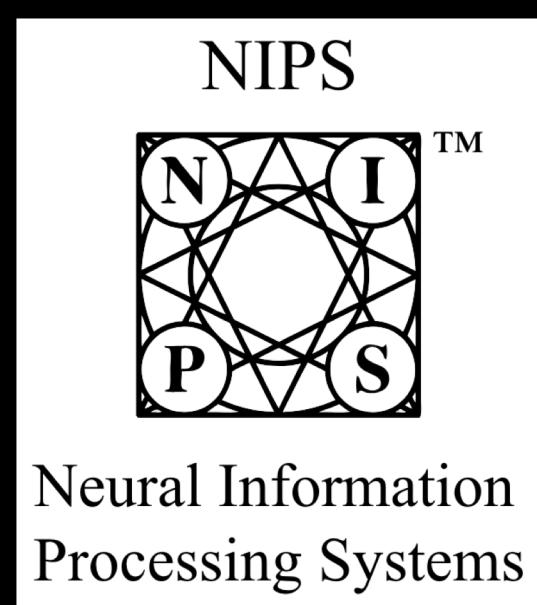


mit  
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LXAI

# **Hover: A Wearable Object Identification System for Audio Augmented Reality Interactions**



# Outline

- Motivation
- Prior and Related Work
- Problem Statement
- Approach
- Testing and Results
- Future Work



# Motivation

Augmented Reality (AR) is (finally) going mainstream

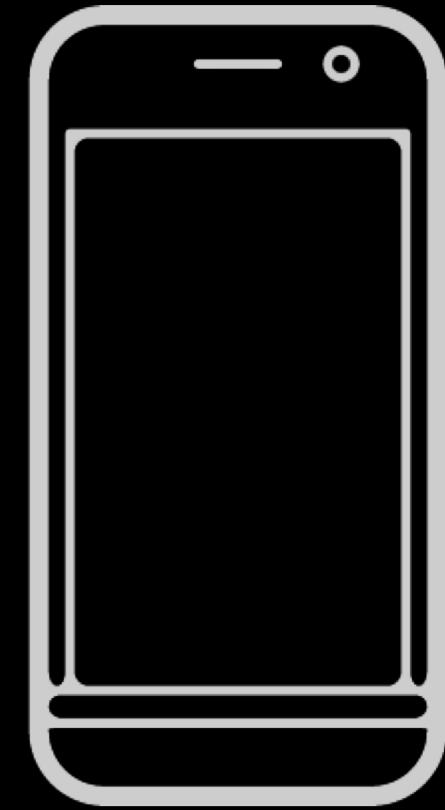
Many promising uses<sup>1,2</sup>

Modern sensors are not being taken advantage of

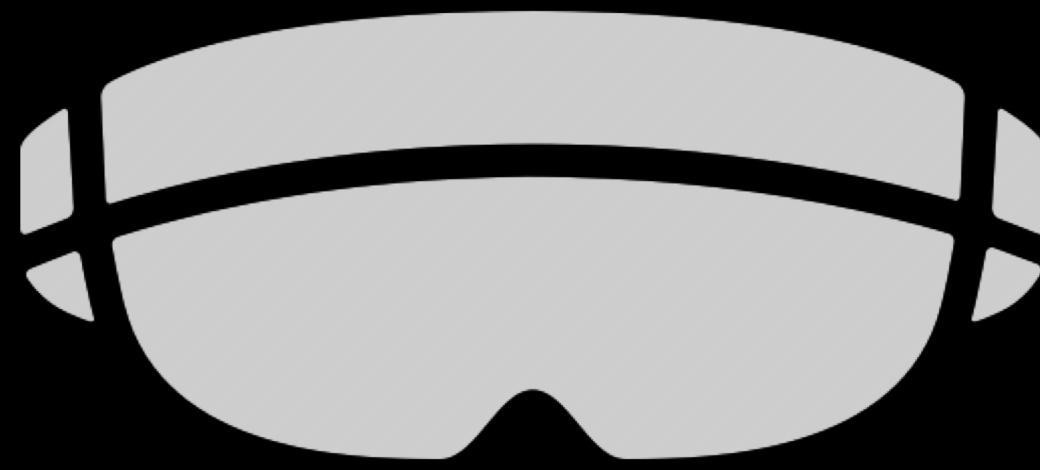
Current approaches are too intrusive, distracting, and cumbersome for daily use<sup>3,4</sup>



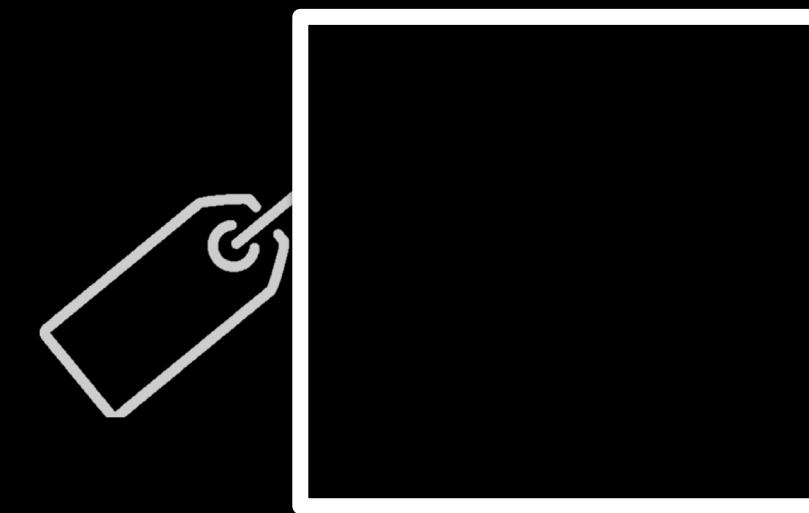
# Current Approaches



Phone

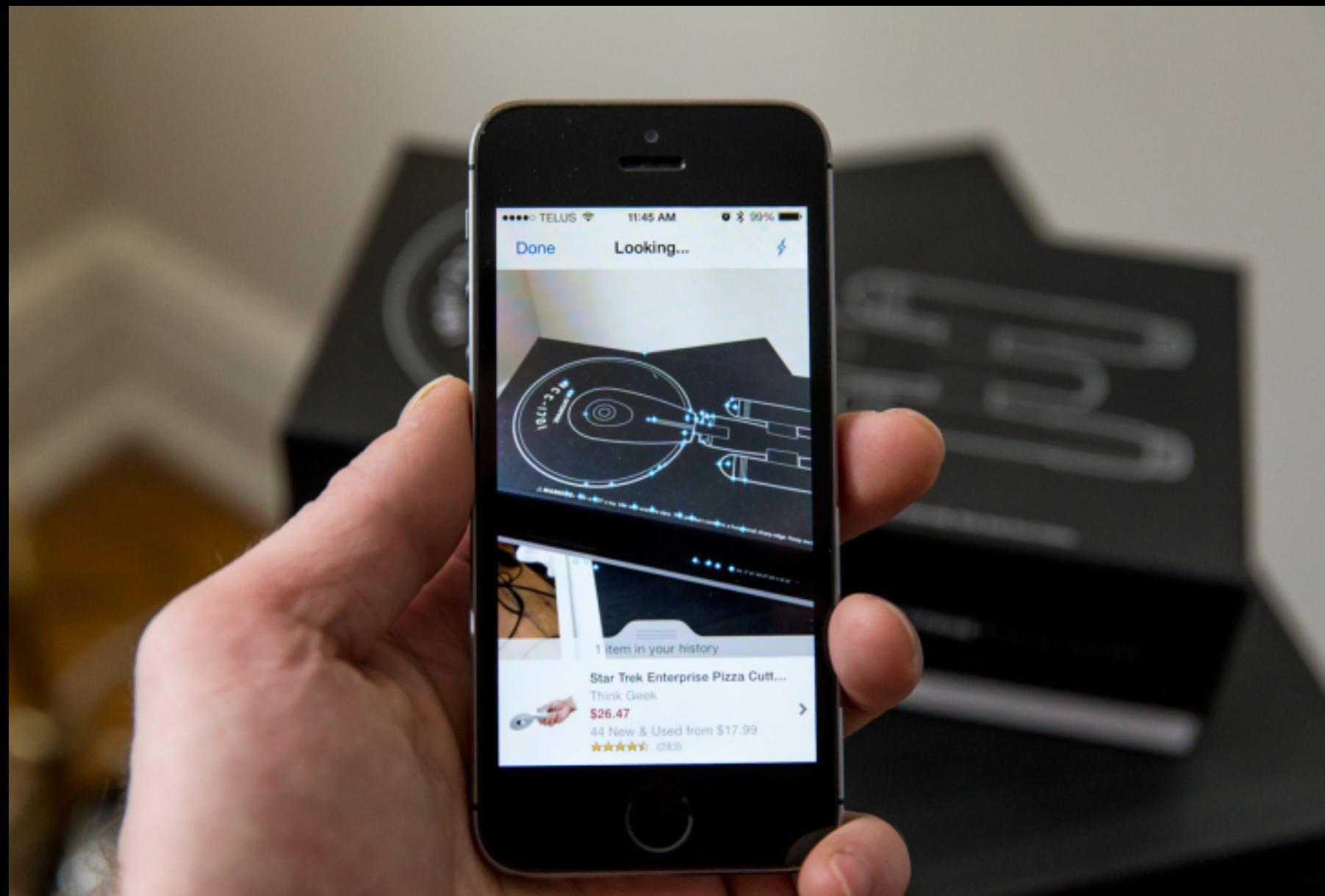


Head Mounted Display



Tagged Objects

# Phone



Amazon



Google Lens



# Head Mounted Display



Wordsense language learning



1. <http://www.businessinsider.com/microsoft-hololens-augmented-reality-headset-roundup-2015-10>
2. <https://www.media.mit.edu/projects/wordsense-learning-language-in-the-wild/overview/>

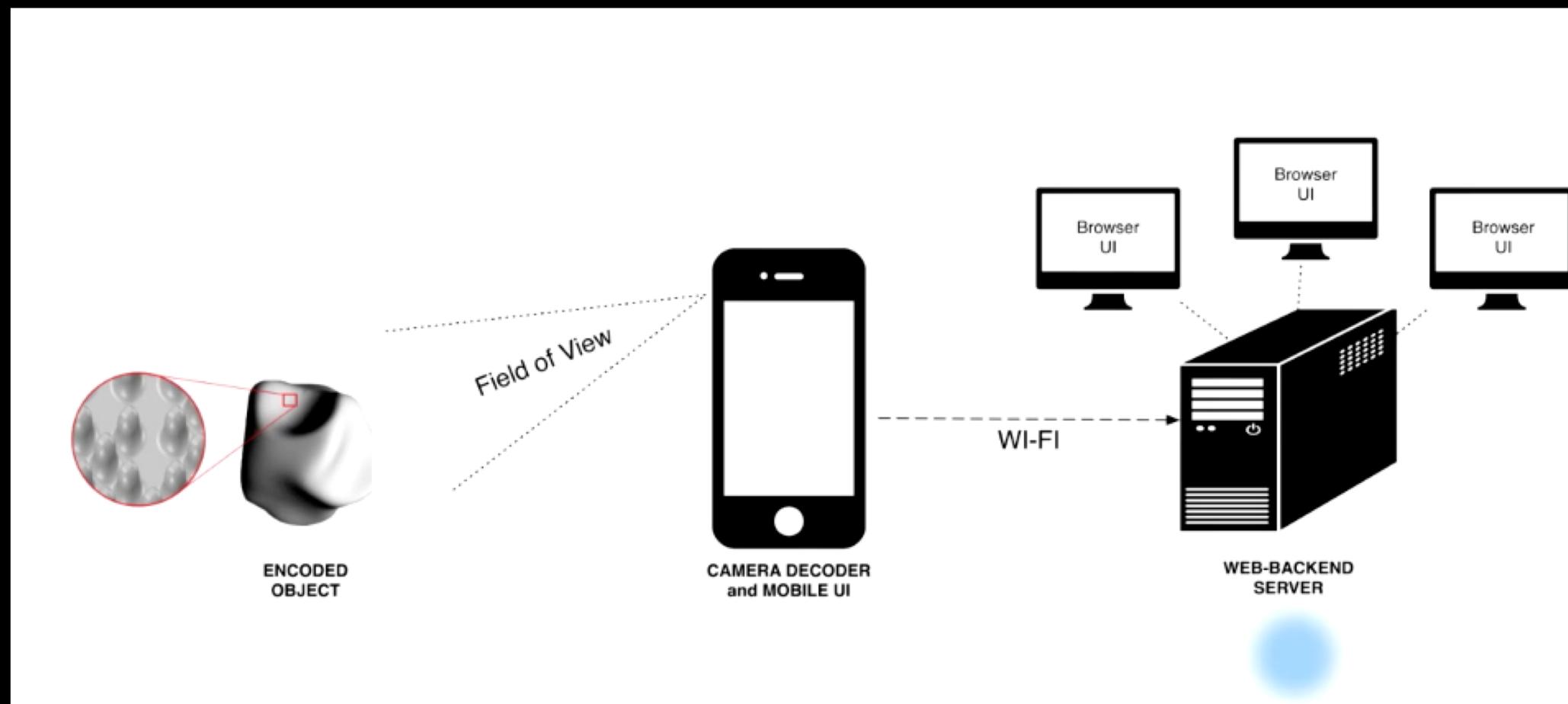


Xperteye

Hover: A Wearable Object Identification System for Audio Augmented Reality Interactions

Pedro Colon-Hernandez

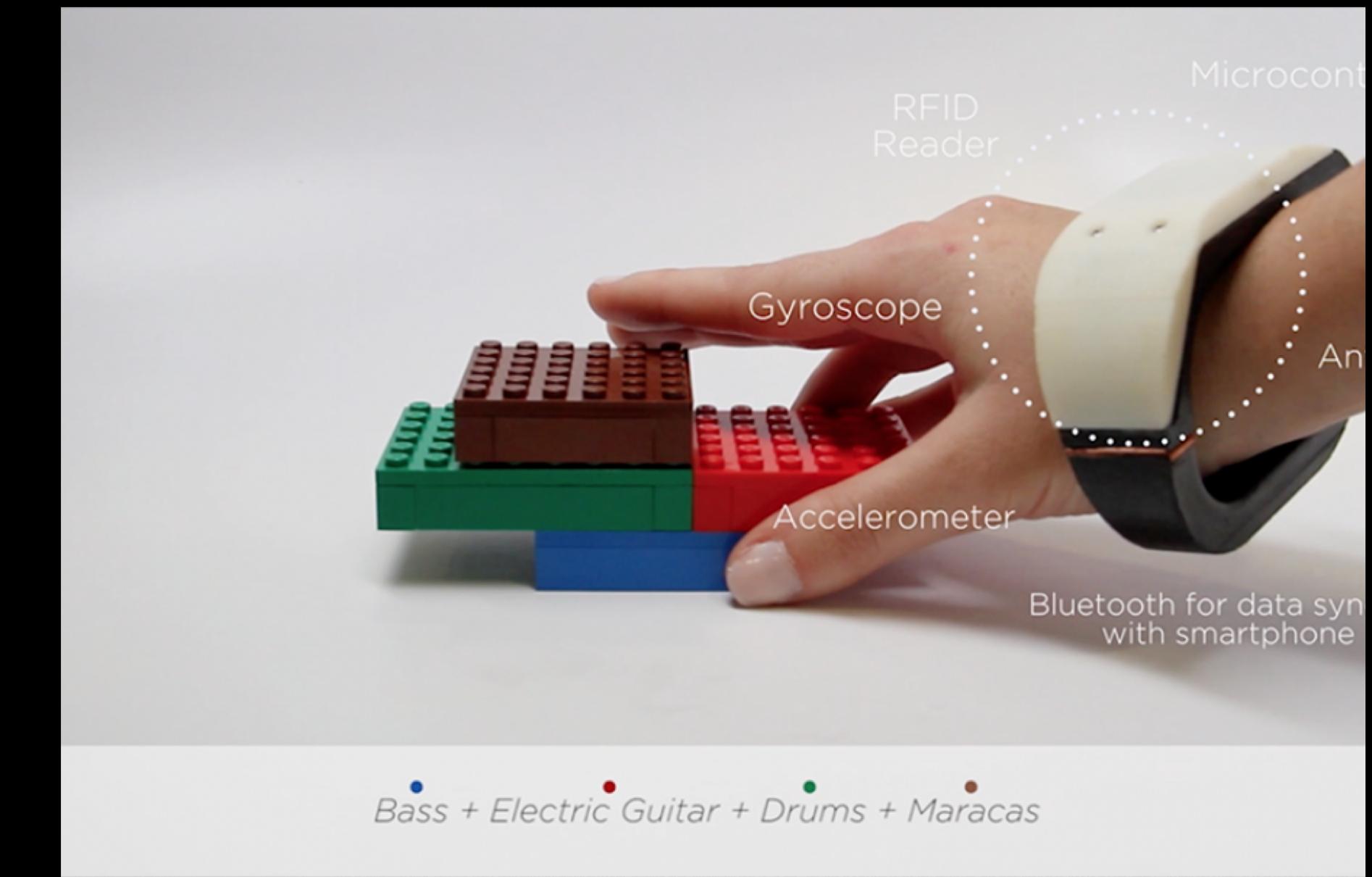
# Tagged Objects



encodedSurfaces



1. <http://www.travisrich.com/project/encodedsurfaces>
2. <http://judithamores.com/tagme/>



TagMe

Hover: A Wearable Object Identification System for Audio Augmented Reality Interactions

Pedro Colon-Hernandez

# Limitations

Phone



Head Mounted Display (HMD)



Tagged Objects



# Problem Statement

*Can we find a multi-modal and seamless way to access contextual information tied to objects in our environment?*



# Approach

Wrist-wearable device

Sensor fusion (Radar,  
Spectrometers, and camera)

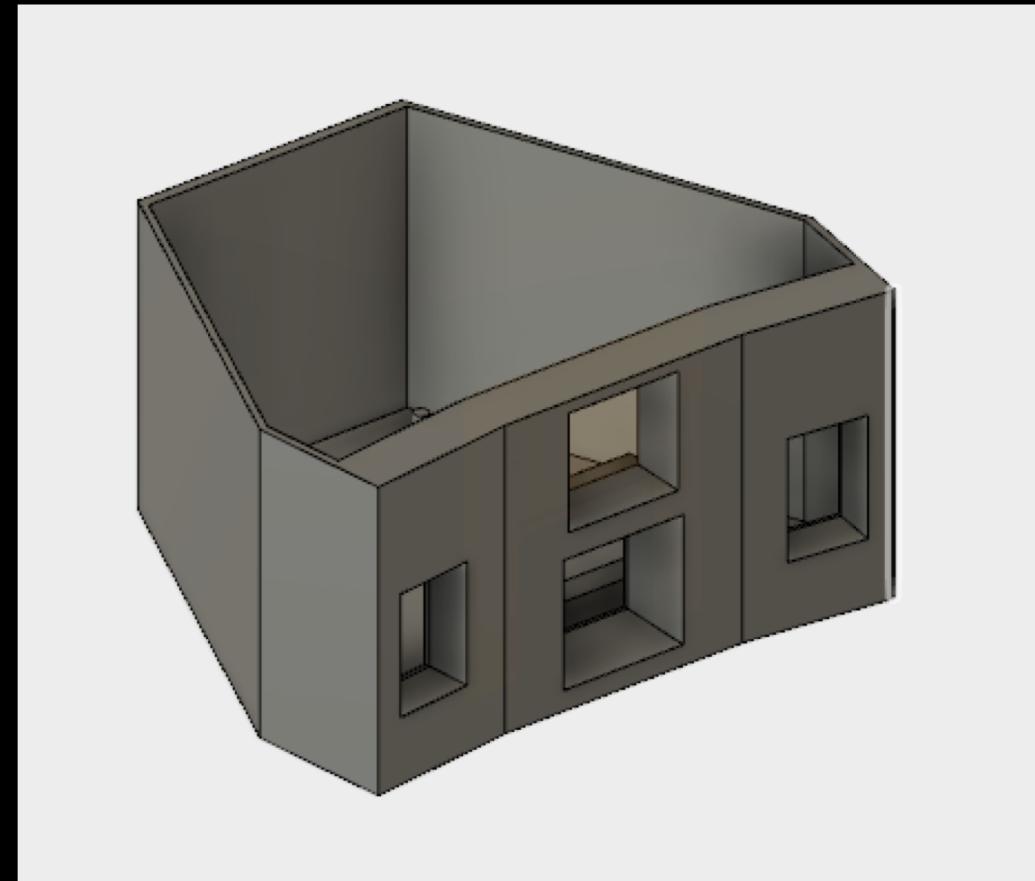
Intelligent assistant for information  
retrieval

Bone conduction headset for  
discreet presentation of info

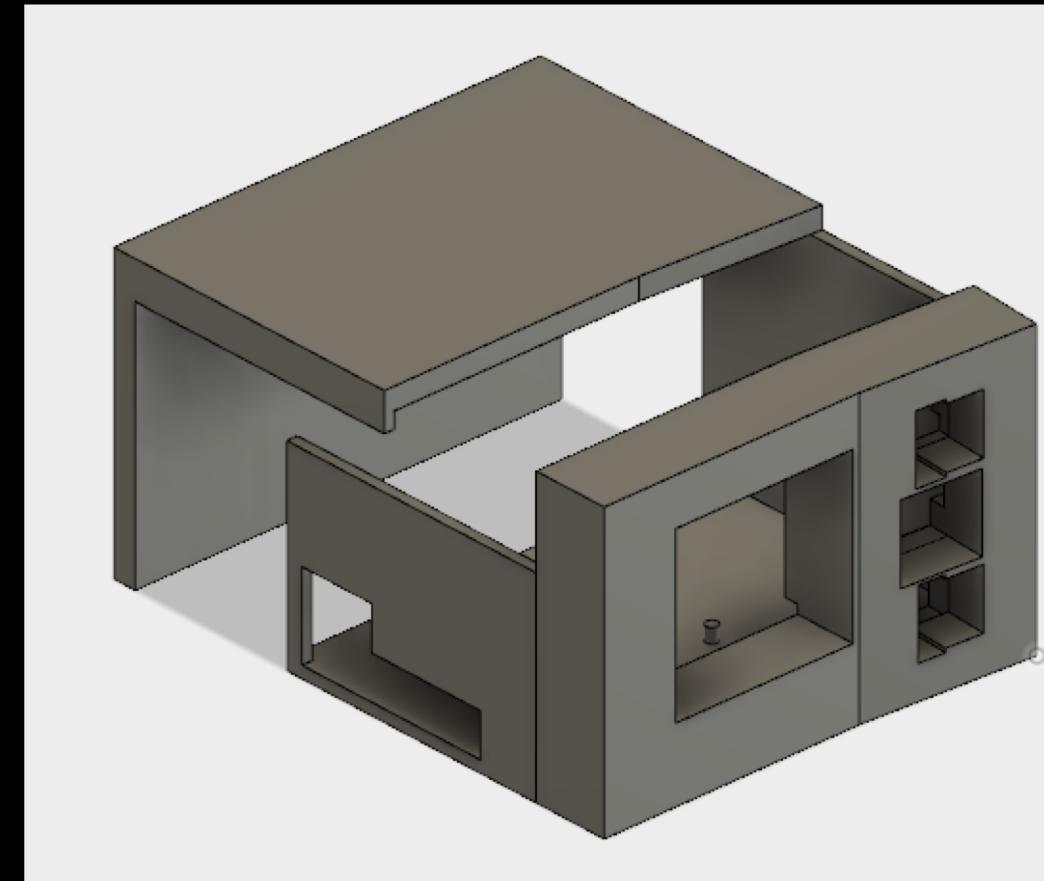


Current Hover device  
prototype setup

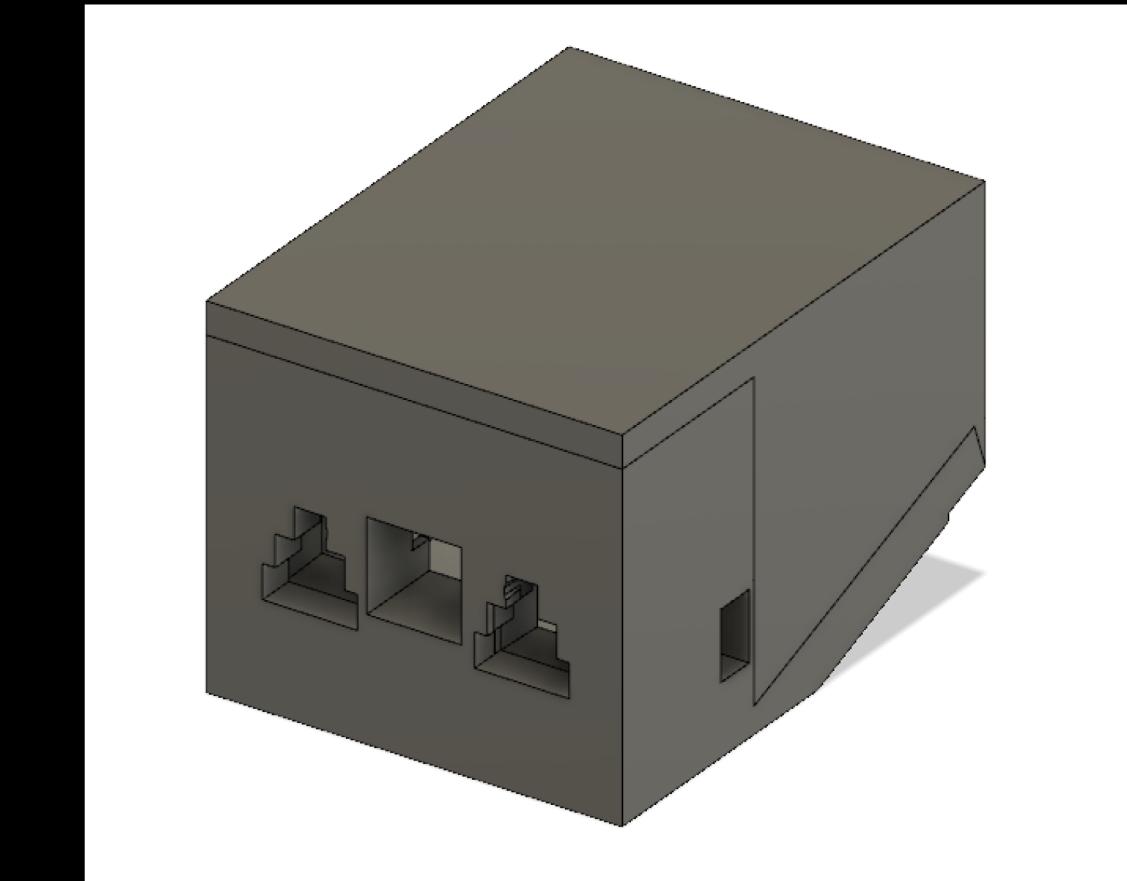
# Wrist Wearable Chassis



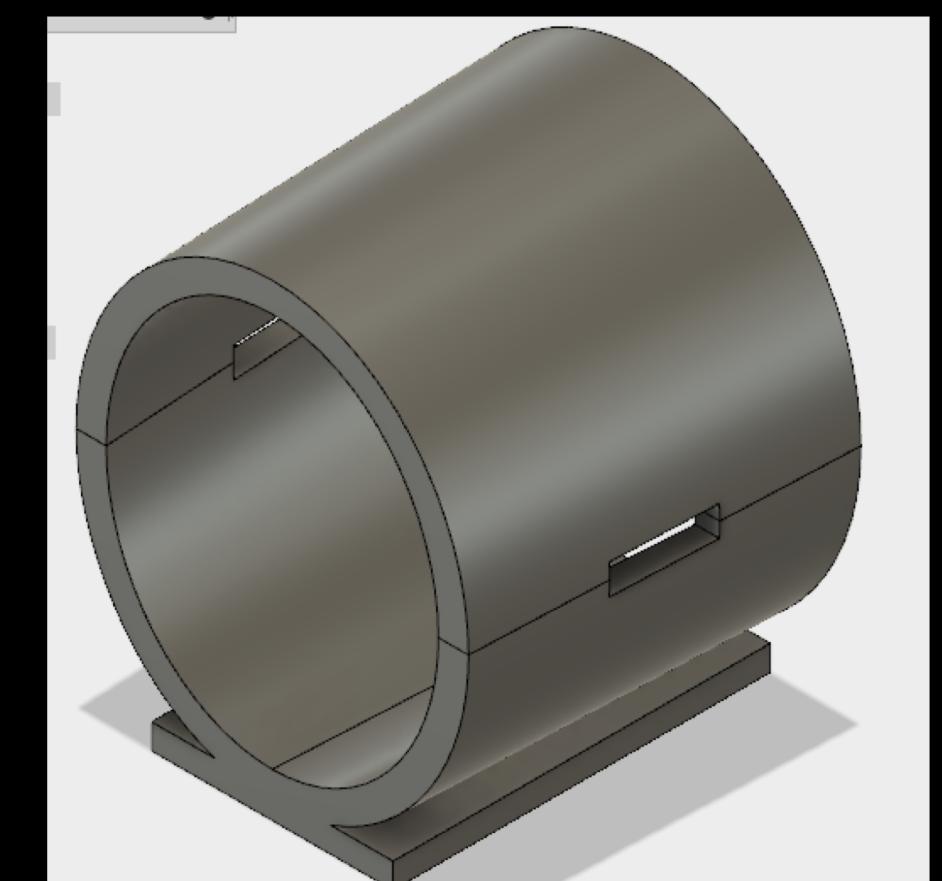
Initial design



Simplified Box Design



Refined Current Design



Bracelet Piece

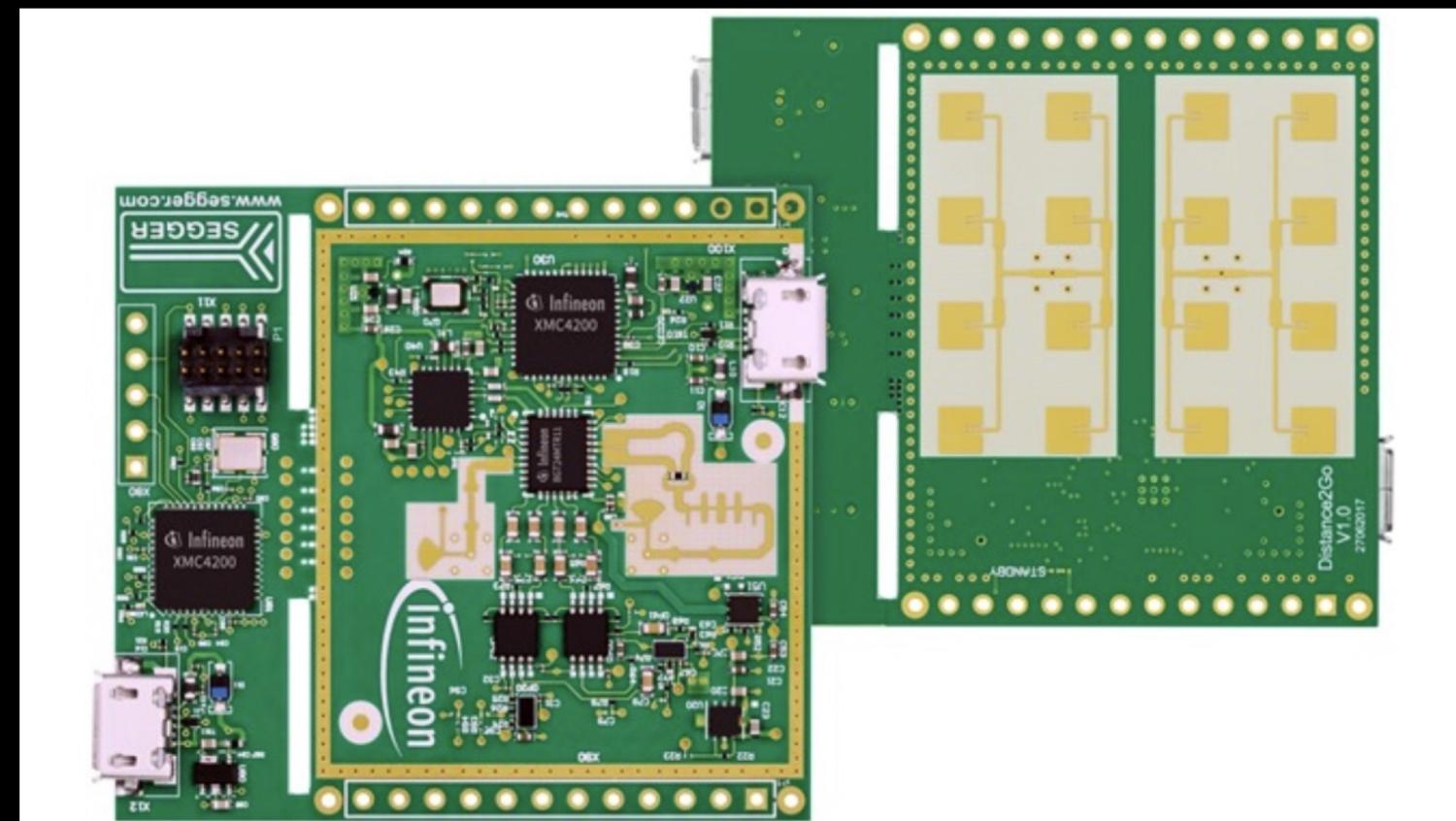
# Sensors

Camera



FA-202 Camera

Radar



Distance2Go

Spectrometers



AS7262/3



# Features

Radar:

range-doppler maps<sup>11</sup>

high range resolution profiles<sup>12</sup>

Spectrometers:

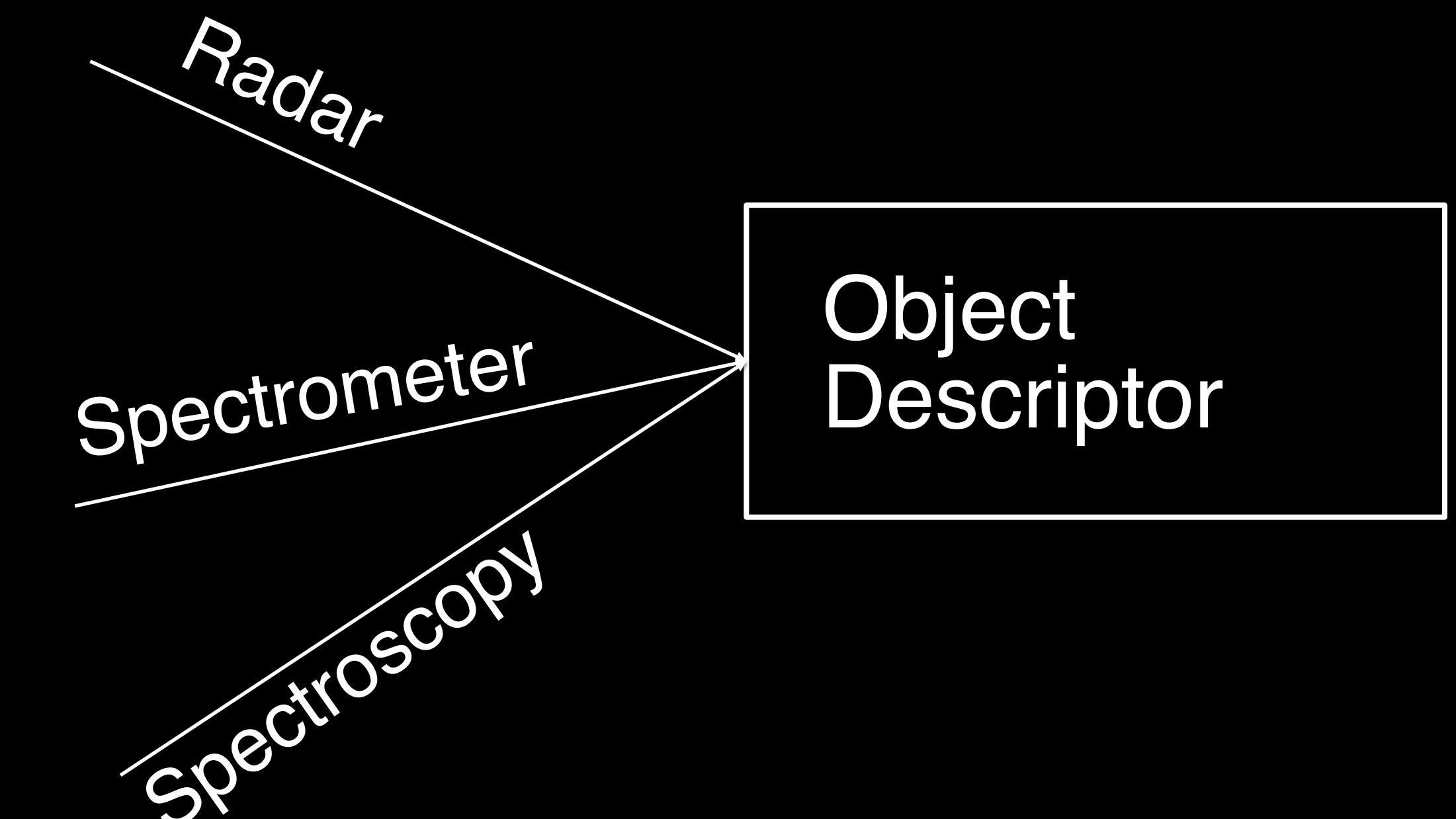
two measurements and average

average value, root mean square, max

Camera:

bag of visual words<sup>10</sup>

histograms visual vocabulary

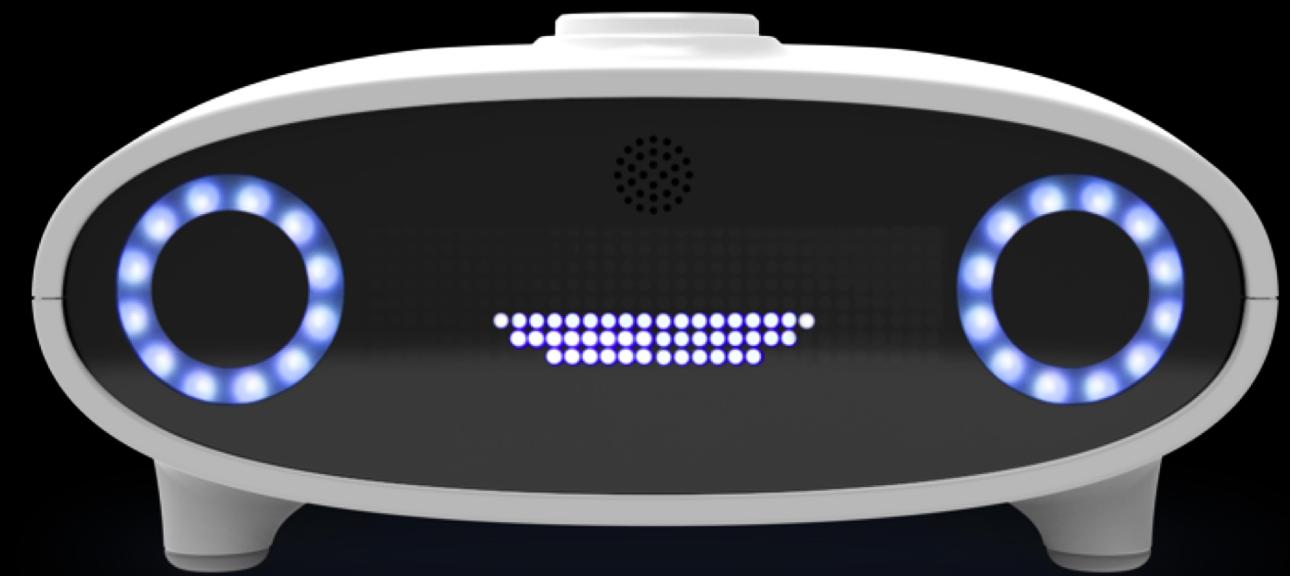


# Intelligent Assistant

Open-source Mycroft AI

Developed a custom skill to:  
register/lookup objects

Relays back object information through spoken audio



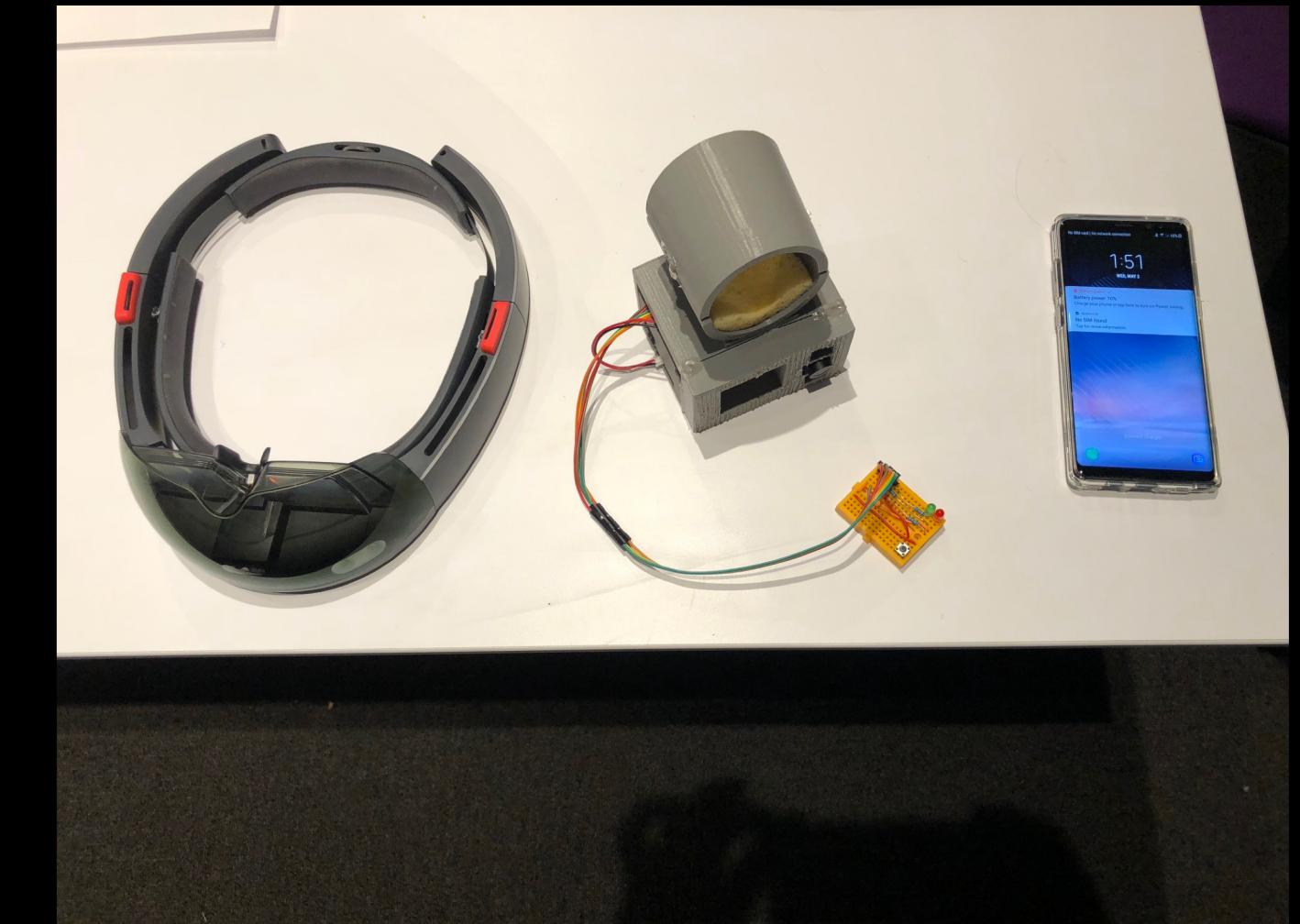
# Testing

## User Testing:

Participants were placed in a predetermined environment to identify a set of objects with 3 devices

## Performance Testing:

Registered 9 objects into the system (one at a time) and proceeded to classify them upon replacement



# User Testing Results

Hover is comparably cumbersome with a mobile phone, and less cumbersome than the Hololens

Hover is comparable in immersion to the Hololens

Hover is also individually less interruptive than a phone but just as interruptive as all the other devices

Hover is comparable in intrusiveness with a phone, and that it is less intrusive than the Hololens

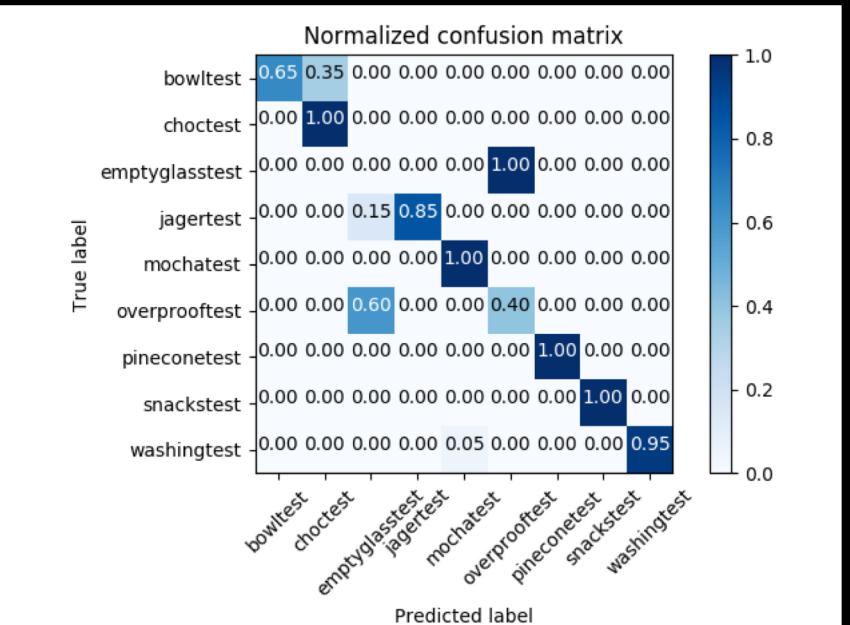


# Performance Testing Results

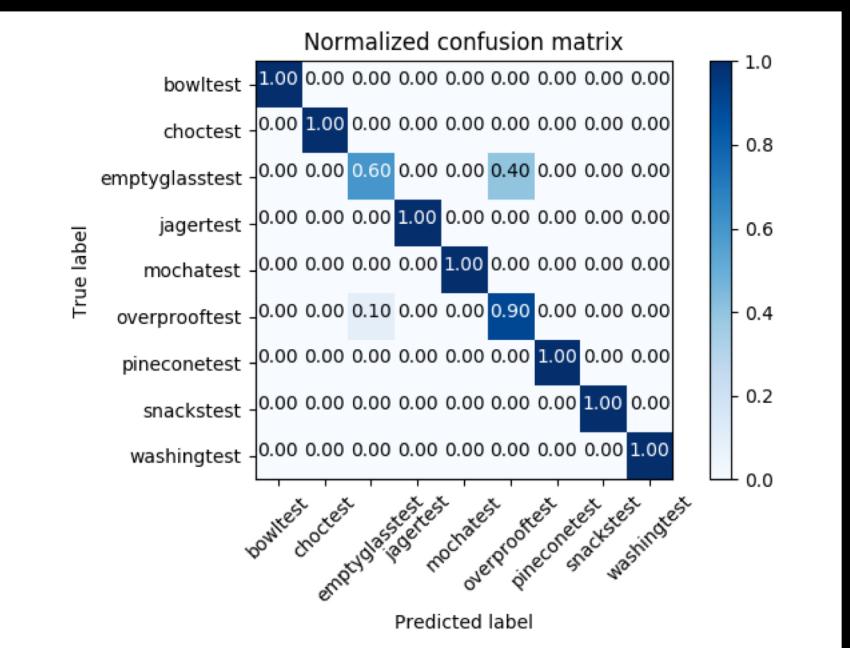
Hover is slightly more accurate than a plain phone camera (0.75 vs. 0.78 accuracy)

A random forest classifier has the best untuned performance (0.78 RF vs. 0.65 SVM vs 0.63 KNN)

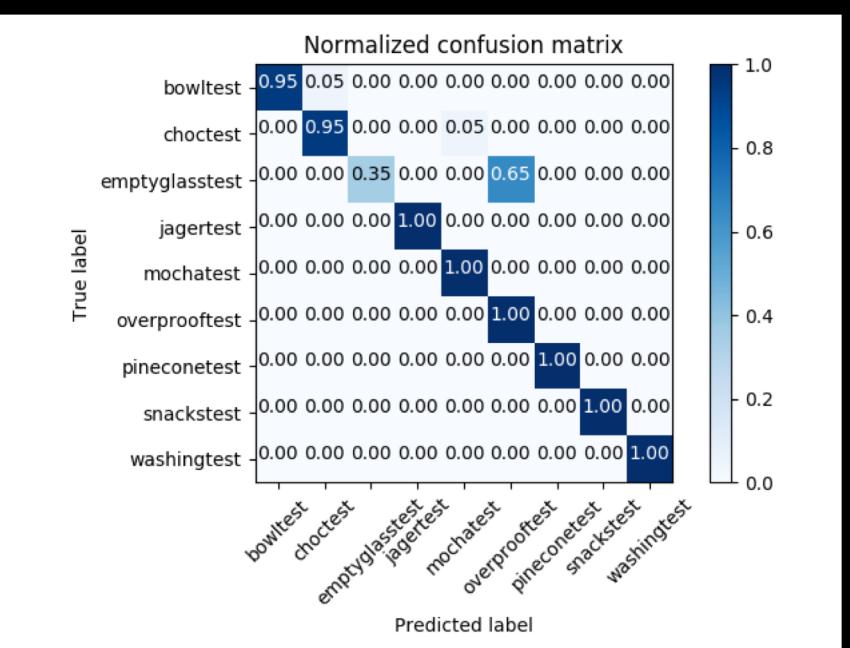
Infrared spectrometer and Radar confuse the system



Fusion System



AS7263 Removed



Radar Removed



# Conclusions

Promising approach if streamlined

Tuning and revision of the sensors is needed



# Future Work

Form factor and directionality assistance

Learned Features

Better testing

Broadband LED and Higher Resolution Radar

Dynamic Intelligent assistant (dynamic information)



# References

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For full references see:

<https://dspace.mit.edu/handle/1721.1/119083>

