AR & VR: Early Achievements, Remaining Problems
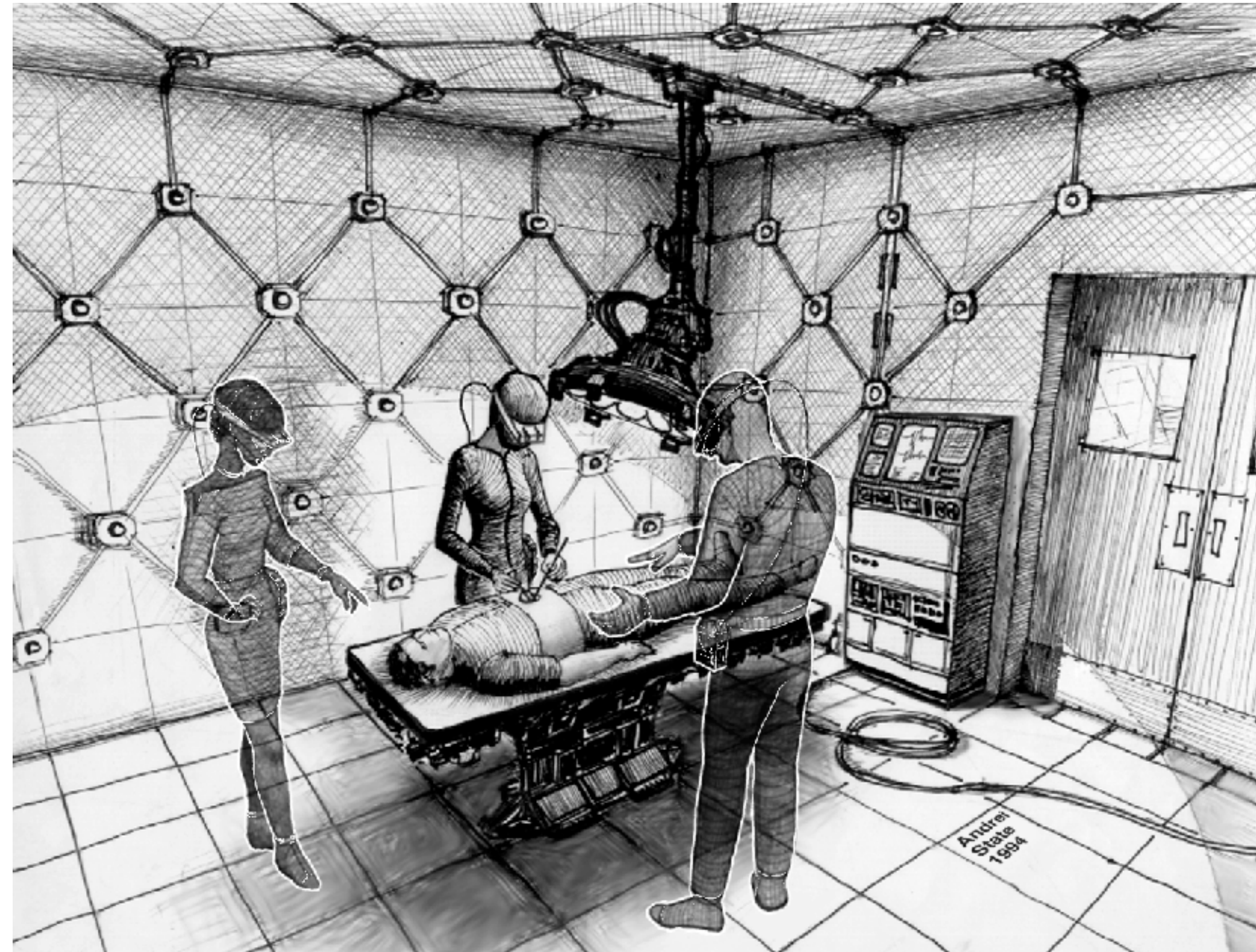

Andrei State (UNC) 1994

Henry Fuchs

UNC Chapel Hill

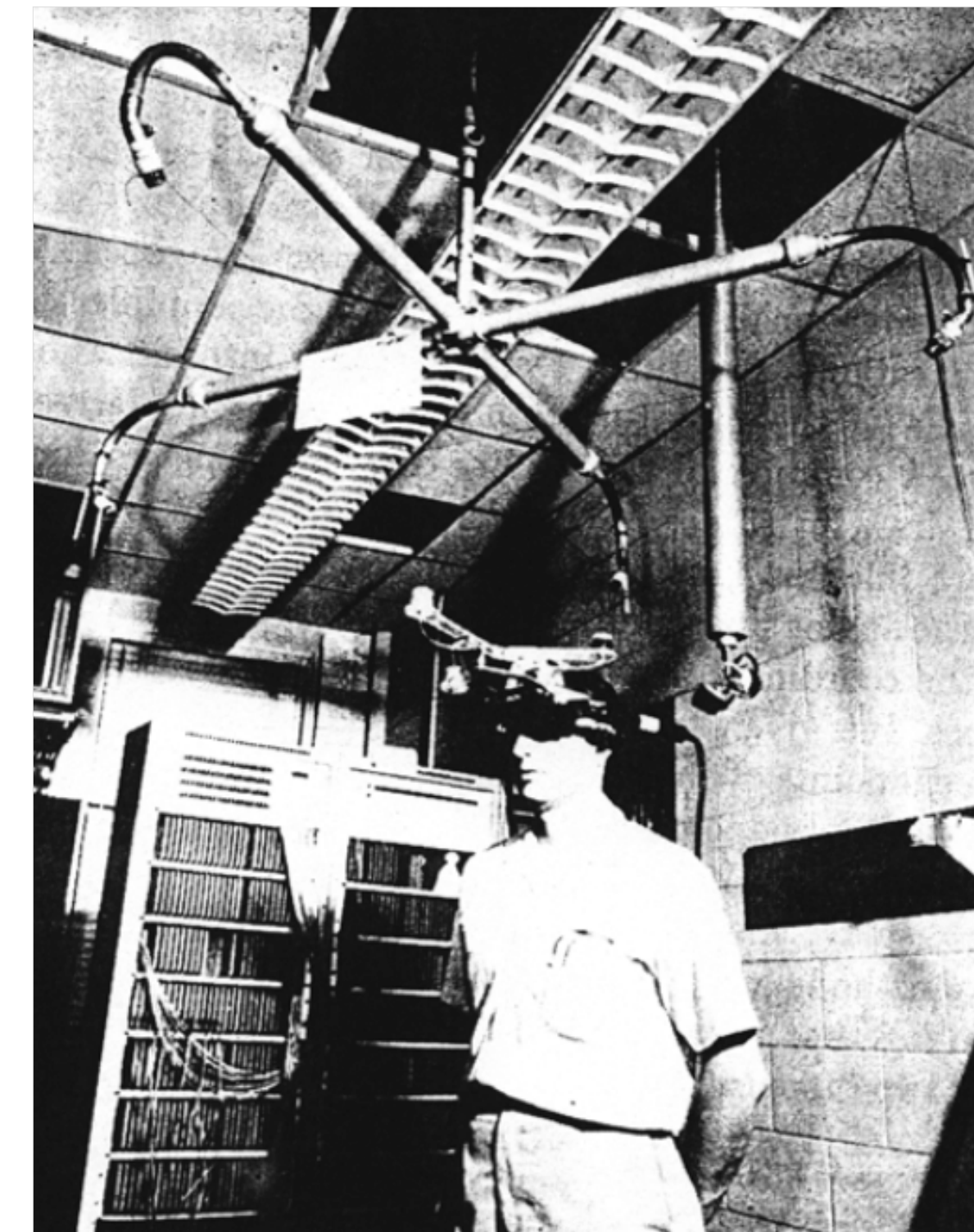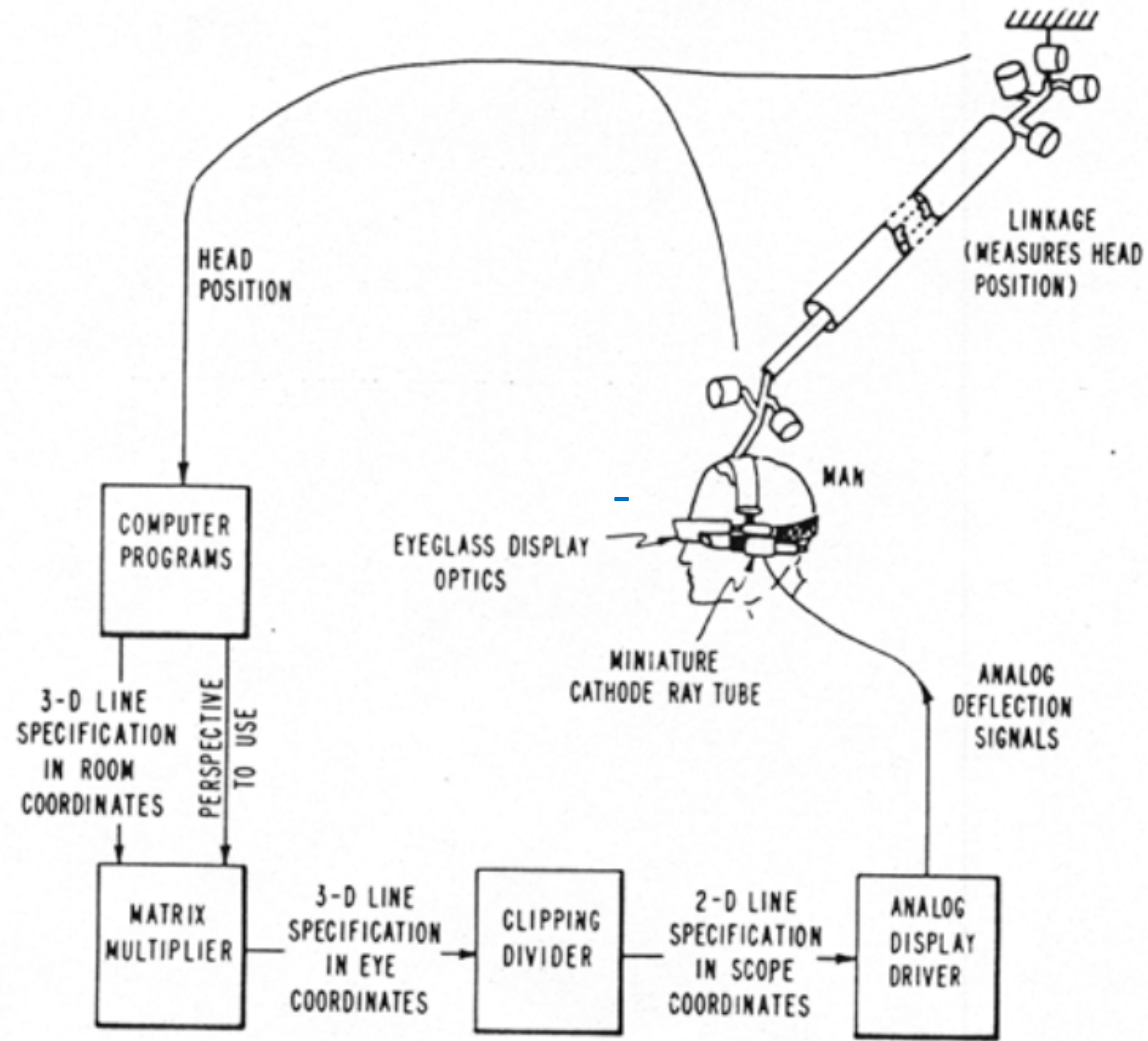9 July 2015

Early Achievements & Remaining Problems

AR/VR subsystems	1968 Sutherland System	1970 Dream	Recent UNC Work	Grade for Current State of the Art	Remaining Problems
Display Device					
Image Generation					
Head Tracking					
Interaction					
Content Creation					

FIRST AR / VR System:
Ivan E. Sutherland, A Head-Mounted Three-Dimensional Display,
1968 Fall Joint Computer Conference

with wireless 6DOF tracking

FIGURE 8—A computer-displayed perspective view of the cyclo-hexane molecule

FIGURE 9—A computer-displayed perspective view of the "room" as seen from outside

Early Achievements & Remaining Problems

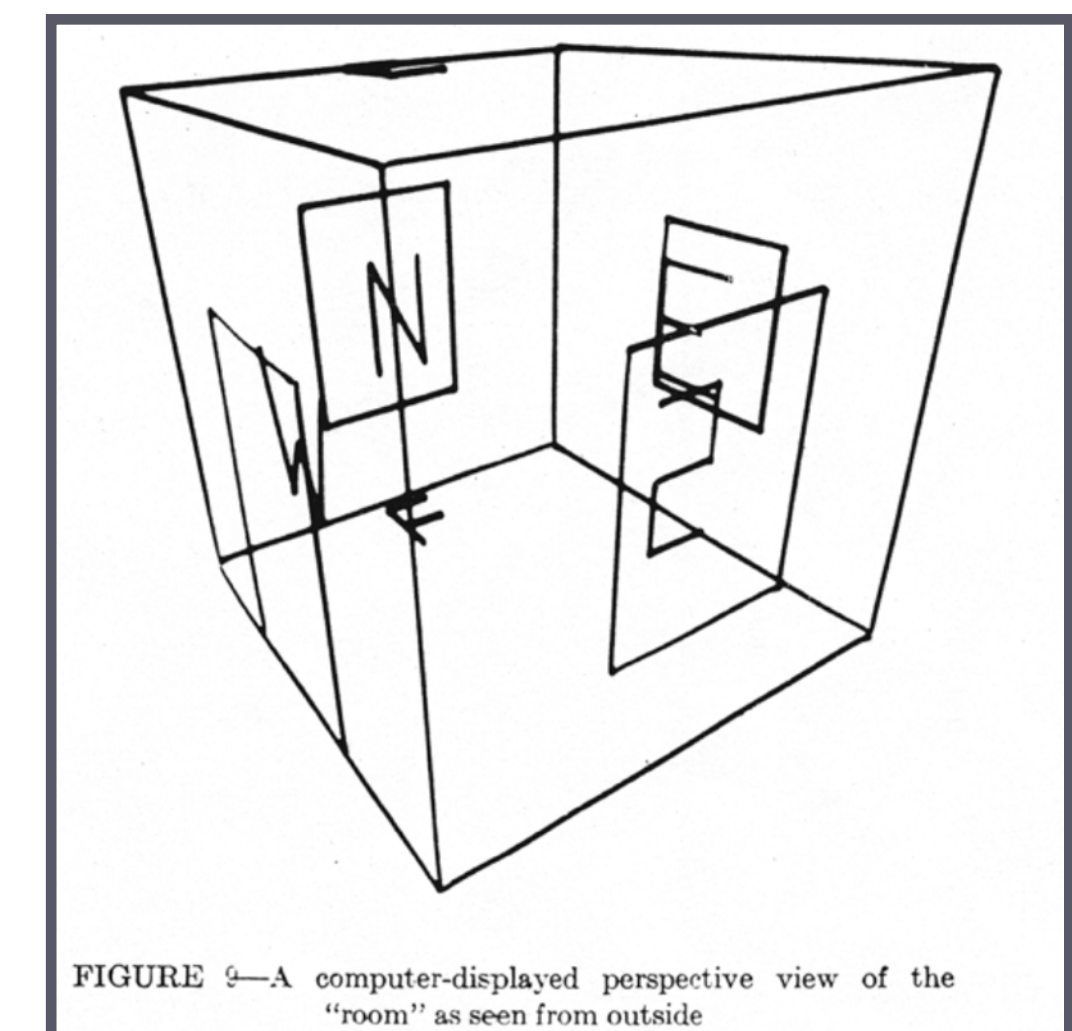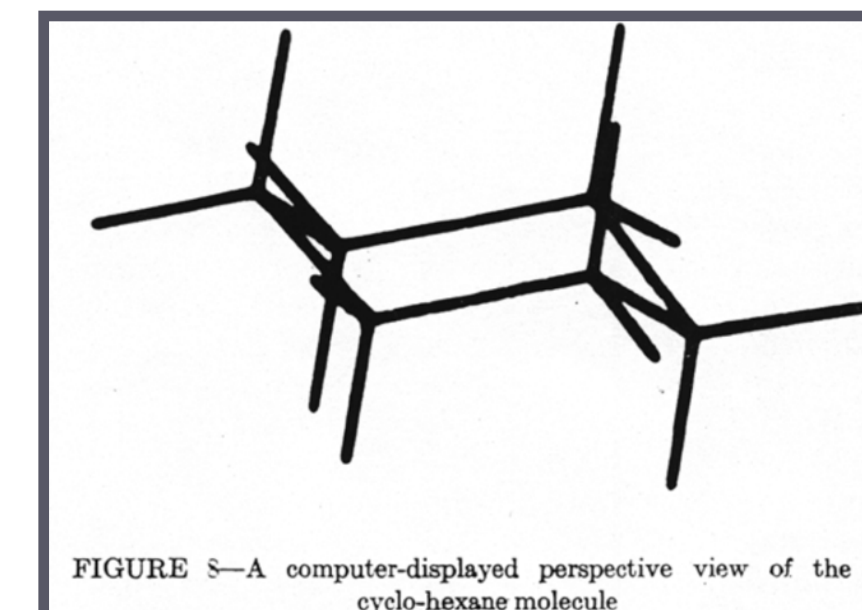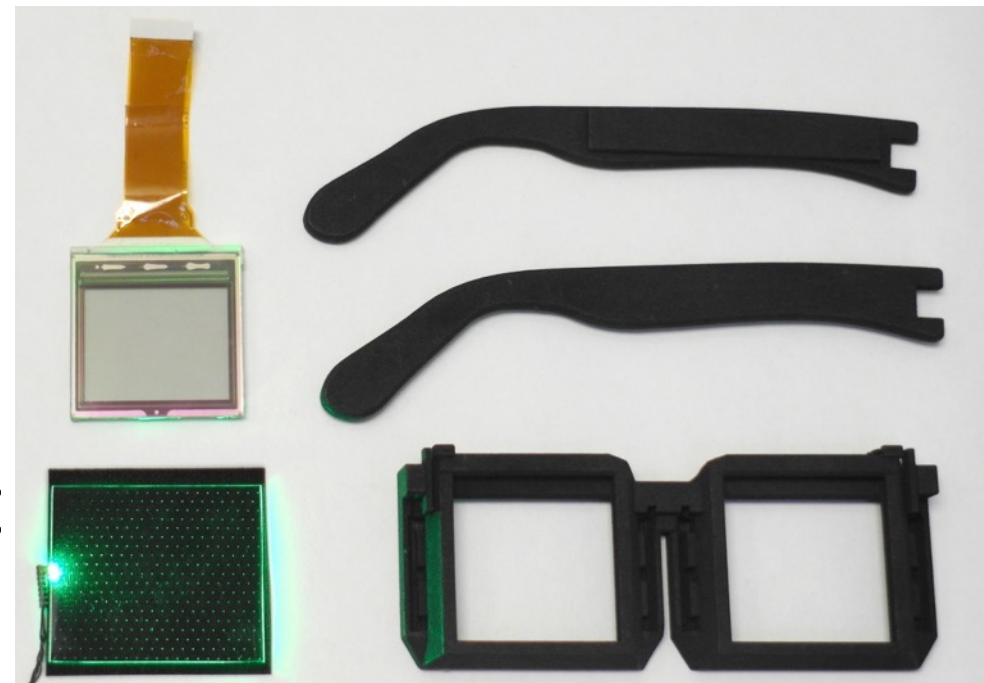| AR/VR subsystems	1968 Sutherland System	1970 Dream	Recent UNC Work	Grade for Current State of the Art	Remaining Problems
Display Device	AR see-through	eyeglasses form factor & field of view	Pinlights 100°AR eyeglasses [SG'14] w/NVIDIA		
Image Generation	realtime line-drawing				
Head Tracking	•wireless •wired				
Interaction	3 DOF mechanical				
Content Creation	manual				

"Pinlights" AR Eyeglasses

LCD

Edge-lighted acrylic sheet
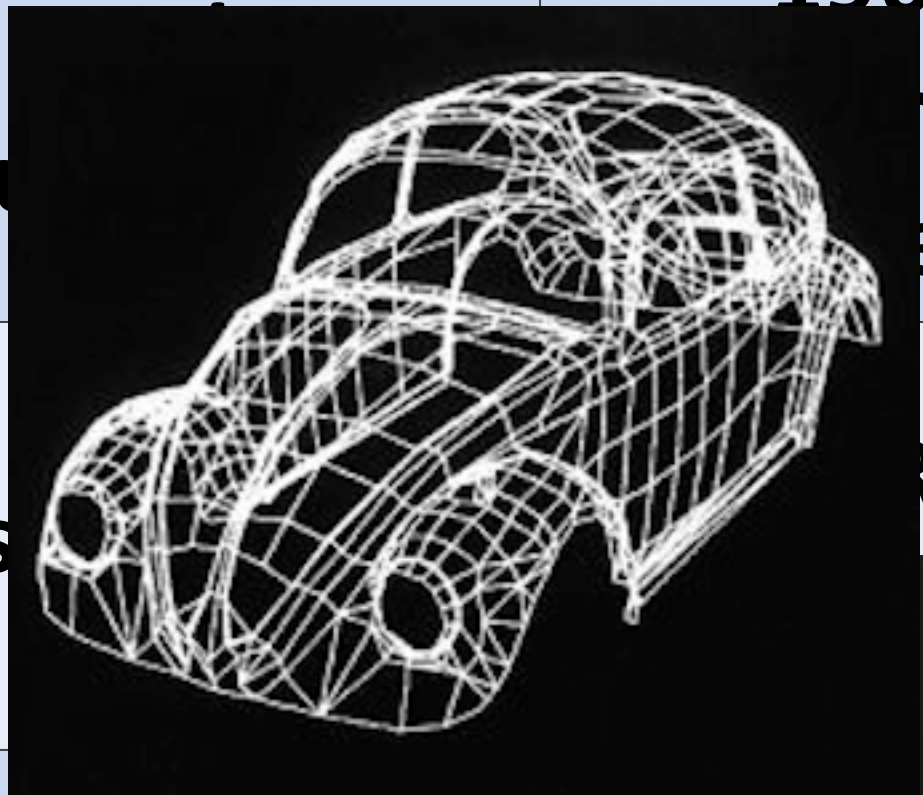w/grid of tiny "lights"

100° FOV
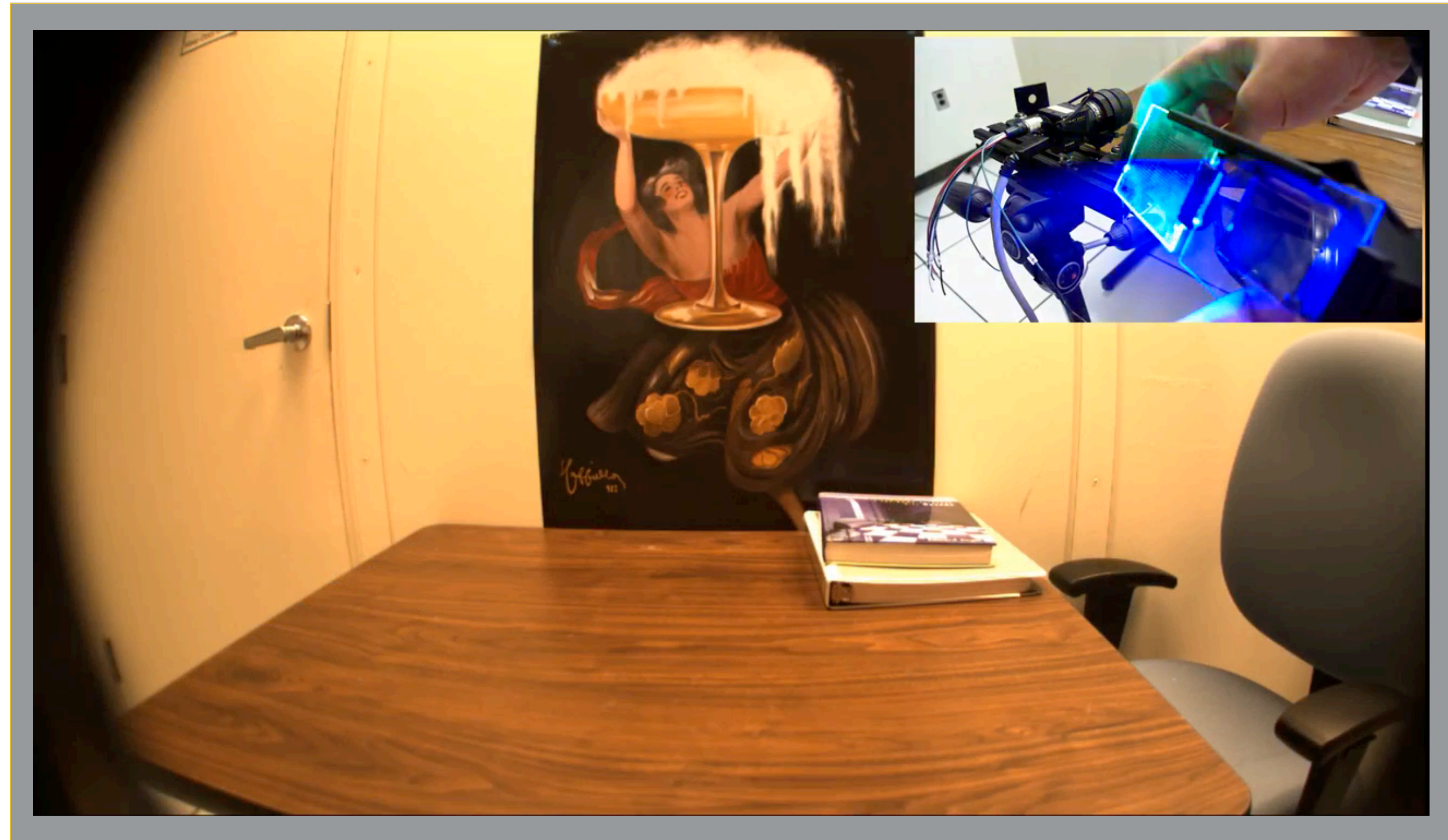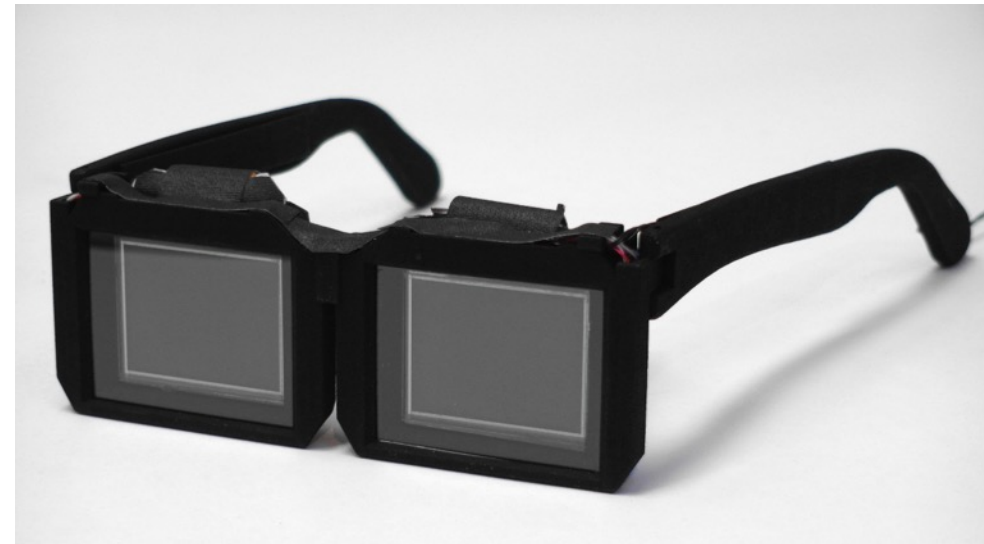
Maimone, A., D Lanman, K Rathinavel, K Keller, D Luebke, and H Fuchs.
Pinlight Displays: Wide Field of View Augmented Reality Eyeglasses Using Defocused Point Light Sources,
SIGGRAPH 2014 and **SIGGRAPH 2014 Emerging Technologies Booth** **UNC & NVIDIA**

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Image Generation	realti... line-dra...			
Head Tracking	•wire... •wired	anywhere	[...	...nented ...t
Interaction	3 DOF mechanical	track hands anywhere	19... b... u's...	...here ...em)
Content Creation	manual	automatic	re... pe...	

6

Automatic 3D Scene Reconstruction (2014)

10 Kinect color + depth cameras; prescan room & furniture with single Kinect
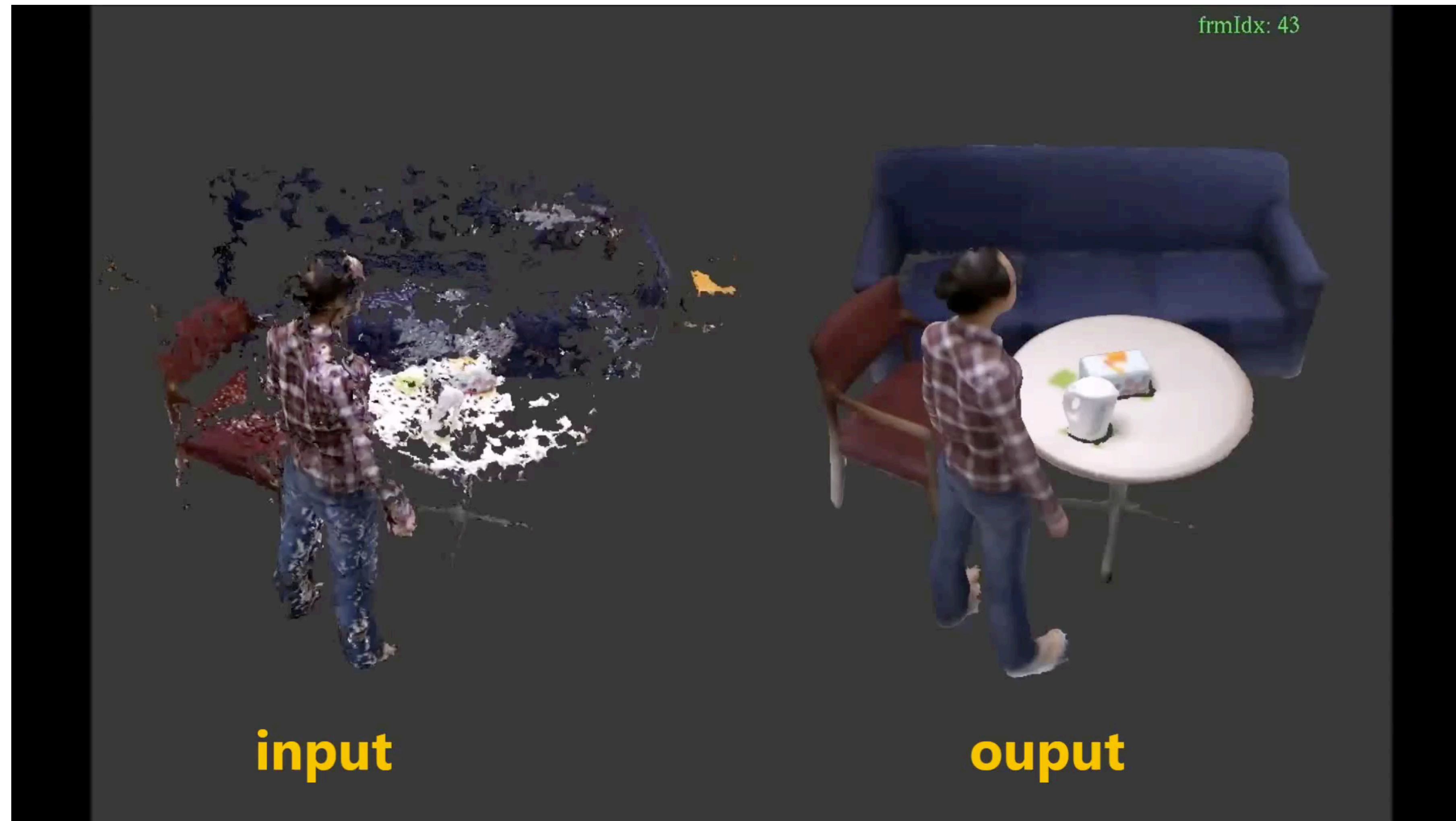
Dou, M. and H. Fuchs. "Temporally Enhanced 3D Capture of Room-sized Dynamic Scene with Commodity Depth Cameras". IEEE VR2014. Best short paper

Early Achievements & Remaining Problems

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Display Device	AR see-through	eyeglasses form factor & field of view	Pinlights 100°AR eyeglasses [SG'14] w/NVIDIA	VR: **B** AR: **C-**	AR: •eyeglass look & field of view • real/virtual occlusion
Image Generation	realtime line-drawing	photo realism	Pixel-Planes 5 [Siggraph 1991] 2M polygons/sec	**A+**	low power
Head Tracking	•wireless •wired	track anywhere	9ftx12ft tracked area @1kHz [demo SG'91]	**C+**	track anywhere: uninstrumented spaces indoors & out
Interaction	3 DOF mechanical	track hands anywhere	1995: AR breast biopsy w/ live u'sound & needle	**C to B-**	track bare hands anywhere (even if not looking at them)
Content Creation	manual	automatic	Room reconstruction & people [VR2014]	**C**	capture complex, dynamic scenes indoors & out without setup

Six Additional Problems & Opportunities

6. Walking around in mass market immersive VR systems

   Trip over cables, furniture; walk into walls?

   Will showing the real environment with the virtual destroy the immersive experience?

5. How walk around a VR space that is much bigger than the physical space

4. How see other users when everyone is wearing VR headgear

3. AR/VR experience difficult to convey to audiences: video inadequate
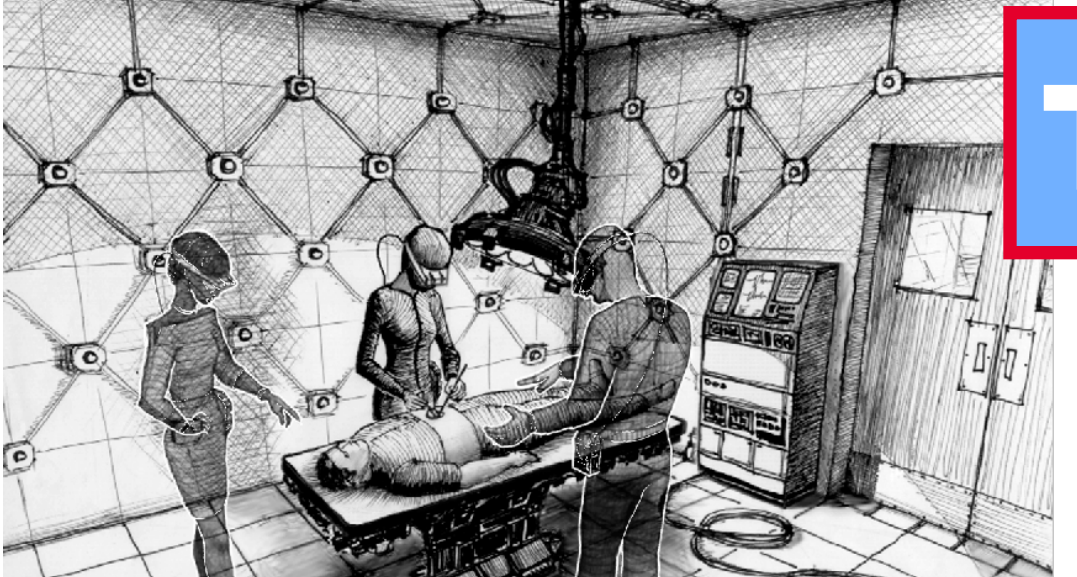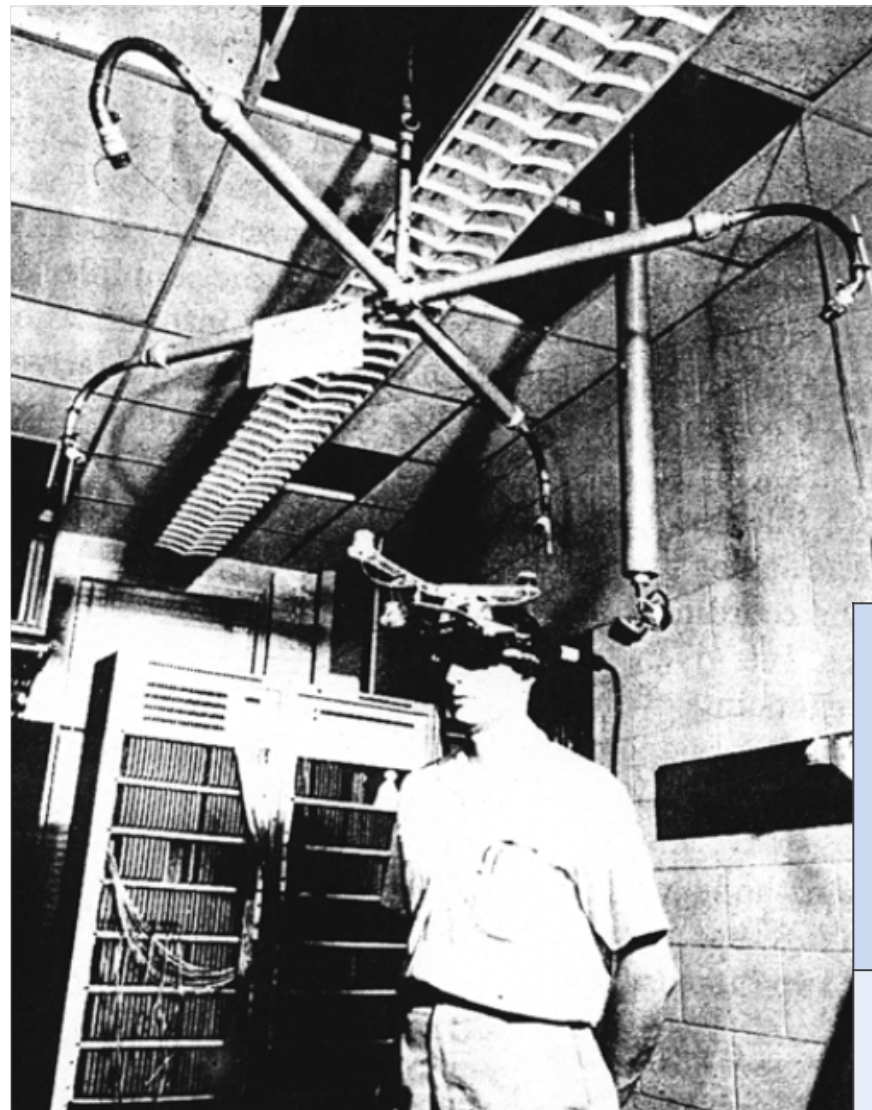
   Easy to "cheat" (FOV, latency) and hard to convey the immersion experience

2. Haptics still too hard: sit in a virtual chair, pick up a virtual cup

1. Biggest Research Opportunity: Cheap VR equipment removes financial barriers to great many applications, collaborations, early experiments

   community size growing from hundreds to MILLIONS

Thank You

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