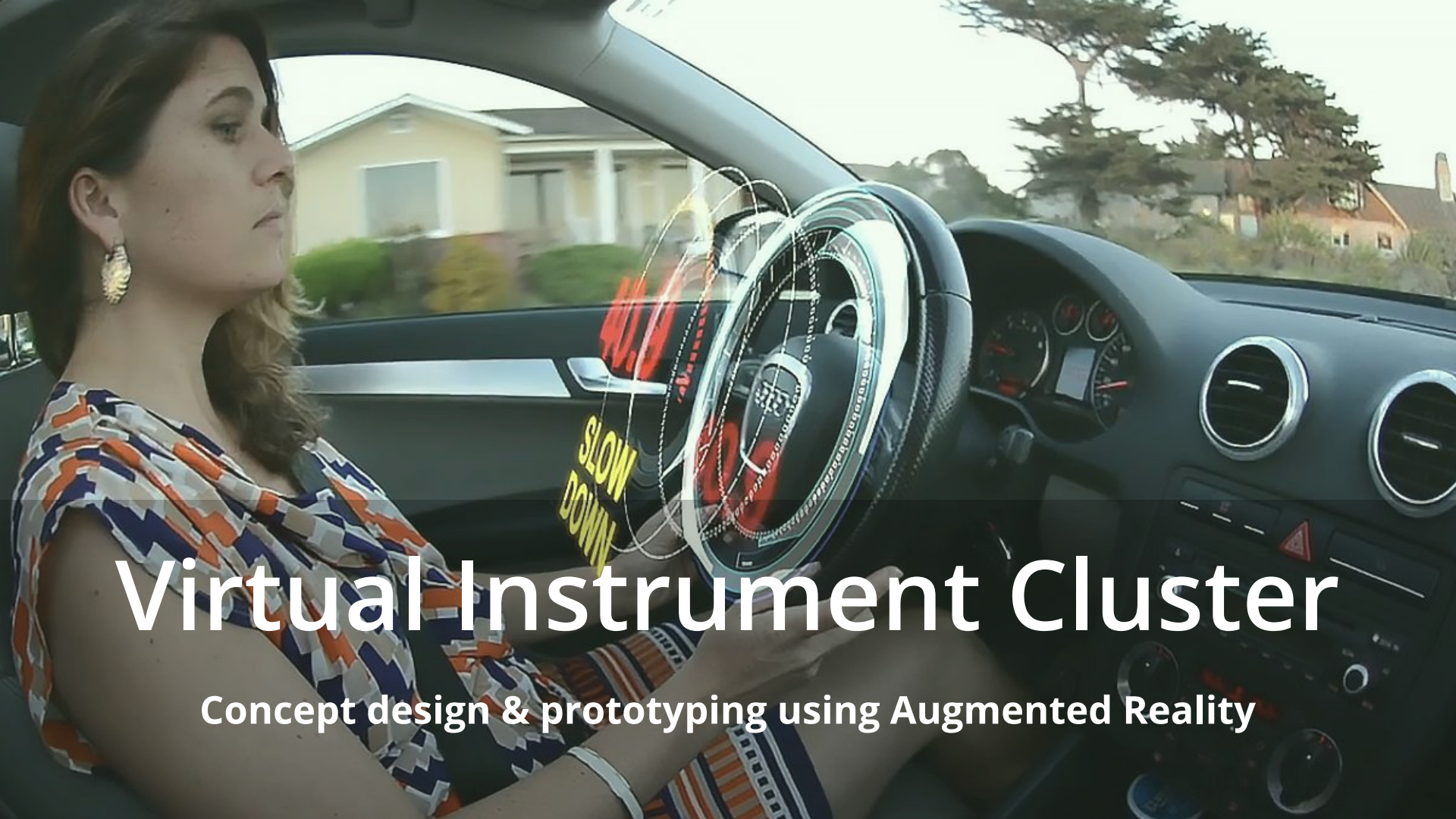


Virtual Instrument Cluster

Concept design & prototyping using Augmented Reality

Team

Dr. Stefan Marti

VP of Design

Adam Boulanger

UX Director

Joey Verbeke

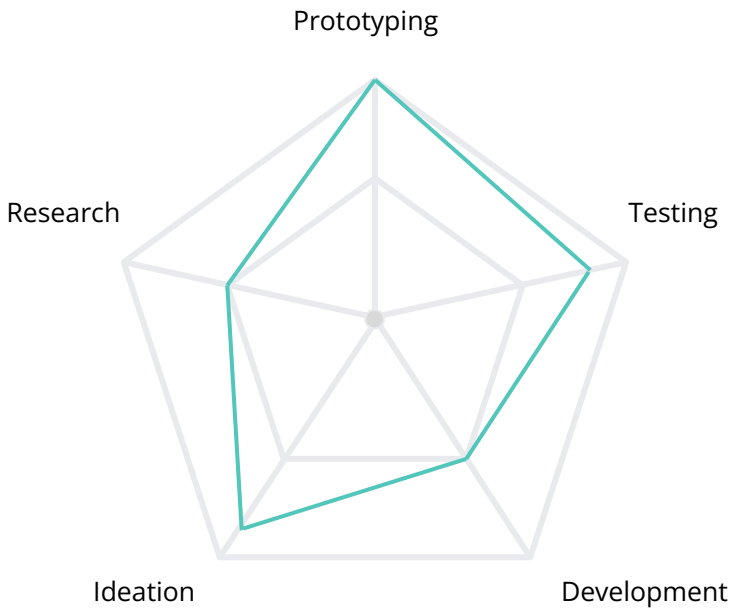
UX Lead & Mentor

Pruthviraj

Design technologist intern

My role & contributions

- **UX Research**
  3 user interviews, literature review (patents, NHTSA guidelines), market analysis - AR devices
- Contributed to concept generation, storyboards
- **Prototyping**
  Created low-fidelity (Google Blocks VR) & high-fidelity prototypes using Unity (interactive shared hologram experience)



Empathize & discover

TARGET AUDIENCE

Who are the users?

This project was intended to be demoed to business clients - BMW, Audi.

Users who drive commute cars equipped with multiple dashboard screens and integrated with connected-car technology.

Source: Google Images

PRIMARY RESEARCH

Semi-structured interviews & shadowing

Interviewed 3 participants - Colleagues and drivers associated with ride-sharing services.

Joined them on drive and observed their behavior in different scenarios.

“It’s hard for me to read notifications in the infotainment system, check speed, navigate myself juggling multiple things on my smartphone.”

Ray, 34, Audio Engineer

“I do food deliveries … it’s a different game when you had to constantly keep checking navigation, too many app alerts and I’ve missed red signals many time ...”

Mina, 22, Uber food delivery driver

SECONDARY RESEARCH

NHTSA guide & literature review

- NHTSA human factors design guide
- Market analysis of various AR devices.
- Patent documents related to automotive dashboard design.

	Hololens Development Edition by Microsoft	R7 Smartglasses by Osterhout Design Group...	Moverio BT-300 by Epson	Meta 2 Developer Kit by Meta
Status	Dev Kits Shipping	Product Shipping	Product Shipping	Dev Kits Shipping
Market	Consumer	Commercial/Industrial	Commercial/Industrial	Commercial/Industrial
Form Factor	Visor	Spectacles	Spectacles	Visor
Optical Class	Binocular	Binocular	Binocular	Binocular
Design Form Factor	Self Contained	Self Contained	Tethered Controller	Tethered to PC
Cost	$3,000	$2,475	$779	$1,495
Weight headpiece (+peripheral)	579g	113g	69g	420+210g
Battery Life	5.5 hrs	5.5 hrs	6 hrs	n/a
Platform	Windows	Android	Android	Windows
Processor	Intel Atom x5-Z8100	Qualcomm Snapdragon 805	Intel Atom5 1.44GHz Quad Core	Intel I7-3610MQ
Audio	Stereo	Stereo	Stereo	Quadraphonic
Optics	Optical see-through	Optical see-through	Optical see-through	Optical see-through
Resolution	1280x720	1280x720	1280x720	1280x720
Field of View	30°	30°	23°	90°
Rx Lens Compatible	Yes	Opt	Yes	Yes
VR Convertible	Yes	-	Opt	-
Depth Camera	Yes	-	-	Yes
RGB Camera	Yes	Yes	Yes	Yes
Microphone	Yes	Yes	Yes	Yes
IMU	Yes	Yes	Yes	Yes
Button Control	Yes	Yes	Yes	Yes
Touchpad Control	-	Yes	Yes	-
Motion Controller	-	Yes	Yes	-
Voice Control	Yes	Yes	Opt	Yes
Gesture Control	Yes	Opt	Opt	Yes
BlueTooth	Yes	Yes	Yes	-
GPS	-	Yes	Yes	-
LTE	-	-	-	-
NFC	-	-	-	-
RFID	-	-	-	-
WiFi	Yes	Yes	Yes	-
SDK	Yes	Yes	Yes	Yes
3rd party toolkit support	-	Yes	Yes	Yes

Source: theverge.com

Research insights

ISSUES IDENTIFIED

High cognitive load while dashboard interaction

Frequent interactions with dashboard interfaces, smartphones including mapping between real-world spatial content and 2D components.

Source: Google images

“I try my best to search for controls on dashboard without looking but it’s not easy and with recent screens on the dashboards, it’s inevitable to look at them ...”

Ray, 34, Audio Engineer

ISSUES IDENTIFIED

Less contextually driven instruments

With incremental feature addition to catch up in the competition, the dashboards only became more cluttered and complicated.

Source: Google images

“I don’t really use most of the controls on my dashboard & on the other hand I’m a phone person … I can barely focus on road while I switch to phone for calls & navigation … ”

Mina, 22, Uber food delivery driver

The Challenge

Improve in-car dashboard experience with **contextually-driven instrument cluster** and **minimal driver distractions**

IDEATION

Concept generation & validation

How might we create an experience that is non-intrusive?

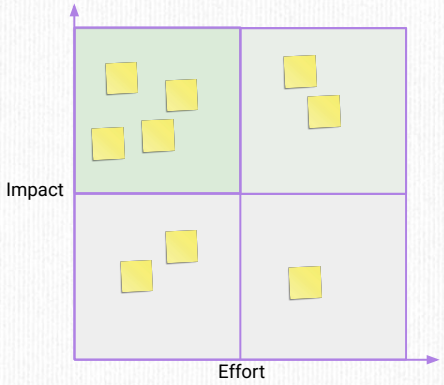
How might we simplify dashboard with cluttered instrument cluster?

How might we design for minimal distractions?

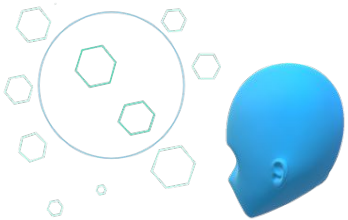
Augmented reality / Virtual reality

Functional while driving

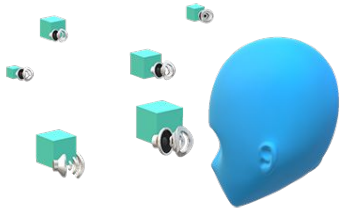
2 months to deliver final functional prototype



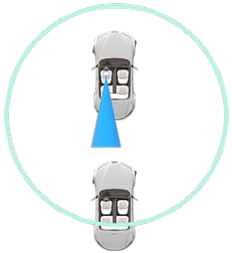
Initial solution concepts



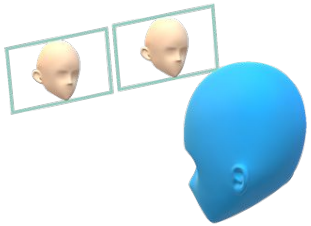
Eye gaze dependent AR content transition-in and out



Associating spatial sound with hologram components

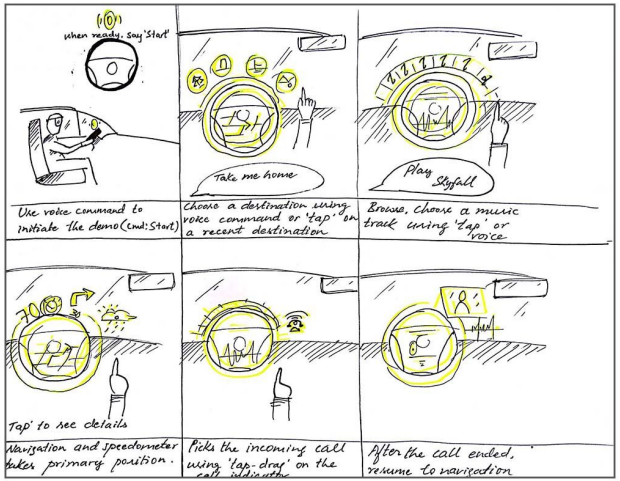


Augmenting a 360 view as see-through

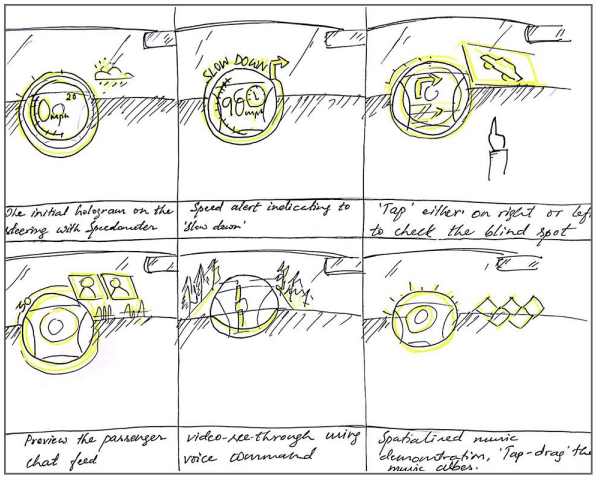


In-Car interaction with fellow passengers

Storyboards



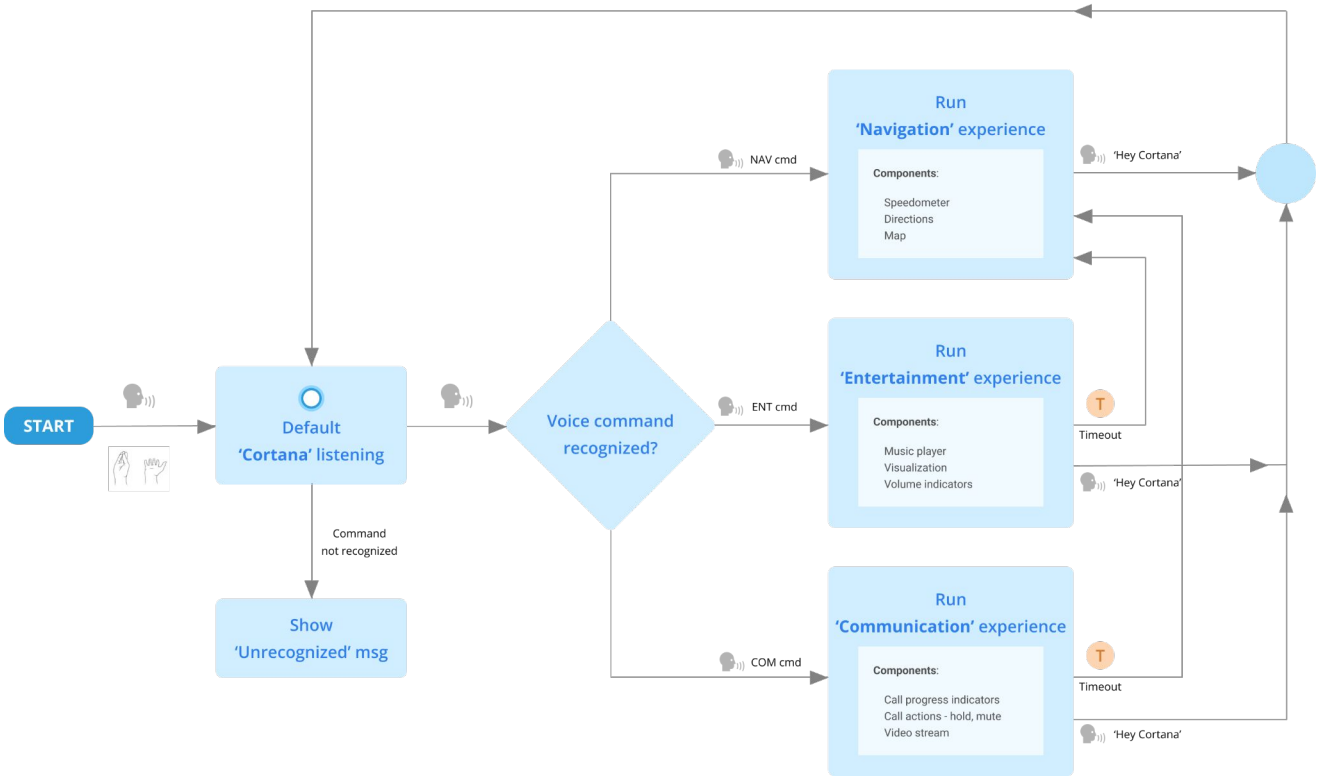
Navigation, Entertainment, communication use cases



Weather, Navigation, See-through, Blind spot views

Design & prototype

Task flow diagram



Voice commands pre-configured with HoloLens :

- NAV cmd - "Show me directions to Airport"
- ENT cmd - "Play recent playlist"
- COM cmd - "Call dad"

Bloom gesture

- Used to initiate the demo (pops up Cortana in listening mode)

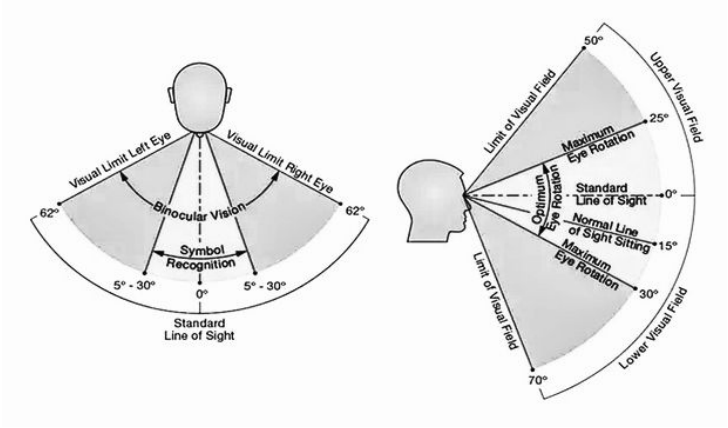
Timeout value set to 8 seconds

AR CONTENT ARCHITECTURE

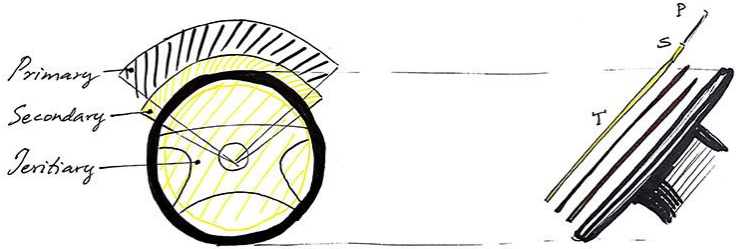
Virtual Instrument Cluster content

- Stacked layers specific to content - Navigation, Communication, Entertainment
- Content architecture in relation to driver's FOV

Source:
Intersection Angle Geometry and the Driver's Field of View, 1998
https://journals.sagepub.com/doi/abs/10.3141/1612-02
Accessed on 13 Sep 2017

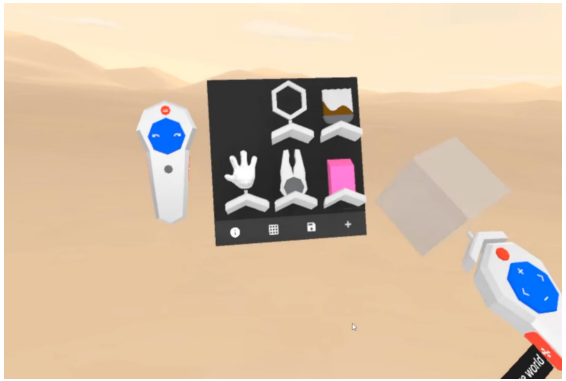


Driver's visual field of view - Horizontal, Vertical



Virtual Instrument Cluster architecture

Getting early feedback using VR



With the help of Google Blocks app in VR, getting quick & early feedback became easier

Using Vuforia marker image to position & test interactions

Prototype iterations

Paper sketching

Google Blocks VR mockups

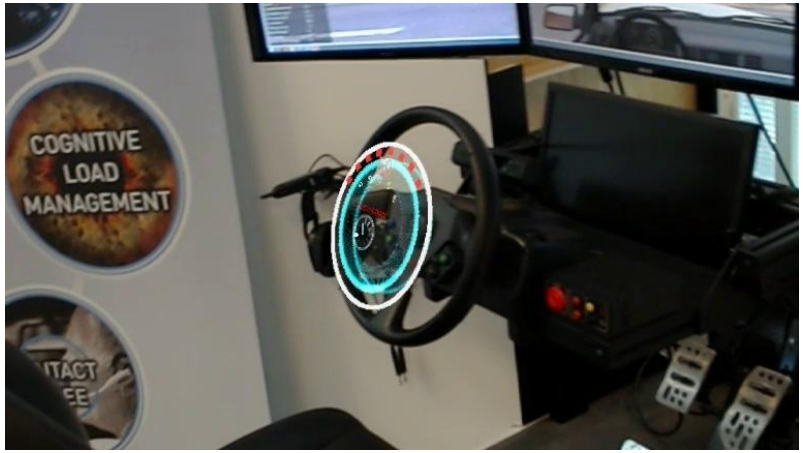
Transitions & Interactions using Unity

Demo & Feedback

PROTOTYPE - Medium fidelity

Testing & evaluating with a simulator

- Simulator could be used to demonstrate specific scenarios easily.
- Future vision of virtual instrument cluster would be much more constrained.



Driving simulator used for demo purpose

Final Shared AR Virtual Instrument Cluster Experience

Content captured using HoloLens

THE IMPACT

What are the end results?

Business collaboration

Final demo led to further **collaboration with BMW** for physical prototype development

Net Promoter Score

Responses from 24 participants showed **NPS = 83**

Task success rate

Start navigation to Airport (87%)
Play recent playlist after navigation (75%)

LIMITATIONS

Shortcomings & opportunities to improve

User fatigue

Majority users mentioned **~20 min** as the comfortable time using HMD (HoloLens)

Stationary experience

Due to technical limitations, the final demo cannot be experienced while driving

Interaction limitation

Sharp learning curve for users to get used to hand gestures

REFLECTIONS

What did I learn from this project?

Throwaway prototyping with VR

Using VR applications (Google Blocks) can significantly lower iteration efforts & time

Progressive disclosure in 3D space

Use of depth, proximity and transparency to drive user focus on the content

Shared AR experience

Users interacting with the same AR content perceived the experience to be more natural & immersive