

Implementing Effective Rapid Design and Prototyping Strategies for AR/MR/VR

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About Me



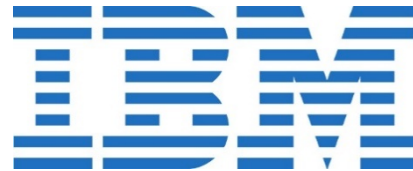
Butte College



VirginiaTech
Invent the Future



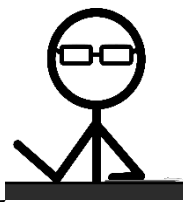




Setting Expectations

Scope

- ▶ Is:
 - ▶ Intermediate-level discussion
 - ▶ UX-focused
 - ▶ UCD methods
 - ▶ Rapid prototyping
 - ▶ Interface/interactions, immersion, ROI
- ▶ Is Not:
 - ▶ Computer vision/object recognition/computer science
 - ▶ Going to solve all your problems
 - ▶ A boring lecture



Me



2014-2017

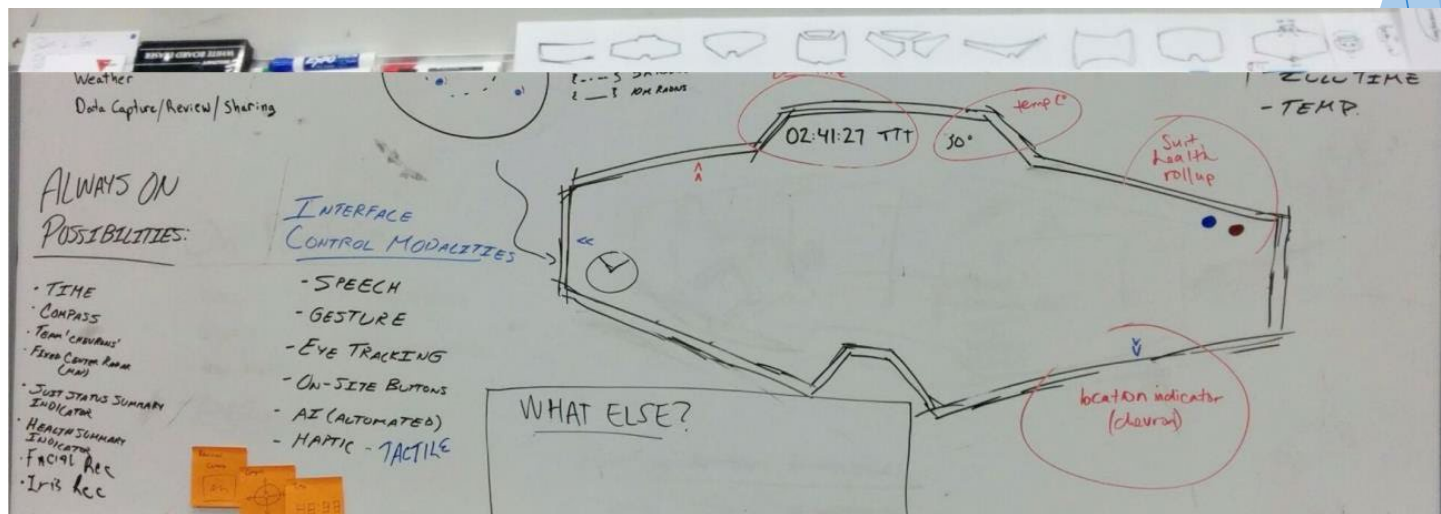
The Formal Measures

First Responder User Profile



Name: John Tentpeg, AKA "Duke"

Rank: Sergeant



Categories & Characteristics

- ▶ Cost (in USD)
- ▶ Interface
- ▶ Immersion
- ▶ Display Hardware
 - ▶ Projector
 - ▶ Mobile Phone
 - ▶ VR Headset
 - ▶ AR Headset

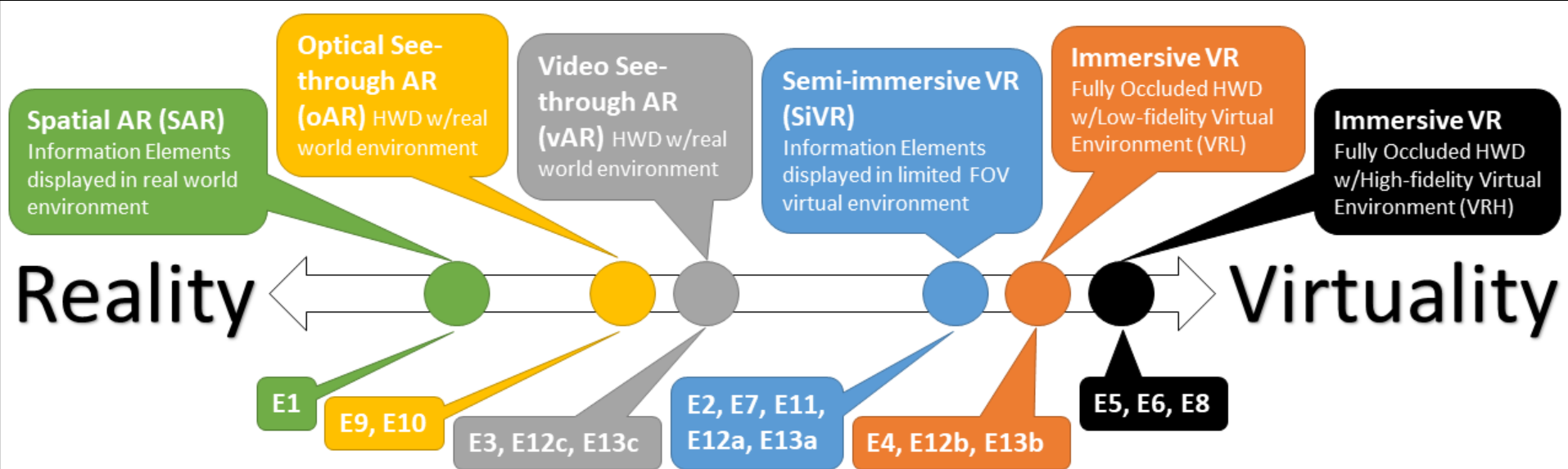
(A. McMahan, 2003; Bjork & Holopainen, 2004; Bowman, Kruijff, LaViola Jr, & Poupyrev, 2001; Bowman & McMahan, 2007; Catani & Biers, 1998; “Doug’s 1968 Demo - Doug Engelbart Institute,” n.d.; E. Adams, 2004; R. P. McMahan, Gorton, Gresock, McConnell, & Bowman, 2006; Rudd, Stern, & Isensee, 1996; Walker, Takayama, & Landay, 2002; Wu, Lee, Chang, & Liang, 2013)

...Continued

- ▶ Interface
 - ▶ Interaction
 - ▶ User Input (user performs action)
 - ▶ System Output (system performs action)
 - ▶ Software (programming between user and system performs action)
 - ▶ Function (interface responds to action)
- ▶ Immersion
 - ▶ Tactical (i.e., interface that responds rapidly & reliably)
 - ▶ Spatial (i.e., looks and feels right)
 - ▶ Strategic (i.e., the “big picture”)
 - ▶ Narrative (i.e., good storytelling)

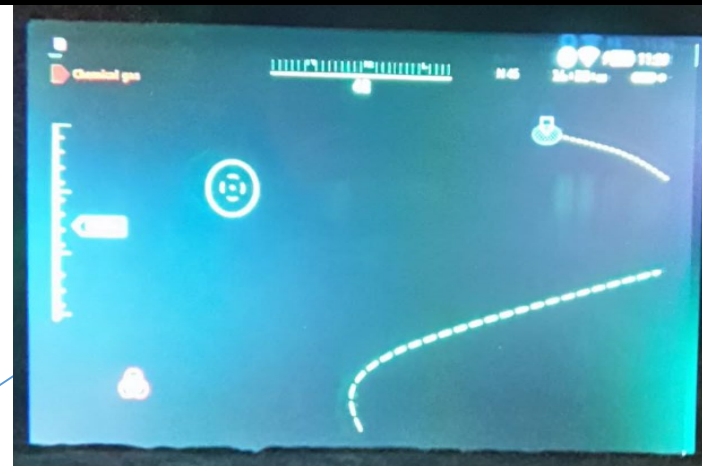
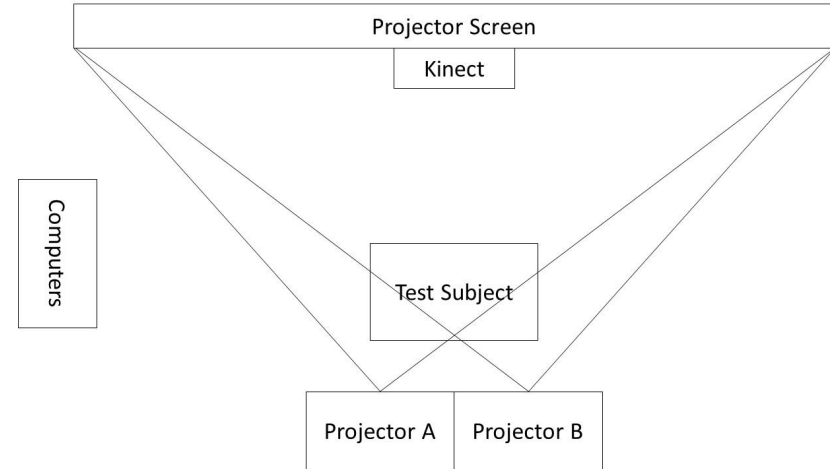
(A. McMahan, 2003; Bjork & Holopainen, 2004; Bowman, Kruijff, LaViola Jr, & Poupyrev, 2001; Bowman & McMahan, 2007; Catani & Biers, 1998; “Doug’s 1968 Demo - Doug Engelbart Institute,” n.d.; E. Adams, 2004; R. P. McMahan, Gorton, Gresock, McConnell, & Bowman, 2006; Rudd, Stern, & Isensee, 1996; Walker, Takayama, & Landay, 2002; Wu, Lee, Chang, & Liang, 2013)

Milgram's Reality-Virtuality Continuum (RVC)



P. Milgram, H. Takemura, A. Utsumi, and F. Kishino, "Augmented reality: A class of displays on the reality-virtuality continuum," in *Telemanipulator and telepresence technologies*, 1995, vol. 2351, pp. 282-293.

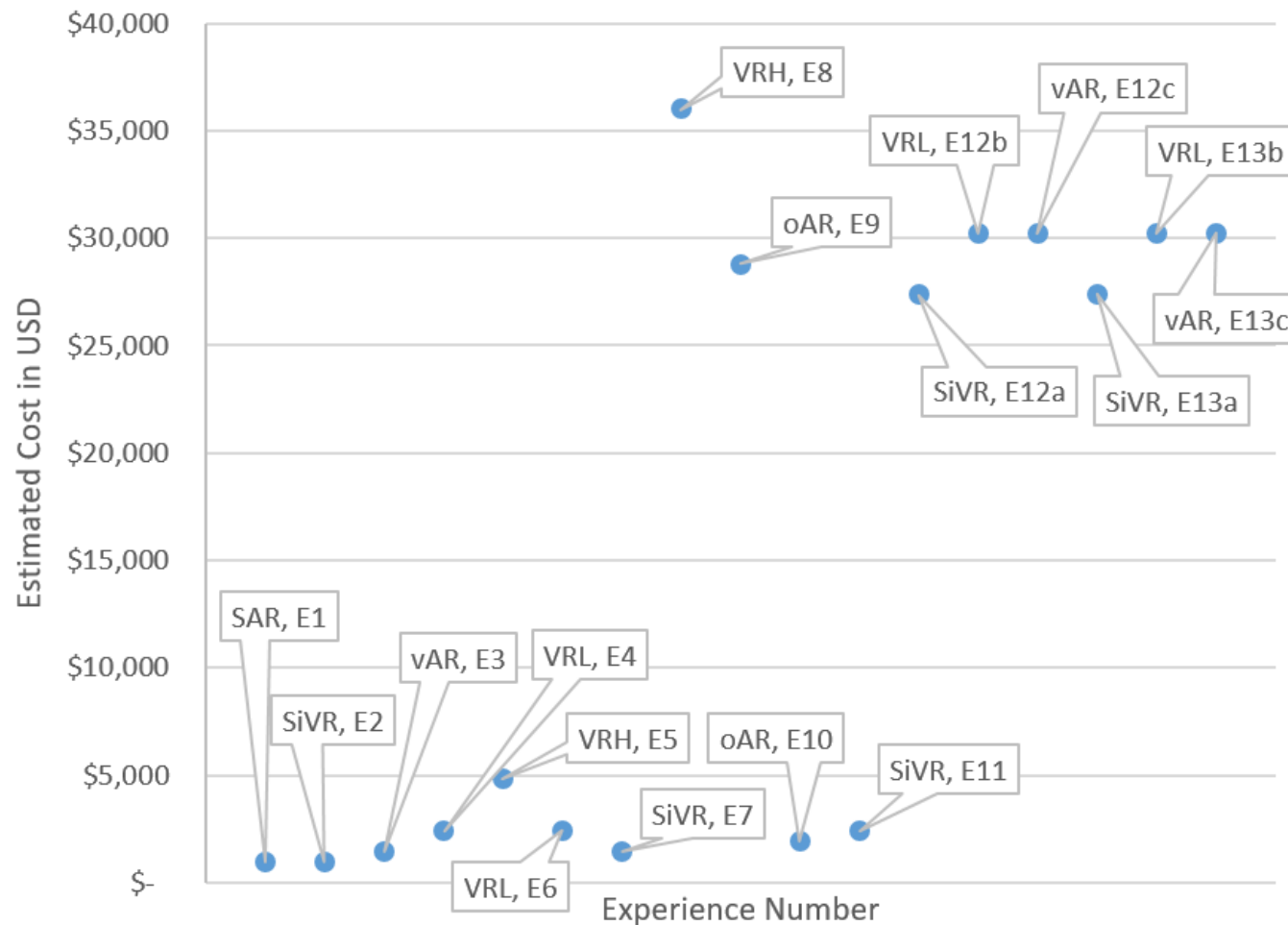
P. Milgram and F. Kishino, "A taxonomy of mixed reality visual displays," *IEICE TRANSACTIONS on Information and Systems*, vol. 77, no. 12, pp. 1321-1329, 1994.



Abbreviated Experience Characteristics

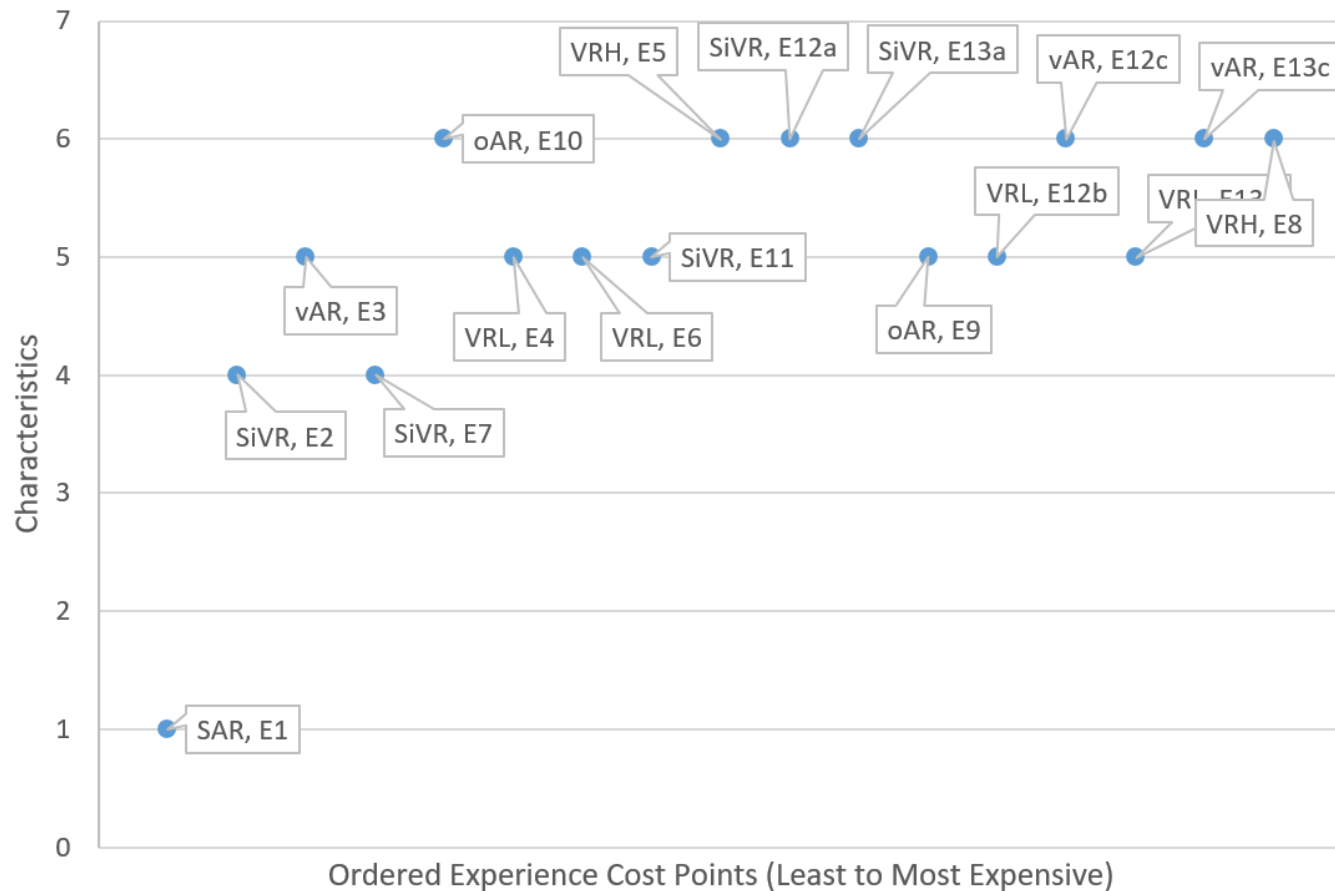
				Interface						
				Interaction			Functional	Immersion		Display Hardware
Name	Description	RVC Category	Costs	User Input	System Output	Software		Tactical	Spatial	
Experience	E1	Projected elements w/real world	SAR	\$ 960				X		Projector
	E2	Projected elements on a projected environment v1	SiVR	\$ 960		X	X	X	X	Projector
	E3	Mobile phone w/real world	vAR	\$ 1,440		X	X	X	X	Mobile Phone
	E4	Mobile phone w/low-fidelity VR world	VRL	\$ 2,400	X	X	X	X		Mobile Phone
	E5	VR HWD w/high-fidelity VR world	VRH	\$ 4,800	X	X	X	X	X	VR Headset
	E6	Tethered AR HWD w/low-fidelity VR world	VRL	\$ 2,400	X	X	X	X		AR Headset
	E7	Tethered AR HWD w/projected environment v1	SiVR	\$ 1,440		X	X	X	X	AR Headset
	E8	Tethered AR HWD w/high-fidelity VR world	VRH	\$ 36,000	X	X	X		X	AR Headset
	E9	Tethered AR HWD w/real world v1	oAR	\$ 28,800	X	X	X		X	AR Headset
	E10	Large FOV AR HWD w/real world	oAR	\$ 1,920	X	X	X	X	X	AR Headset
	E11	Projected elements on a projected environment v2	SiVR	\$ 2,400	X	X		X	X	Projector
	E12a	Untethered AR HWD w/projected environment v2	SiVR	\$ 27,360	X	X	X	X	X	AR Headset
	E12b	Mobile phone w/low-fidelity VR world v2	VRL	\$ 30,240	X	X	X	X		Mobile Phone
	E12c	Mobile phone w/real world v2	vAR	\$ 30,240	X	X	X	X	X	Mobile Phone
	E13a	Untethered AR HWD w/projected environment v3	SiVR	\$ 27,360	X	X	X	X	X	AR Headset
	E13b	Mobile phone w/low-fidelity VR world v3	VRL	\$ 30,240	X	X	X	X		Mobile Phone
	E13c	Mobile phone w/real world v3	vAR	\$ 30,240	X	X	X	X	X	Mobile Phone

Grouped Experience Cost



Name	RVC Category
E1	SAR
E2	SiVR
E3	vAR
E4	VRL
E5	VRH
E6	VRL
E7	SiVR
E8	VRH
E9	oAR
E10	oAR
E11	SiVR
E12a	SiVR
E12b	VRL
E12c	vAR
E13a	SiVR
E13b	VRL
E13c	vAR

Characteristics ROI



Name	RVC Category
E1	SAR
E2	SiVR
E3	vAR
E4	VRL
E5	VRH
E6	VRL
E7	SiVR
E8	VRH
E9	oAR
E10	oAR
E11	SiVR
E12a	SiVR
E12b	VRL
E12c	vAR
E13a	SiVR
E13b	VRL
E13c	vAR

Overall Key Findings

- ▶ Storyboarding/storytelling are critical
- ▶ Semi-structured interviews are critical
- ▶ Prototypes must have advanced capabilities in terms of interface, interaction, and immersion (user defined)
- ▶ User's want to try it out
 - ▶ You can't imagine an MR experience without first-hand knowledge
- ▶ Immersion is king
 - ▶ And can be done at low costs

The background of the slide features abstract, overlapping geometric shapes in various shades of blue, ranging from light sky blue to deep navy blue. These shapes are primarily located on the right side and bottom of the slide, creating a modern, dynamic feel.

2018-2019

The Informal Measures

ABOUT

LAB MAP

EQUIPMENT

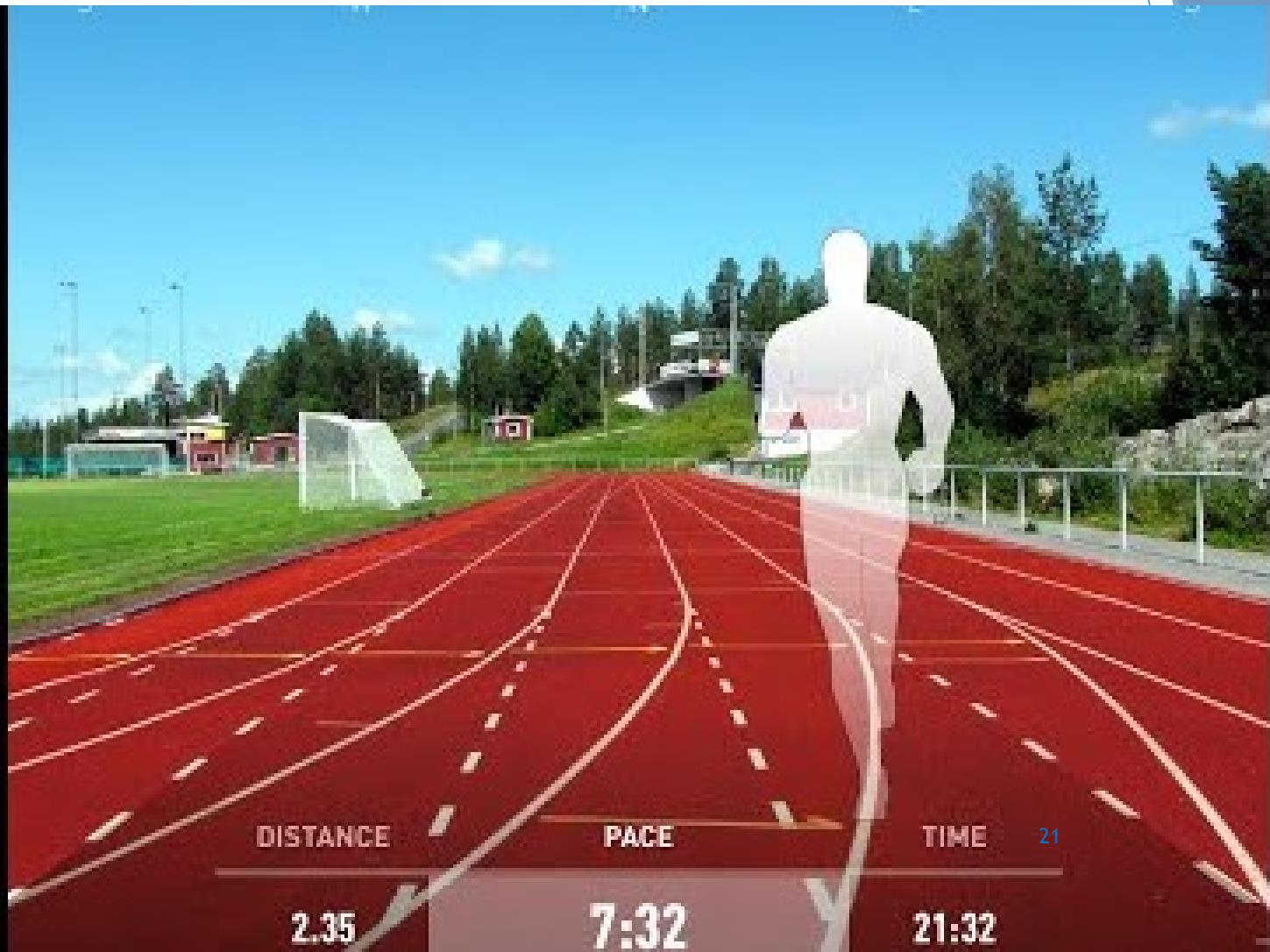
**PAST
PROJECTS**

**REQUEST
ACCESS**



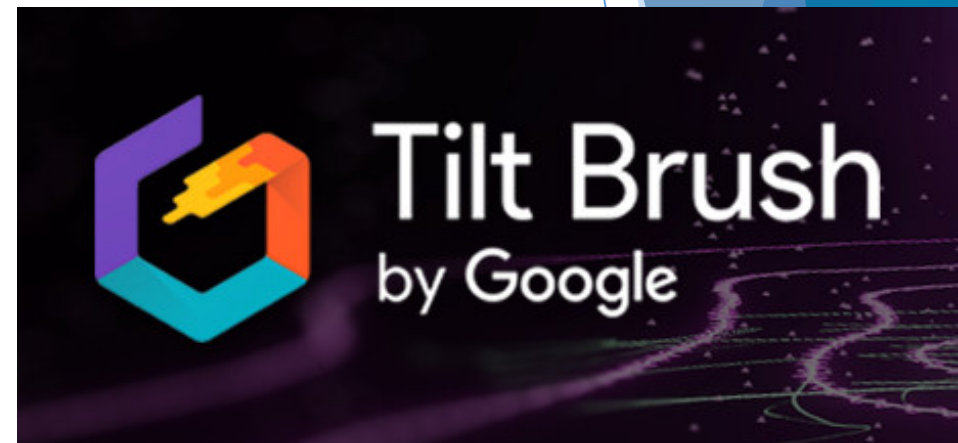
**BYU MR
LAB**

Fall 2018



Finally!

Some Prototyping Tools!



Spring 2019



Questions?