# Human Inclusive Robotics

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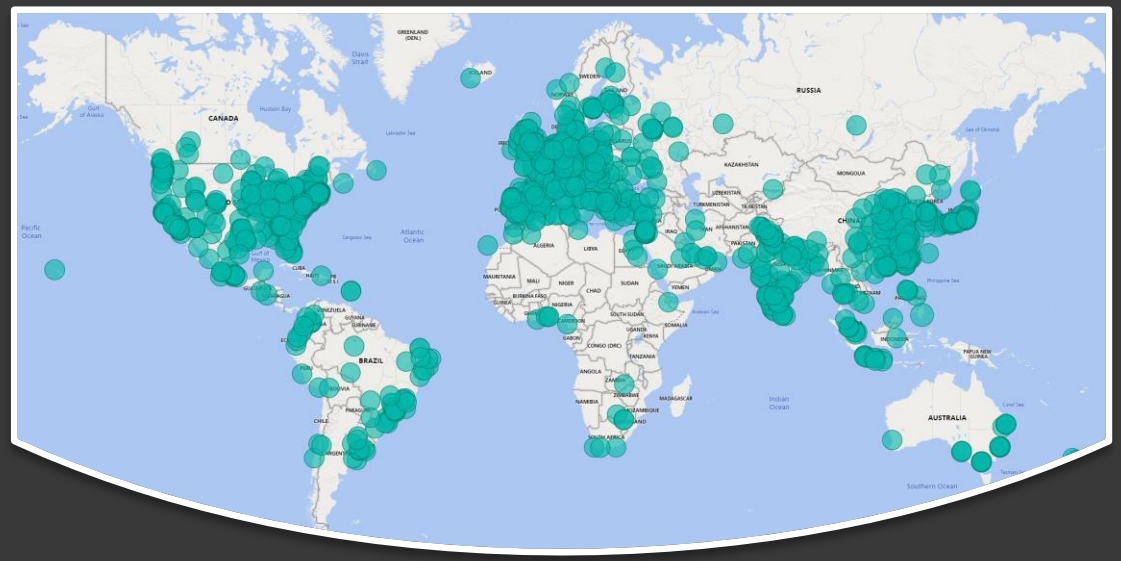
# Robotics in Azure Edge + Platform

**ROS at Microsoft**

- ROS Nodes for Azure & Windows
- RoboOps
- VSCode ROS Extension
  - 90,000+
- ROS On Windows
  - 150,000+

**ROS Community Engagement**

- ROS 2 TSC
- ROS Industrial Consortium
- ROSCon Sponsors
- Active on ROS Answers
- Active on Reddit /r/ROS



# Topics

- Historical perspective
- Microsoft Investments
  - “Citizen Roboticists”
  - Holographic UI for ROS2
  - Natural Language Interaction
  - Natural Body Interaction
  - Simulation Construction Kit

# Discuss the Folklore of John Henry

https://commons.wikimedia.org/wiki/Category:John_Henry_(folk_hero)

# Robots work for people

# Problem Space

Building a Robot is Hard

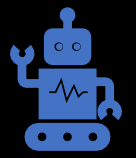


Designing for Multiple Robotics is even more difficult

Interacting with Robots is unnatural

Robots need to understand intention

Robots don't understand nuance



Understanding a robot is important.

# Embrace the ‘Citizen Roboticist’

# Invest in Makers

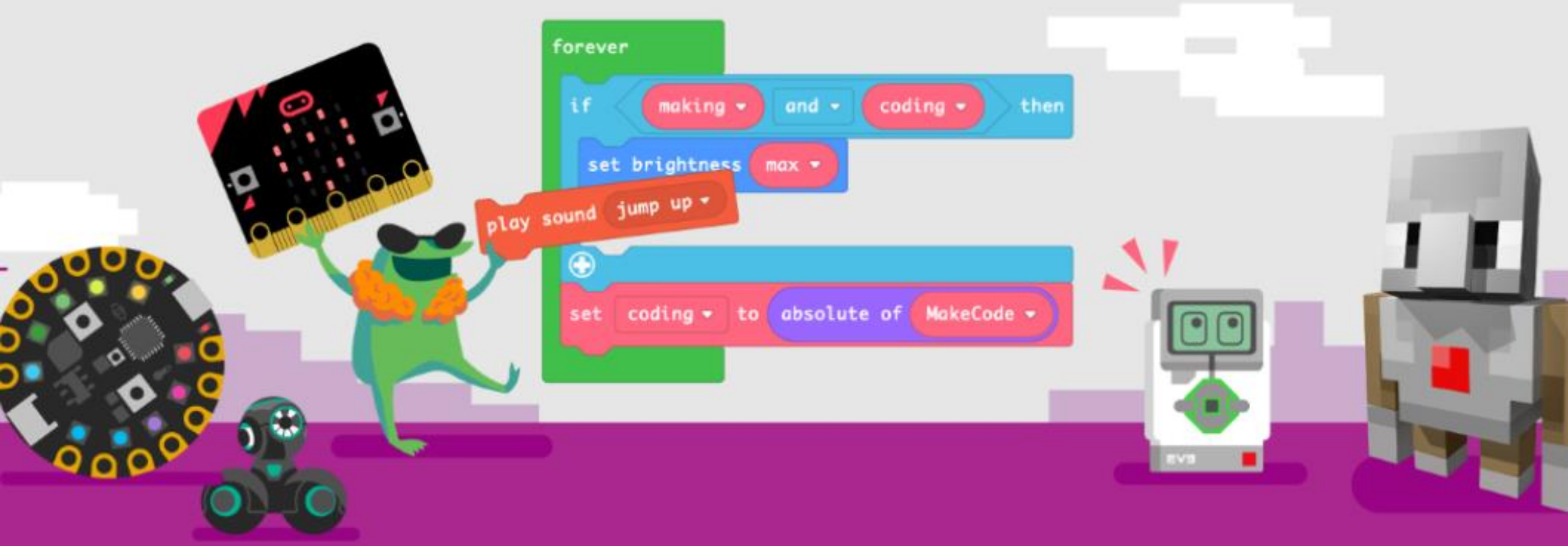
# What's missing for the Maker Moment?

Software

- Reduction in cognitive load
- Low Code & No Code
- Easy end to end
- Exciting scenarios
- Sim to real / Real to sim

Hardware

- Low-cost precision drive platforms
- Low-cost precision arms
- Low-cost precision sensors



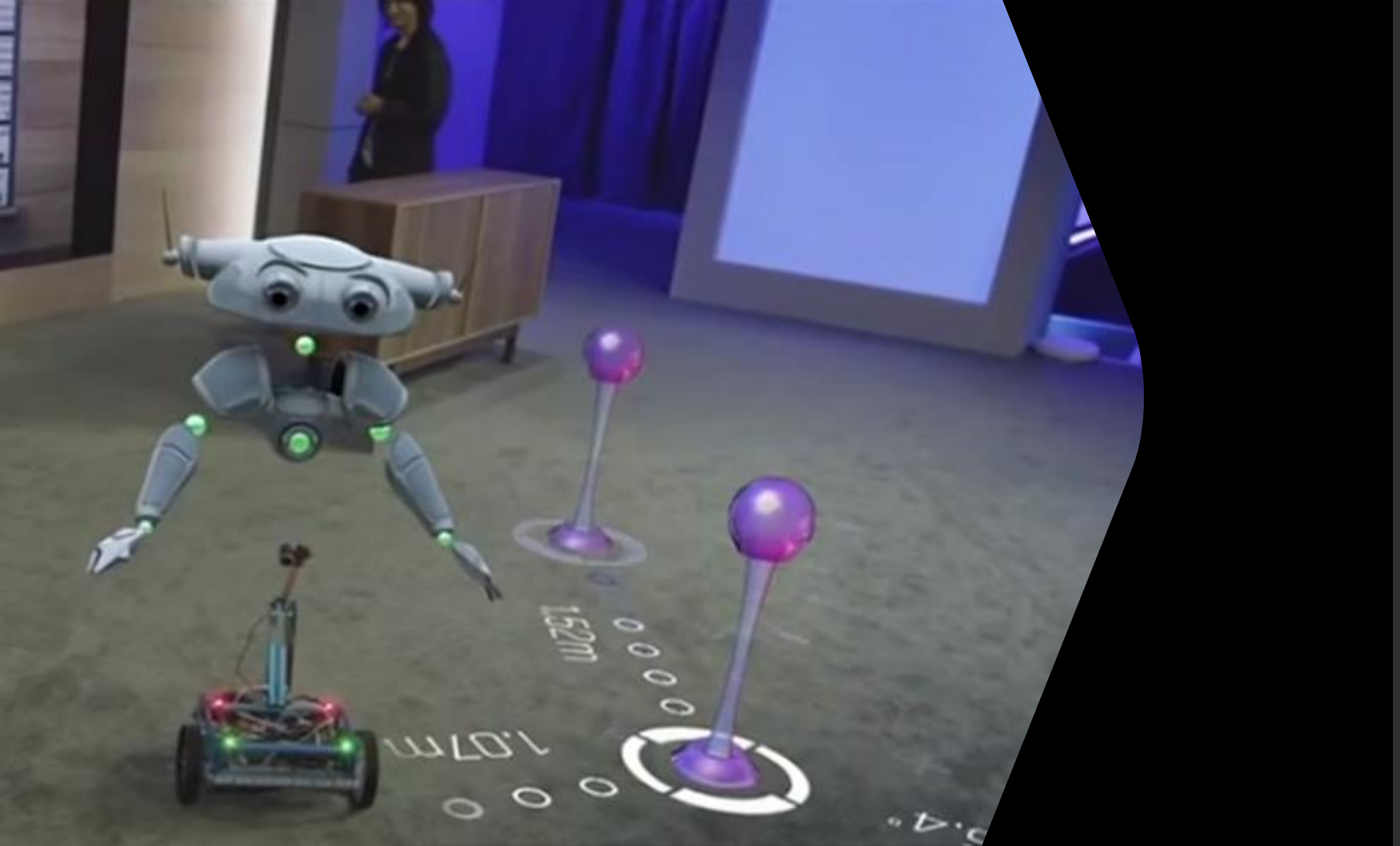

# Make & Code

Combine the magic of making with the power of code across a variety of different products using Microsoft MakeCode.

https://www.microsoft.com/en-us/makecode


# Holographic Robotics Interfaces


Holographic interfaces are natural ways of interacting with robots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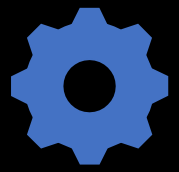
# Mixed Reality Toolkit for ROS2

Under active development

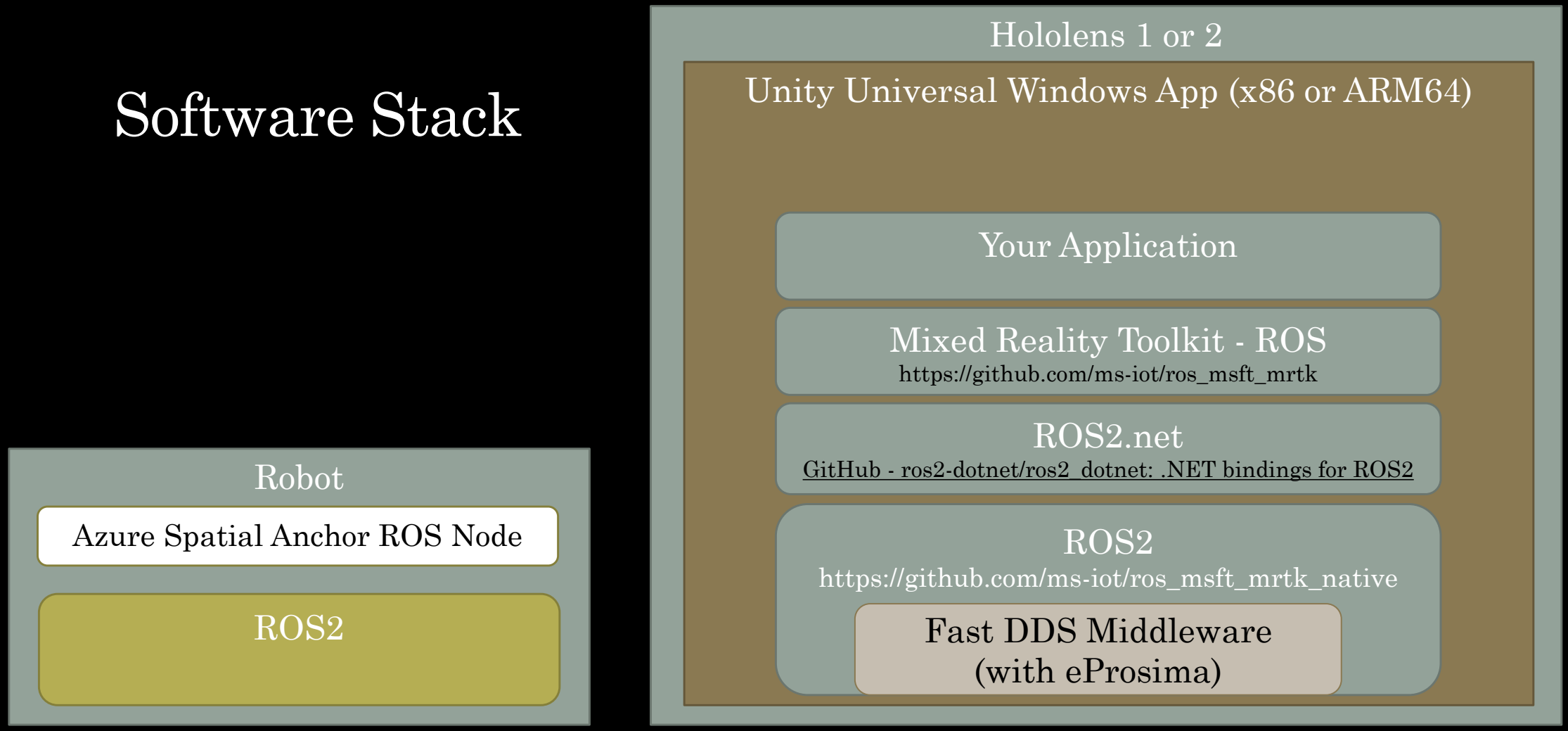
Robotics specific
UI Components

‘Pin’ Holographic
& Robot Space



ROS2.net +
Unity

# Software Stack



# MRTK ROS Extension

ROS1 & ROS2

Spatial Pinning via Apriltag or Azure Spatial Anchors

TF2 Spatial translation from Robot through world to Hololens

Visualization Assets

Interaction Assets

The pose of the fiducial tag relative to the odometer is known a-priori by modifying the robot URDF file before runtime.

Use Apriltag to estimate the pose of the fiducial tag attached to the robot relative to the HoloLens camera.

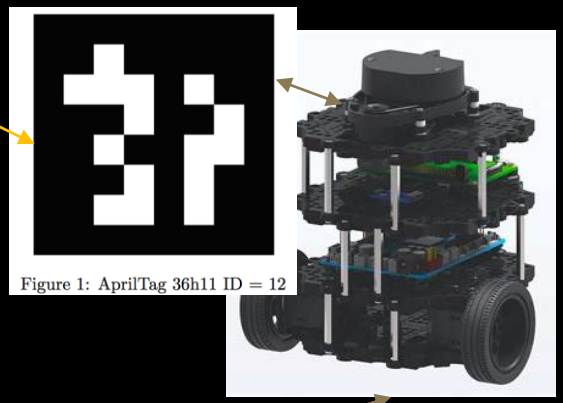


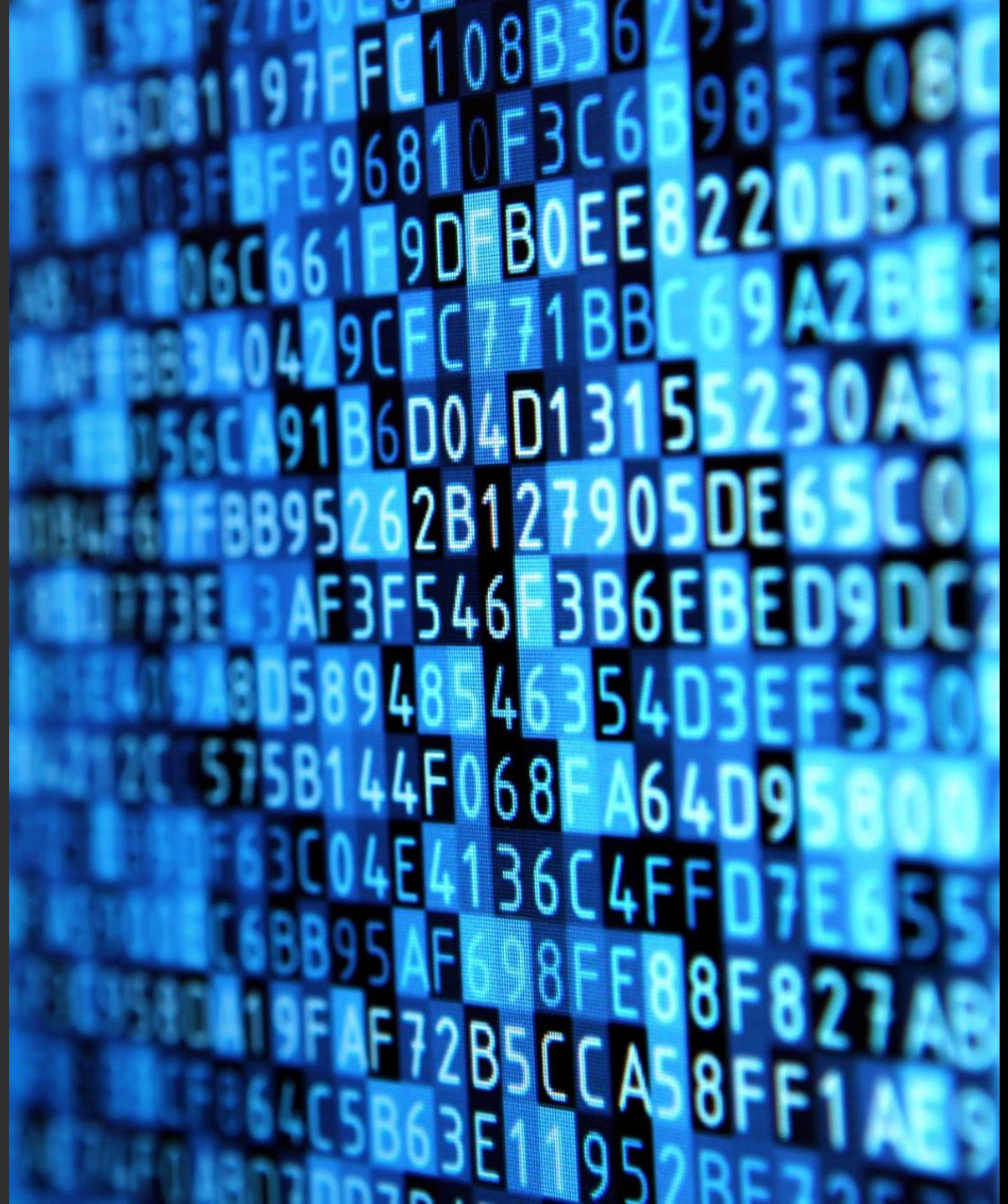
Figure 1: AprilTag 36h11 ID = 12

Use tf2 to get the transform between the fiducial tag and ROS world zero.

## ROS World Zero

Use tag offset from camera + tag offset from ROS world zero to calculate the location of the MRTK world anchor in Unity space.

Once the MRTK anchor is placed, Apriltag is no longer needed. All updates to robot pose can be pulled from tf2.



# Natural Language Interaction

# What?

- A Robot often requires help to execute a task
- A Robot needs to know where to go
- A Robot needs to know when to STOP
- A Robot needs to let you know what it is doing

# Language Understanding

In Preview

- LUIS ROS node
  - Allows a robot to transform voice to a ROS message
  - Intention encoded into an utterance
  - Utterance to ROS action is specific to behavior
- Still to be implemented
  - Behaviors
    - Move_base
    - MoveIt
    - STOP
    - Latency improvements
    - Microphone Array support

https://github.com/ms-iot/ros_msft_luis

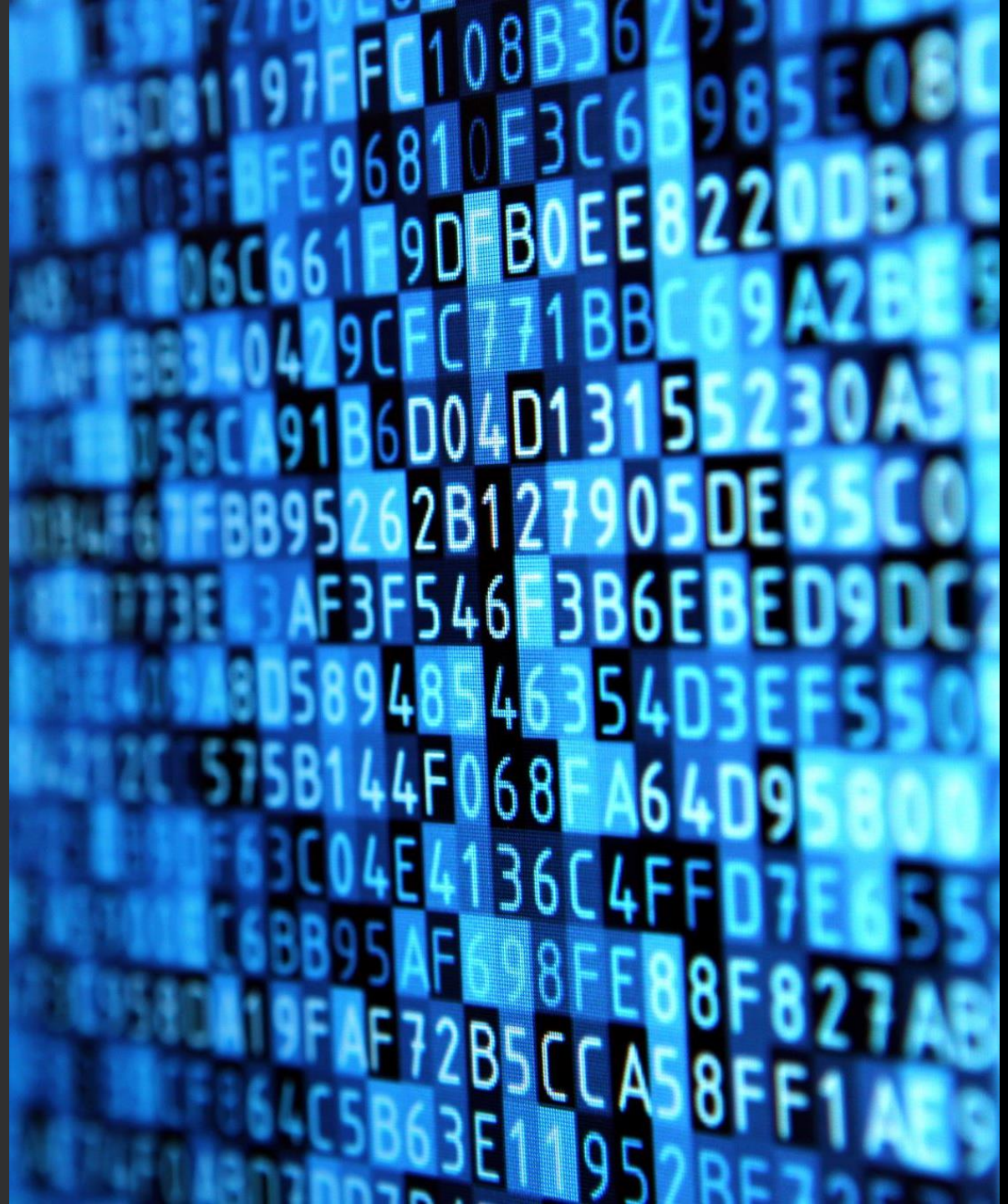
# Speech

Backlog

- ROS node for Microsoft speech Services
  - Multi-language
  - Multi-Voice
  - Local playback

# HiWin demonstration of speech


https://microsoft.github.io/Win-RoS-Landing-Page/hiwin_case_study.html#



# Gesture Interaction

Incubating

# Body tracking

Exposed as Markers from Azure Kinect ROS Node

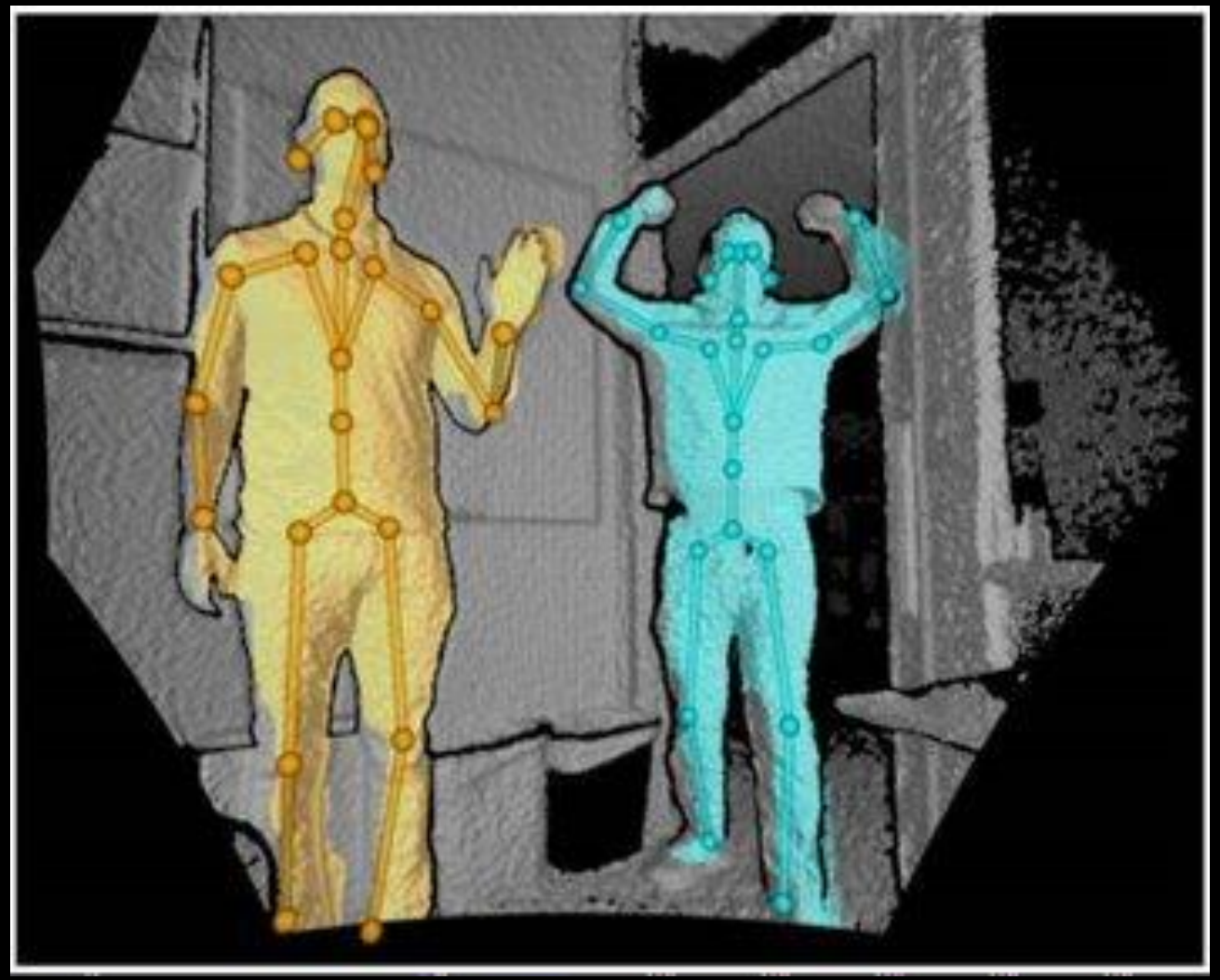
Future Projects:

Static Gesture Solvers

- Elbow to Hand to ground Ray
- Stop Gesture

Dynamic Gesture Solver

- Direction from arm
- Come forward
- Move backward



https://github.com/microsoft/Azure_Kinect_ROS_Driver

# Simulation Construction Kit

Incubating

# Problems?

- Building a simulation environment is hard.
- Scripting a simulation environment is hard.
- Asset creation is hard

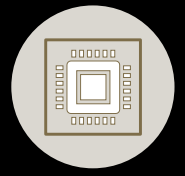
# Let's Make Simulation Easy!

Create environments

Create Assets

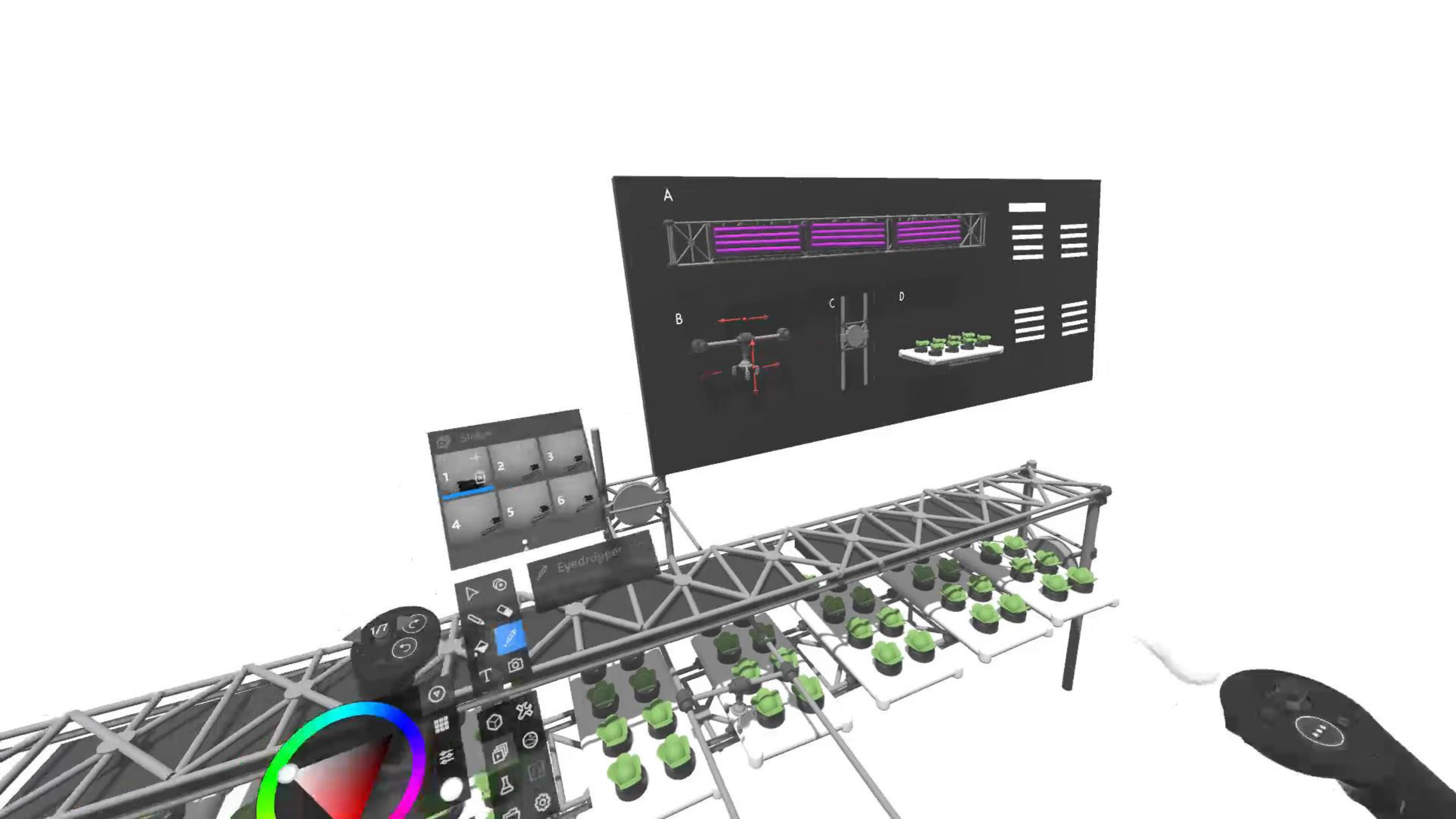
Script Assets

Simulate Robots

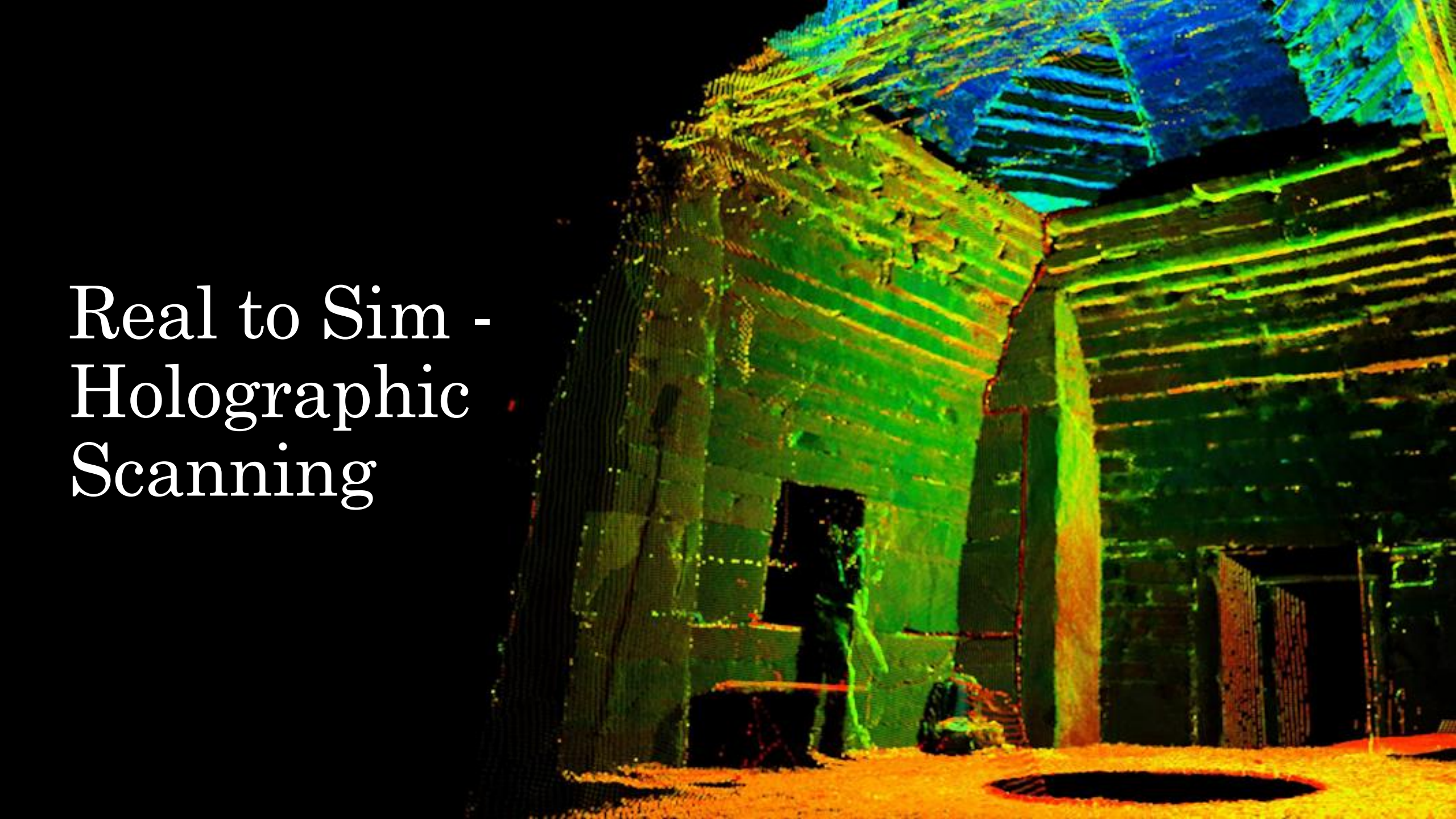


Validate in sim before deploying on robot


Microsoft
Maquette
to
AirSim & Gazebo
https://www.maquette.ms/


A
B
C
D
Eyedropper

# Real to Sim - Holographic Scanning



# Would you like to know more?

http://aka.ms/ros

Reach out: riotsquad@microsoft.com

Thank You!