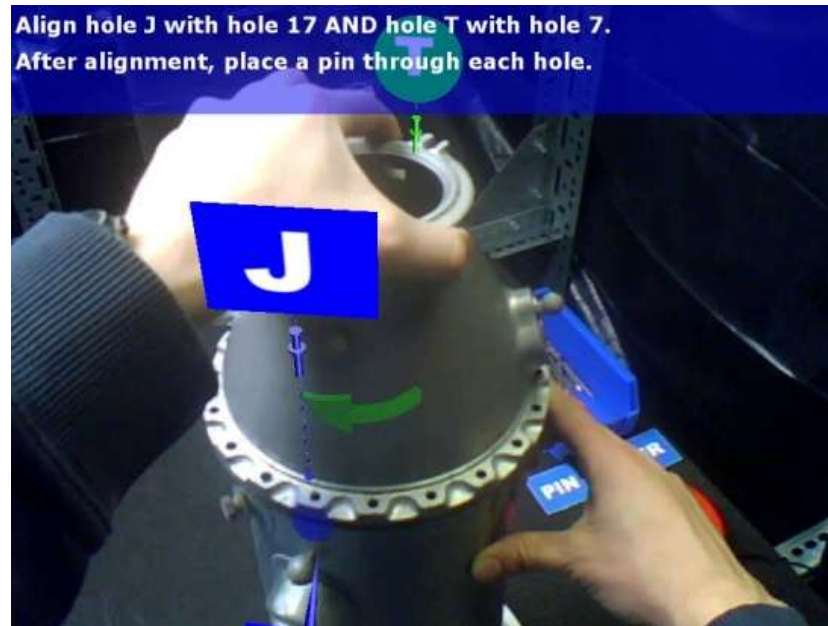
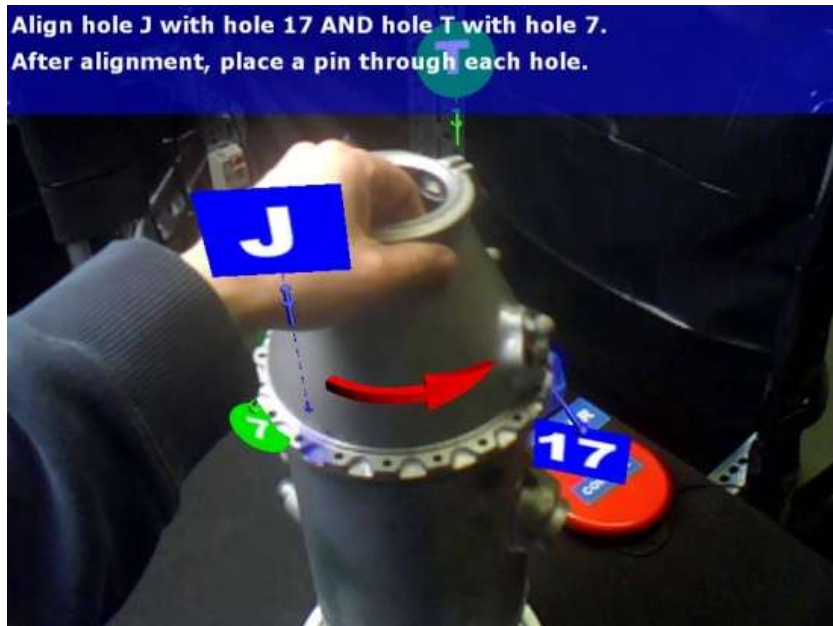
# ARMAR: Workpiece Task Assistance Study

- Source/destination bin highlights
- Motion paths



# ARMAR: Workpiece Task Assistance Study

- Prescriptive 3D arrows
- Billboarded labels

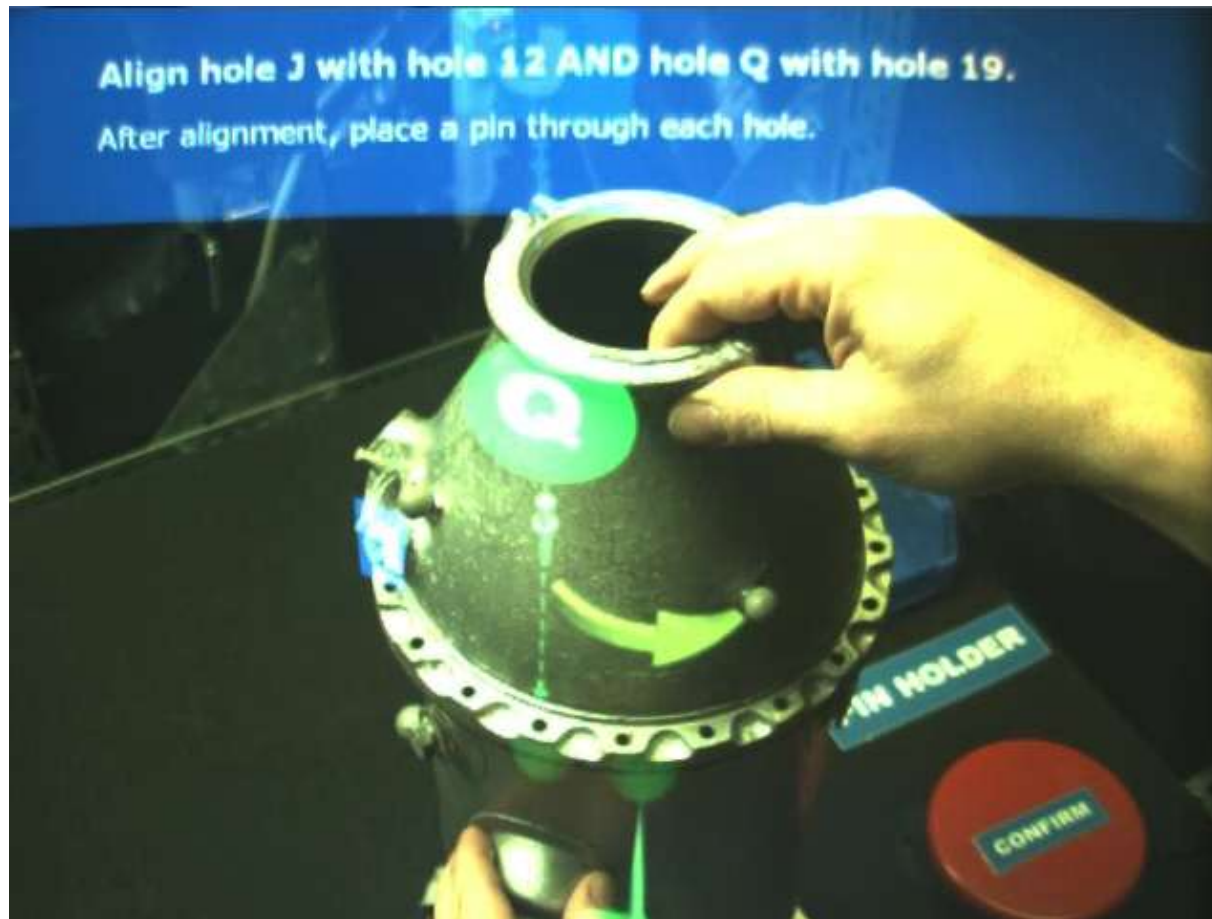


# *ARMAR: Workpiece Task Assistance Study*

- Alignment highlights



# *ARMAR: Workpiece Task Assistance Study*



# *ARMAR: Workpiece Task Assistance Study*

- Results of 22-participant formal study ( $\alpha = .05$ ):
  - 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)





# *Research Directions*

# *Overcoming the Handheld Lifestyle*



“Excuse me while I pull out my phone, turn it on, wait for it to start tracking, hold it at arm’s length,…”

# *Eyewear*



*Not This...*



*Or This...*



Google Glass prototype, 2012

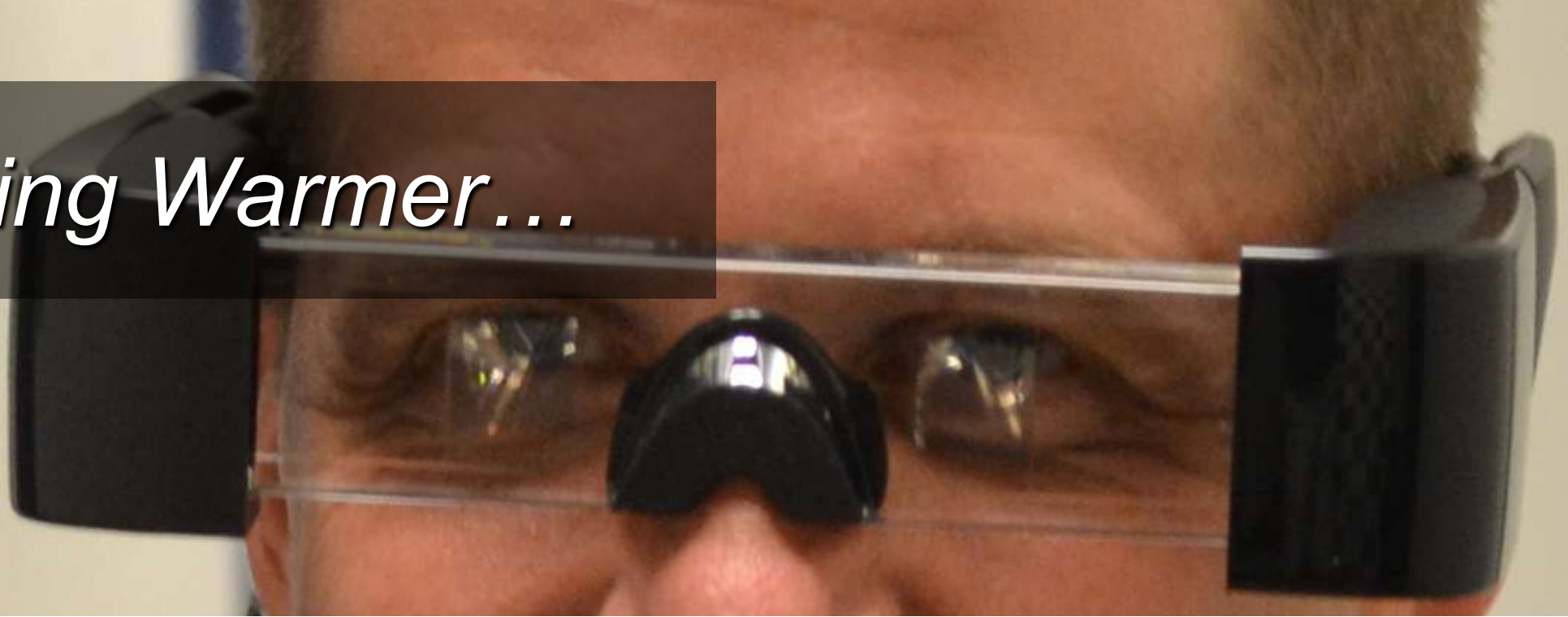


MicroOptical Corp. clip-on, late 20<sup>th</sup> C.



IBM Visionpad,,  
late 20<sup>th</sup> C.

*Getting Warmer...*

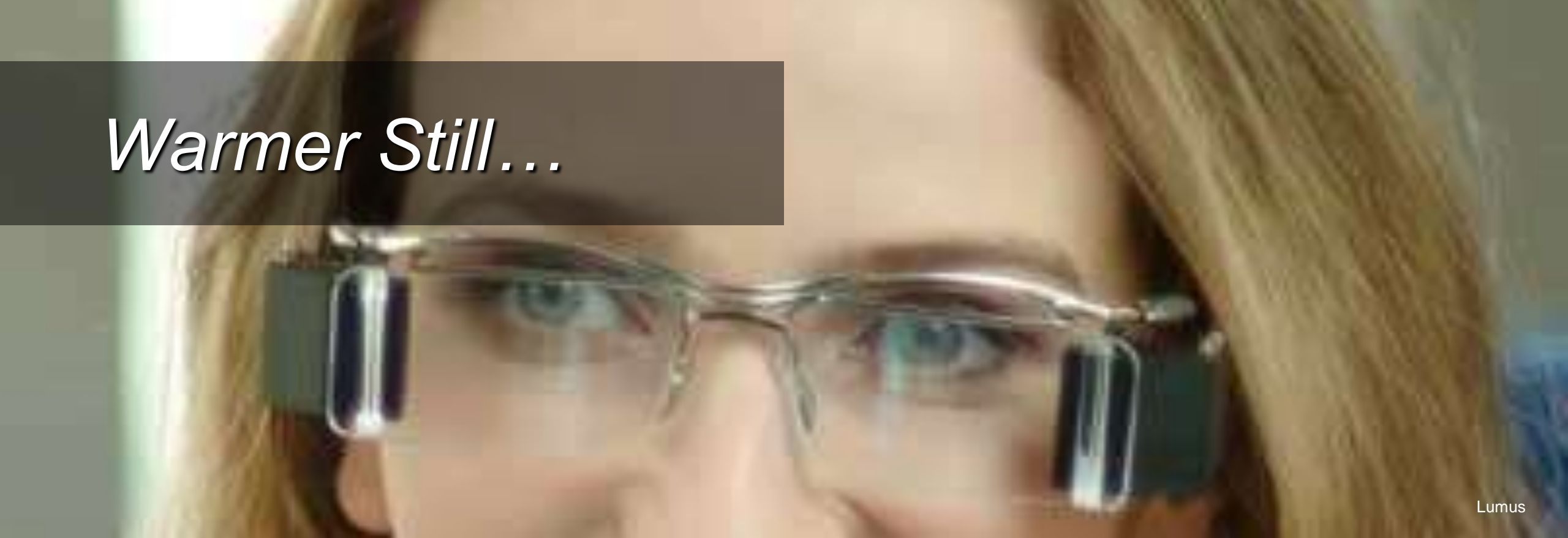


Epson



Vuzix

*Warmer Still...*



Lumus



Sony

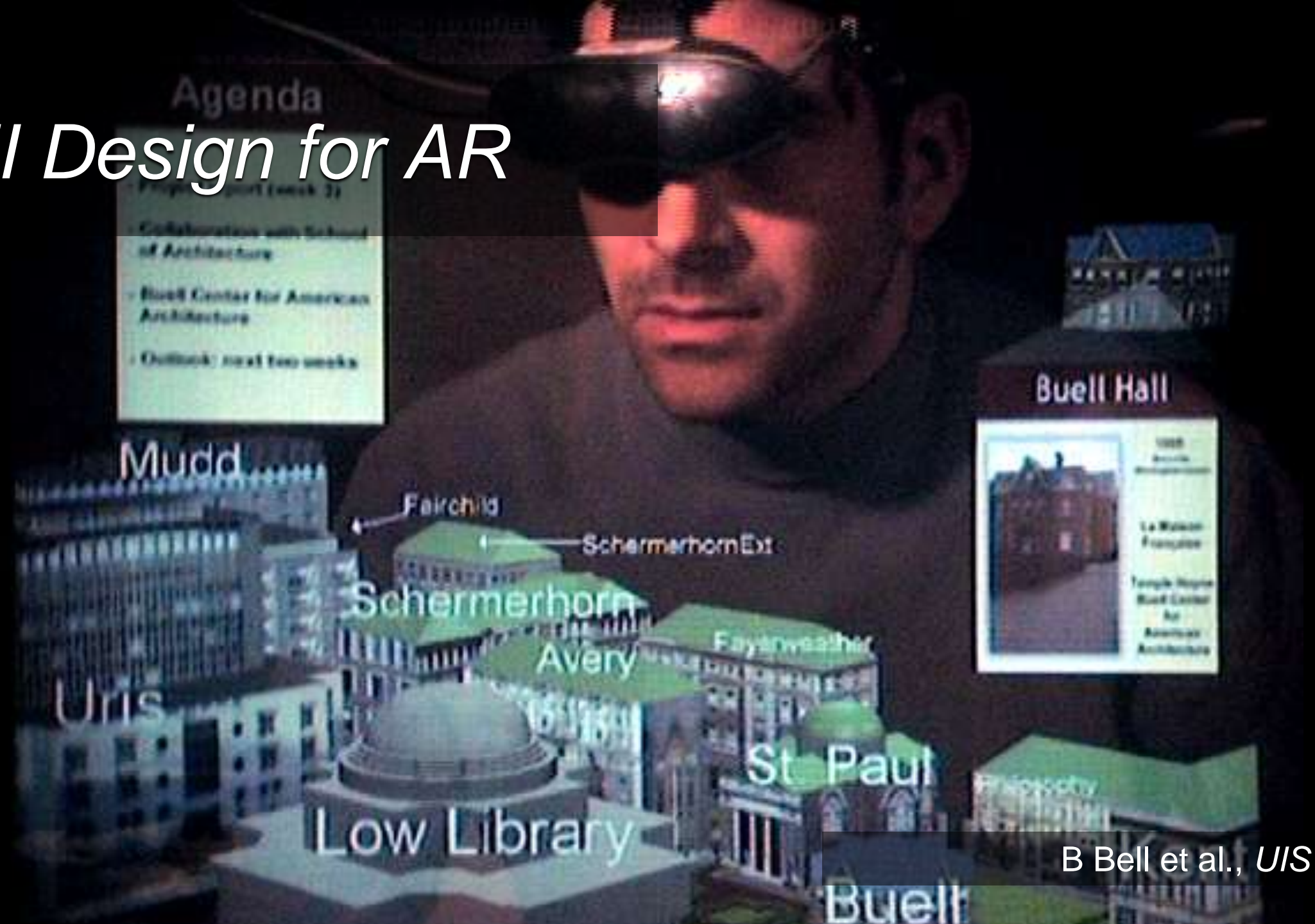
A 3D rendered cityscape with several tall, grey skyscrapers. The buildings have a grid-like pattern of windows. The scene is viewed from a low angle, looking down a street between the buildings. A semi-transparent dark grey banner is overlaid at the top of the image, containing the title text in white. In the background, a person's face is partially visible, suggesting a virtual reality or augmented reality environment.

# *Combining Eyewear with Other Displays*

N. Dedual et al., *ISMAR 2011*



# UI Design for AR



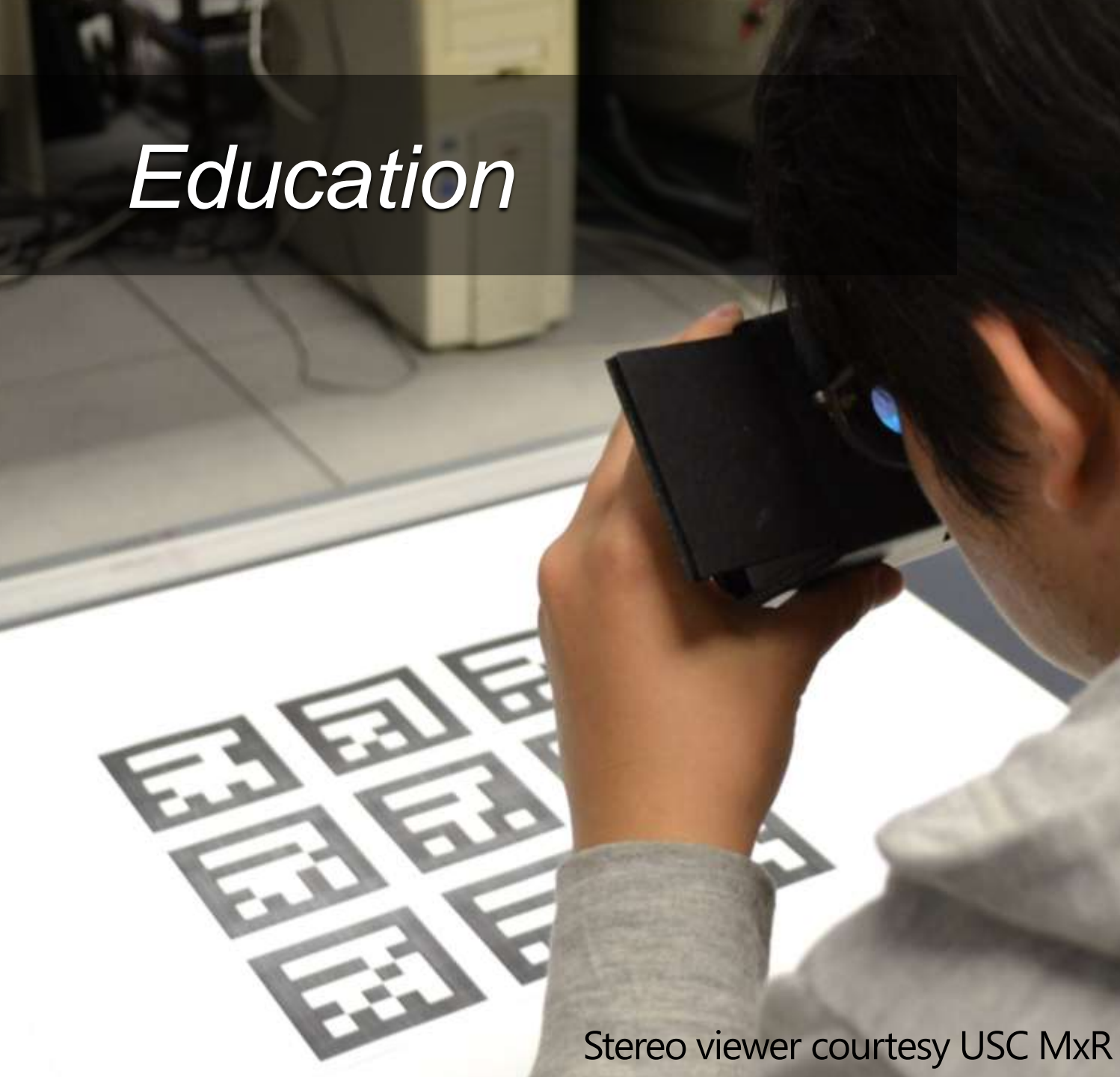
**Agenda**

- Project report (week 2)
- Collaboration with School of Architecture
- Buell Center for American Architecture
- Outlook: next two weeks

**Buell Hall**

1928  
1928  
La Maison  
Française  
Temple House  
Buell Center for  
American  
Architecture

# *Education*



E. Arreguin, C. Galvez,  
S-H Tsai, L. Yang



Stereo viewer courtesy USC MxR

# Privacy

- In the face of massive public deployments of wearable sensors, what are the consequences of streaming, searching, matching, and storing multimedia data that is
  - time-stamped
  - georeferenced



0 - 100 W 42nd St

# Acknowledgments

- Nick Dedual
- Semih Energin
- Steve Henderson
- Ohan Oda
- Mengu Sukan
- Barbara Tversky
- Students of COMS W4172
- USMC personnel at Marine Corps Logistics Base: Mike Shellem, Curtis Williams, Andrew Mitchell, Alan Butterworth
- USMC cadre and students at Aberdeen Proving Ground
- Supported in part by NSF, ONR, Raytheon, USMC, Institute for Information Industry, and gifts from Microsoft, Google, Nokia, VTT, Vuzix
- Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation