

# Using Augmented Reality to give Instructions for Building LEGO Models

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# Motivation

- Give instructions
- No printed manual, no expert, no training
- Building prototype with LEGO models

# Outline

- Augmented Reality
- Requirements
- Implementation
- Challenges
- Outlook
- Demo

# Augmented Reality

- Add Information to real world
- Devices:
  - Head Mounted Displays
  - Phones

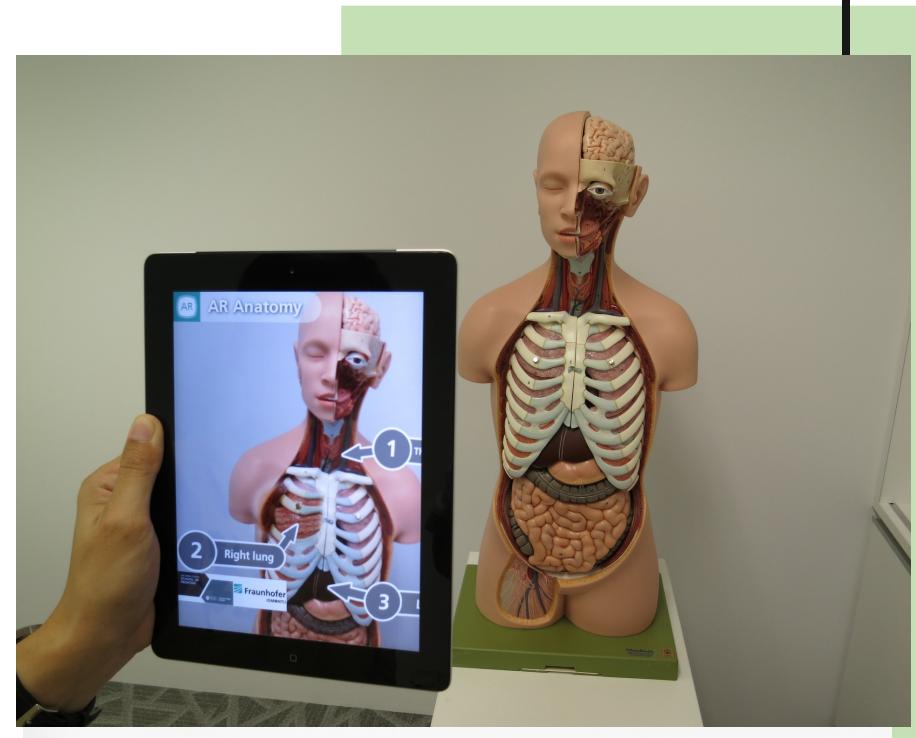


<https://www.wevolver.com/wevolver.staff/hololens.gen.1>



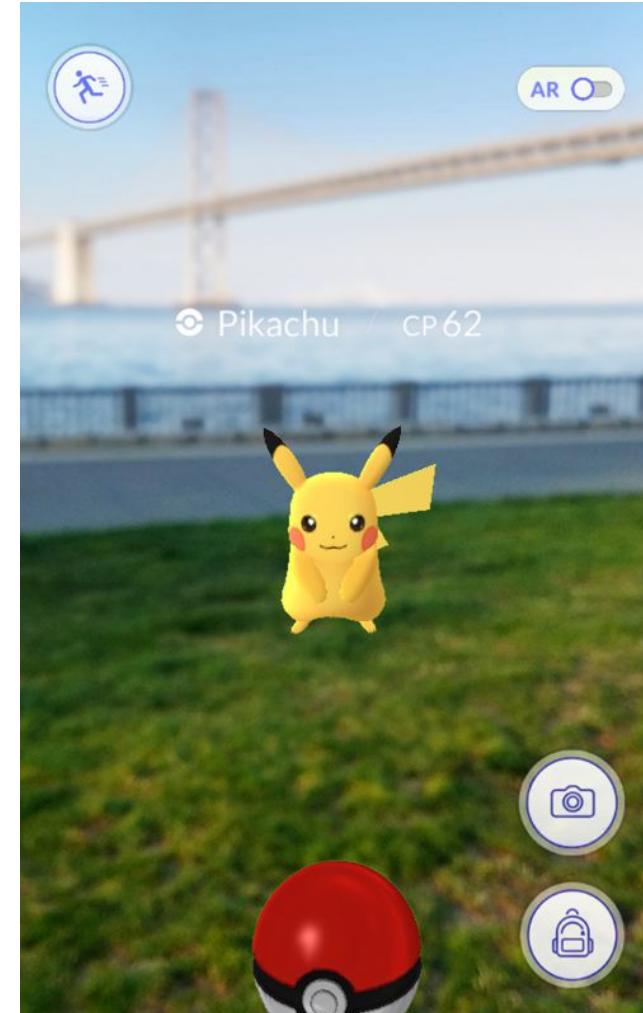
# Augmented Reality

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- Devices:
  - Head Mounted Displays
  - Phones
- Use Cases:
  - Information/Instructions
  - Games
  - Architekture
  - TV



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<https://pokemongolive.com/en>

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<https://www.ibm.com/products/max-reality>



<https://www.derstandard.de/story/2000109270202/oesterreich-flach-gelegt-die-fliegenden-wahlgrafiken-des-orf>

# Requirements

- Head Mounted Device
- Model Picker
- Step by Step Instruction
- Voice Input
- Movable and Scalable
- Highlighting



# Implementation

- Hardware
  - HoloLens
- Software
  - Python, Unity/C#/MRTK
  - Different File Formats
- 2 Steps
  - Preprocessing Model
  - Unity App



<https://www.wevolver.com/wevolver.staff/hololens.gen.1>

# Step 1: Preprocessing

- Input
  - LDraw files: .ldr, .mpd
- Output
  - .obj Step files
  - .obj Preview file
  - .mtl Material file
- Asset Bundles

```
1 0 FILE 1096 - Go-Kart.ldr
2 0 Go-Kart
3 0 Name: 1096 - Go-Kart.ldr
4 0 Author: Tomas Kralicek [Rabbit_CZ]
5 0 !LDRAW_ORG Model
6 0 !LICENSE Redistributable under CCAL version 2.0 :
7
8 1 0 0 -8 -40 -1 0 0 0 1 0 0 0 -1 6157.dat
9 1 0 0 -8 40 -1 0 0 0 1 0 0 0 -1 6157.dat
10 0 STEP
11 1 15 0 -8 0 0 0 1 0 1 0 -1 0 0 3795.dat
12 0 STEP
13 1 15 0 -16 -50 1 0 0 0 1 0 0 0 0 1 2540.dat
14 1 7 0 -16 40 1 0 0 0 1 0 0 0 0 1 3022.dat
15 0 STEP
16 1 7 -10 -40 50 1 0 0 0 1 0 0 0 0 1 3062b.dat
```

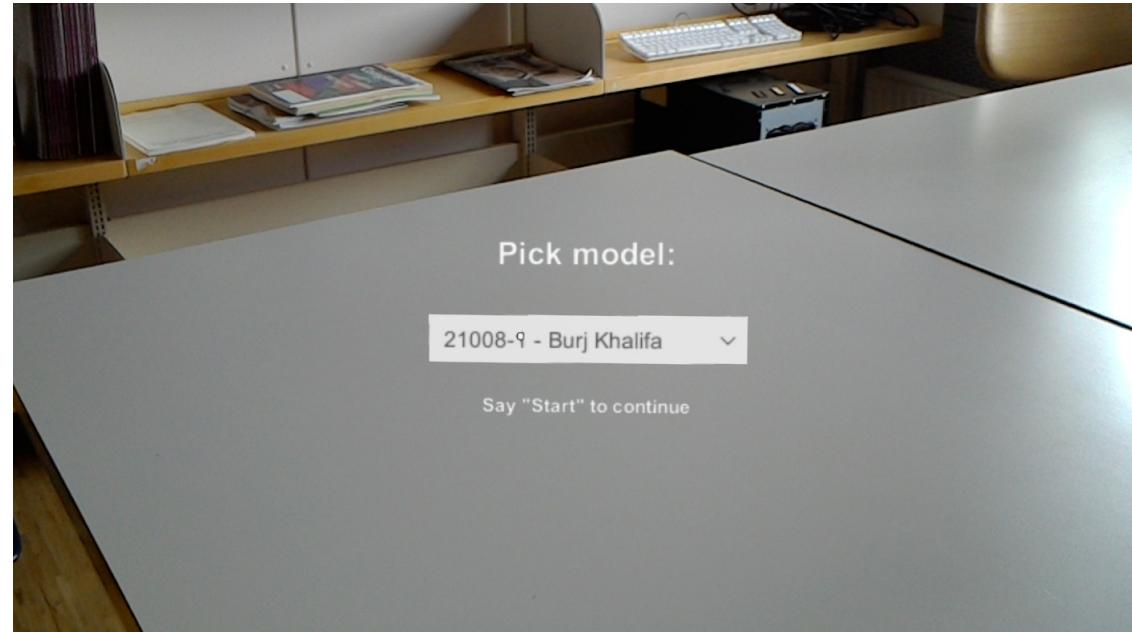
# Step 1: Preprocessing

- Input
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```
1 0 Stud Tube Open Split without Split Base Edges (Fast-Draw)
2 0 Name: 8\stud22a.dat
3 0 Author: Joerg Sommerer [Brickaneer]
4 0 !LDRAW_ORG 8_Primitive UPDATE 2013-02
5 0 !LICENSE Redistributable under CCAL version 2.0 : see CReadme.txt
6
7 0 BFC CERTIFY CCW
8
9 0 !HISTORY 2013-12-23 [PTadmin] Official Update 2013-02
10
11 2 24 -5.6 0 5.6 -7.1429 0 2
12 2 24 -5.6 -4 5.6 -7.1429 -4 2
13 2 24 -4.2 0 4.2 -5.1429 0 2
14 2 24 -4.2 -4 4.2 -5.1429 -4 2
15 4 16 -5.1429 -4 2 -4.2 -4 4.2 -5.6 -4 5.6 -7.1429 -4 2
16 4 16 -7.1429 -4 2 -5.6 -4 5.6 -5.6 0 5.6 -7.1429 0 2
17 4 16 -5.1429 0 2 -4.2 0 4.2 -4.2 -4 4.2 -5.1429 -4 2
18 1 16 -6.1429 -2 2 1 0 0 0 0 -2 0 1 0 rect3.dat
19 2 24 -5.6 0 5.6 0 0 8
20 2 24 -5.6 -4 5.6 0 -4 8
21 2 24 -4.2 0 4.2 0 0 6
22 2 24 -4.2 -4 4.2 0 -4 6
```

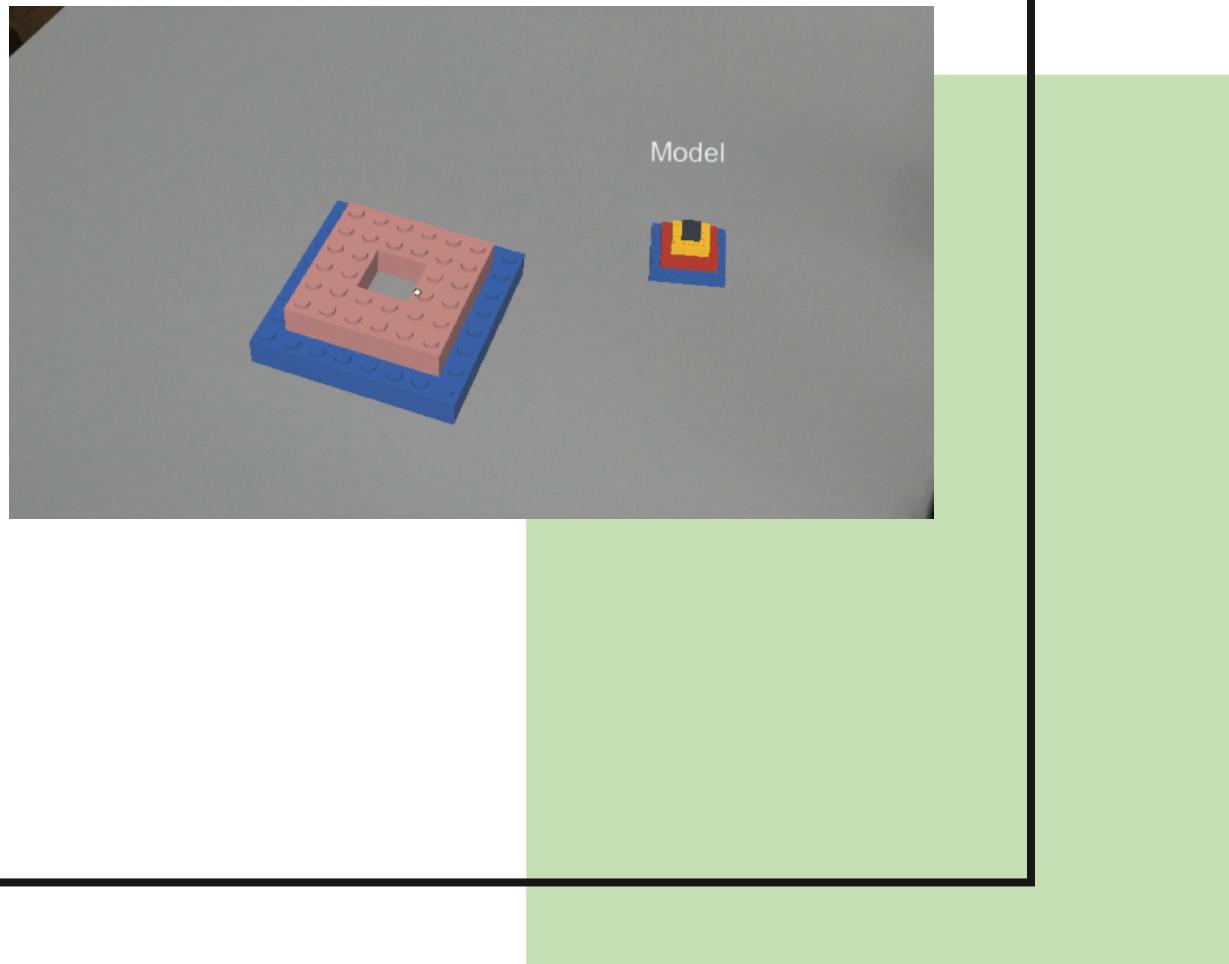
# Step 2: Unity App

- Model Picker
- Voice Commands
- Preview
- Highlighting



# Step 2: Unity App

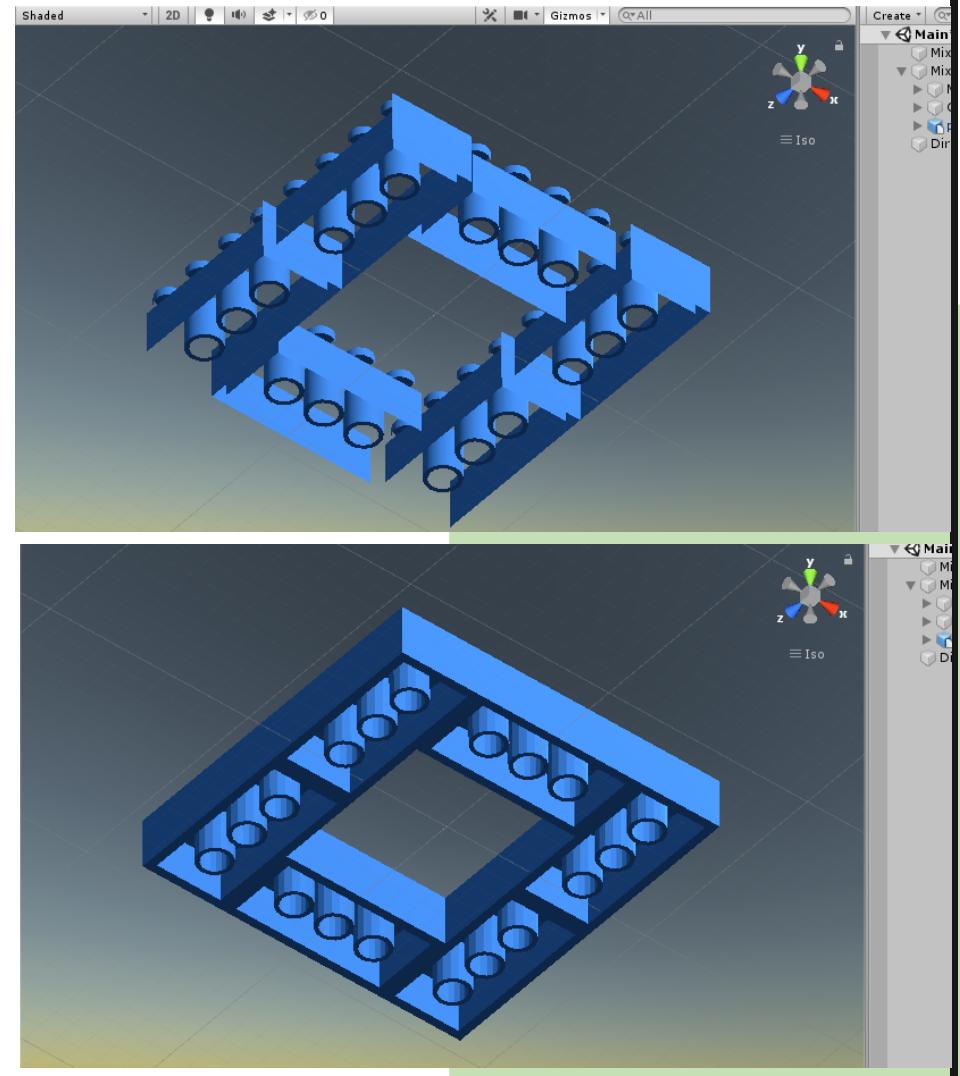
- Model Picker
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# Challenges

- Preprocessing Orientation
- Color
- Double Sided Shading
- Lines Performance
- Preview Scaling
- Runtime Model Adding

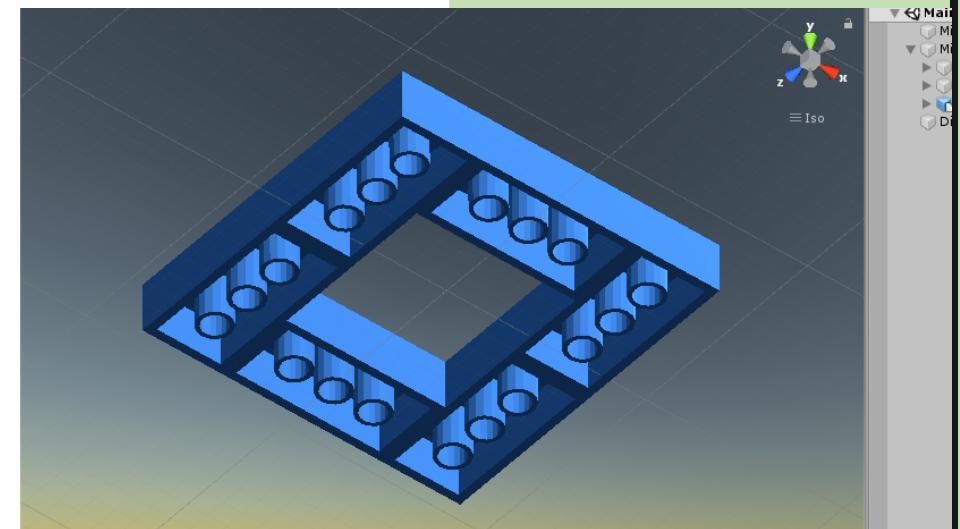
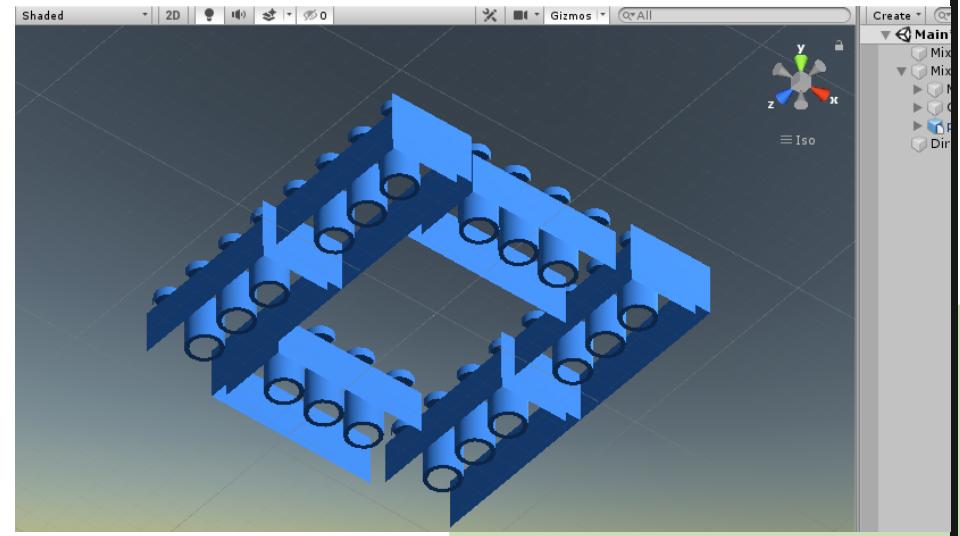
```
1916 v 10.0 28.0 -70.0
1917 v 15.5434 28.0 -72.2962
1918 v 14.2426 28.0 -74.2426
1919 f -1 -2 -3
```



# Challenges

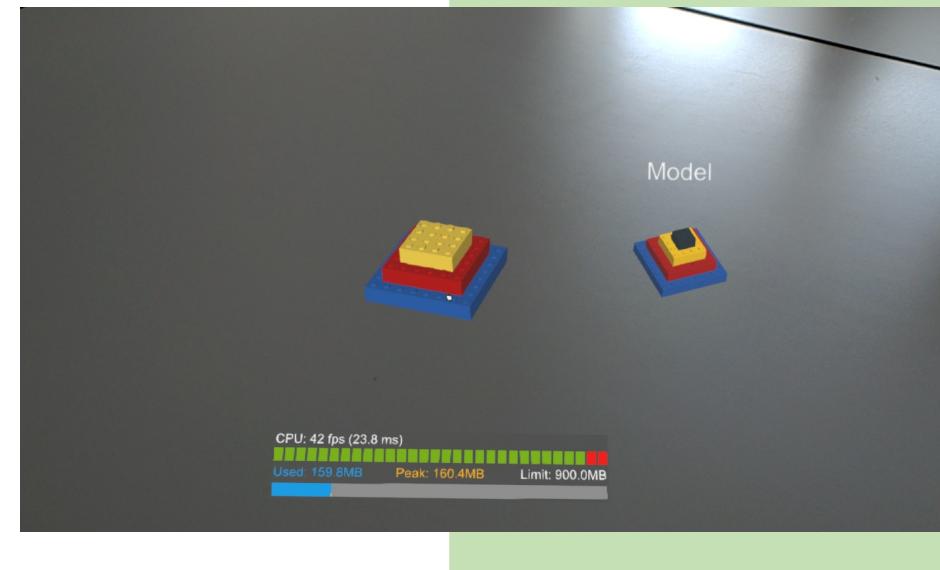
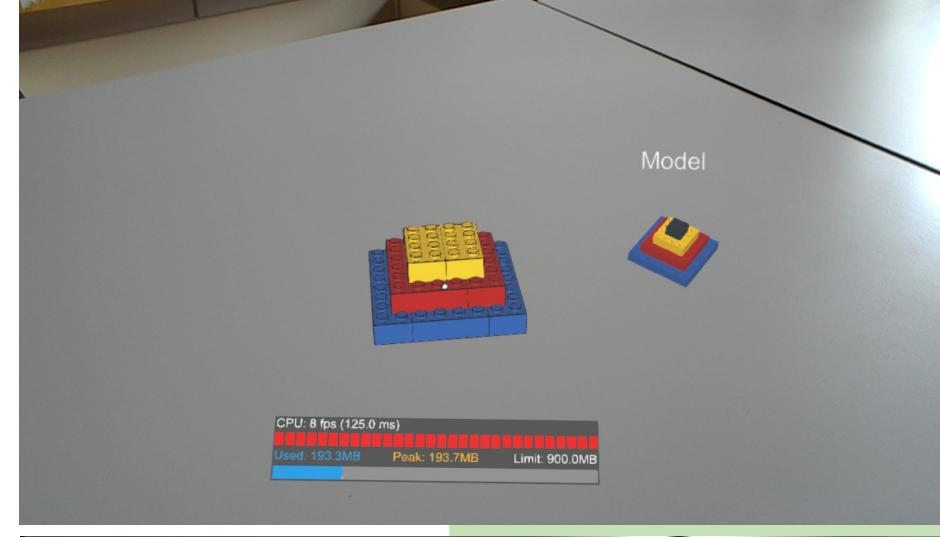
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```
1916 v 10.0 28.0 -70.0
1917 v 15.5434 28.0 -72.2962
1918 v 14.2426 28.0 -74.2426
1919 f -1 -2 -3
1920 f -3 -2 -1
```



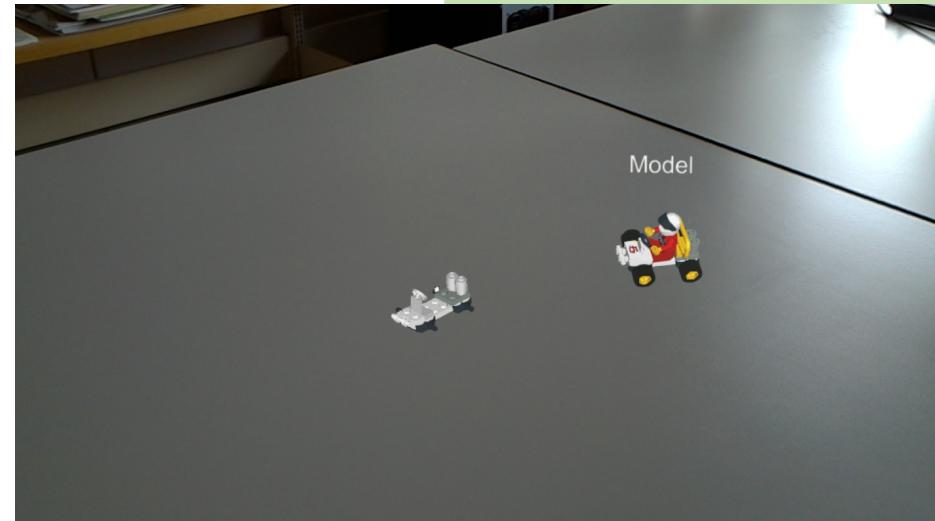
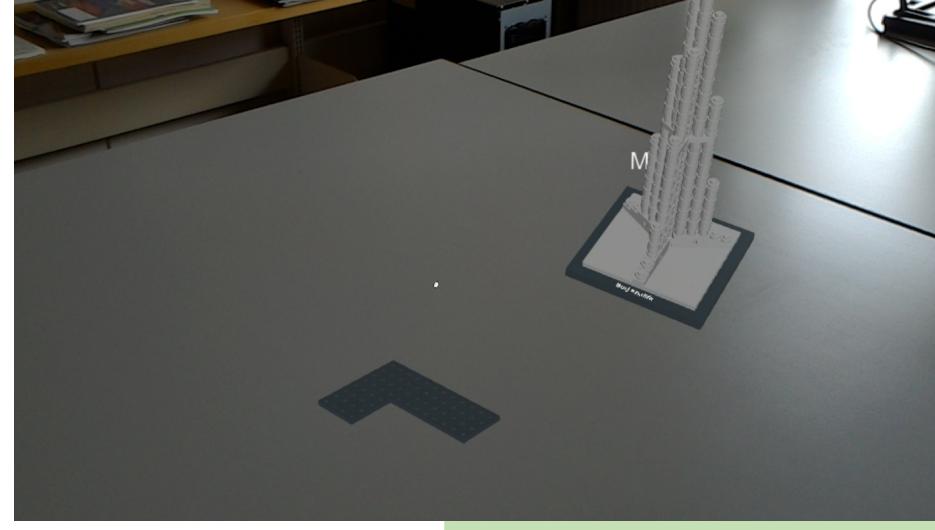
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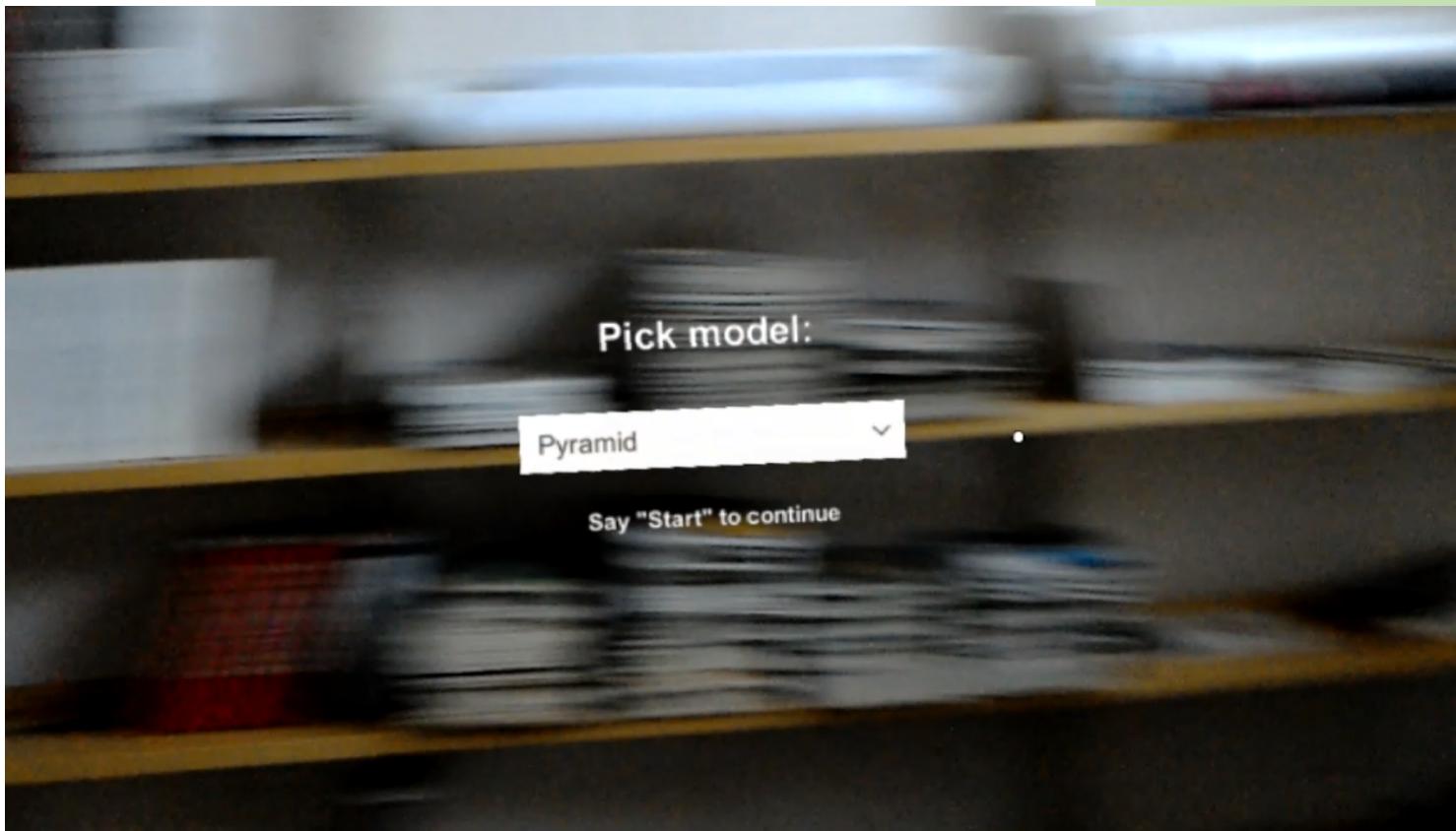
- Preprocessing Orientation
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# Outlook

- Optimizations
  - Delete unseen Vertices/Faces
- Additions
  - Detection
  - Additional Information
- Changes
  - Real Runtime Loading

# Demonstration



# Questions?

# References

LDraw.org. LDraw. url: <https://www.ldraw.org> (visited on 07/23/2020).

Microsoft. Microsoft HoloLens. url: <https://www.microsoft.com/en-us/hololens> (visited on 07/23/2020).

Microsoft. Mixed Reality Toolkit for Unity. url: <https://microsoft.github.io/MixedRealityToolkit- Unity/README.html> (visited on 07/23/2020).