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Augmented Reality

Beyond Virtual Objects Floating in Physical Space

Morten Birk

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Who am I

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Computer Scientist

Software Developer at The Alexandra Institute

Co-Founder at FieldSense A/S

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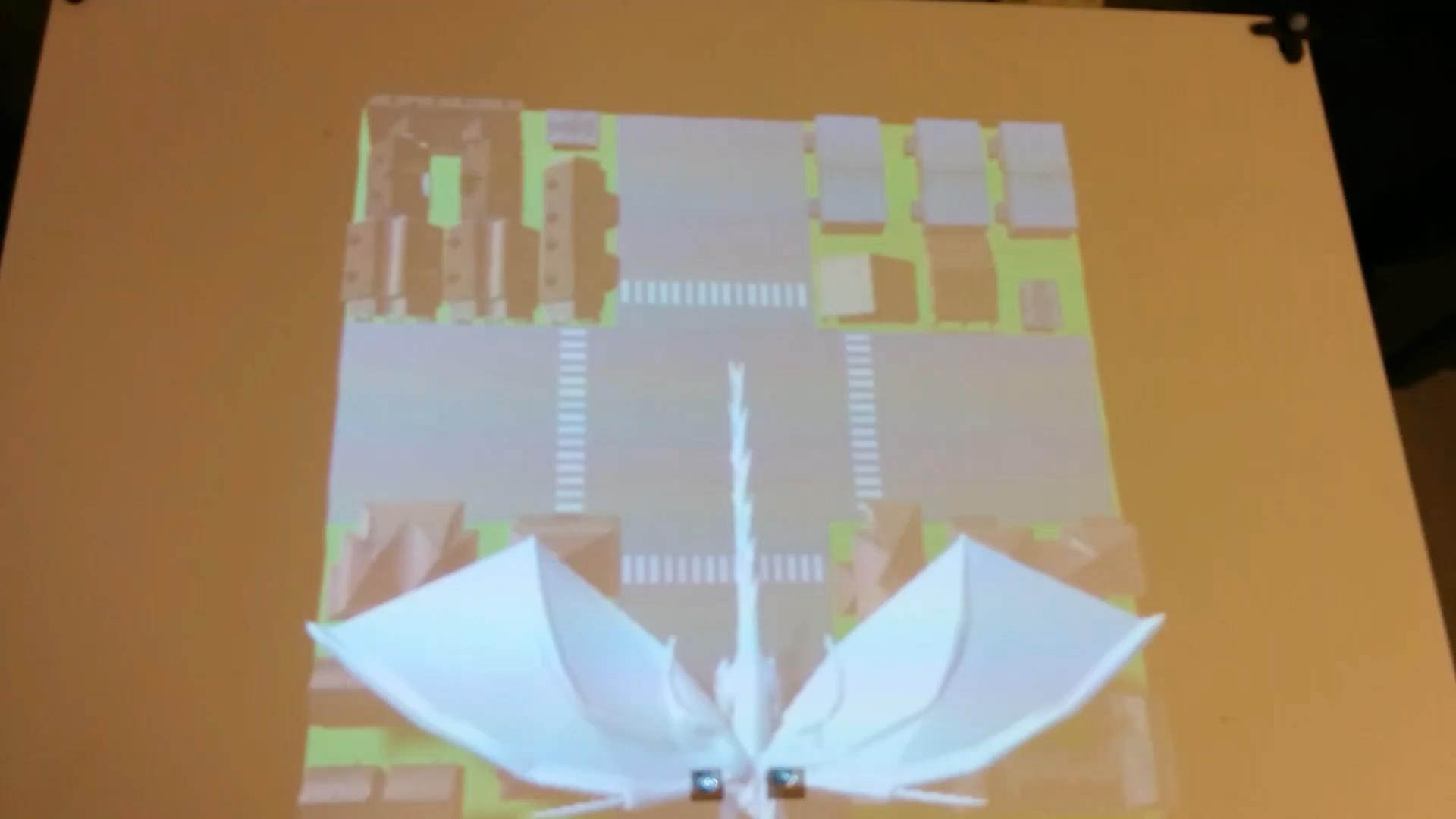

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Our mission is to merge research, innovation, IT and business
to create value, growth and welfare in society.

AGENDA

- **The vision for Augmented Reality**
- **Where are we today?**
- **Where are all the AR applications?**
- **Working around current limitations**
- **Moving beyond virtual objects floating in physical space**

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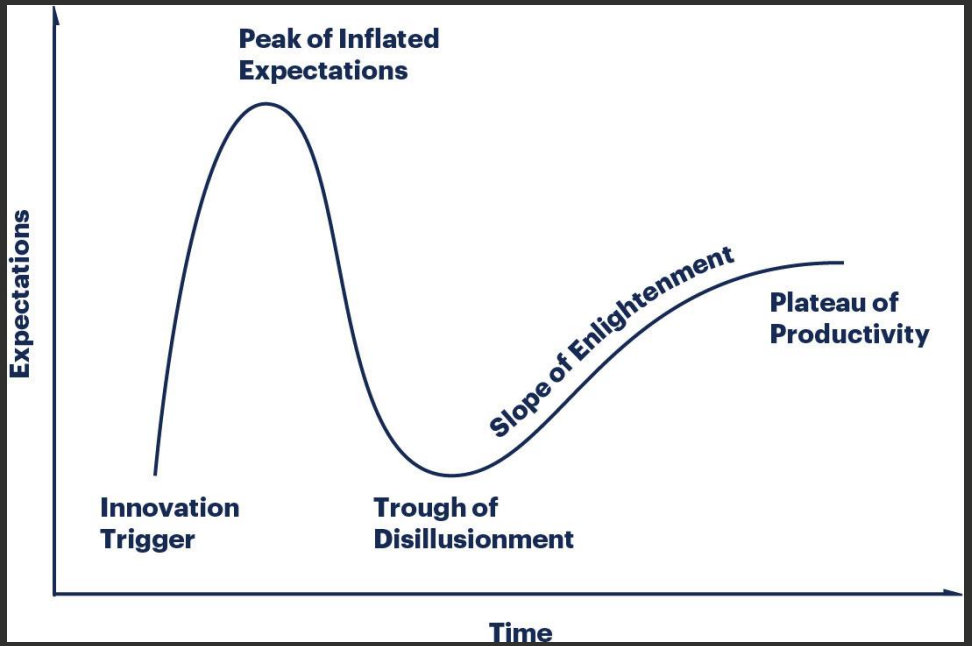
AUGMENTED REALITY HYPE



Gartner Hype Cycle

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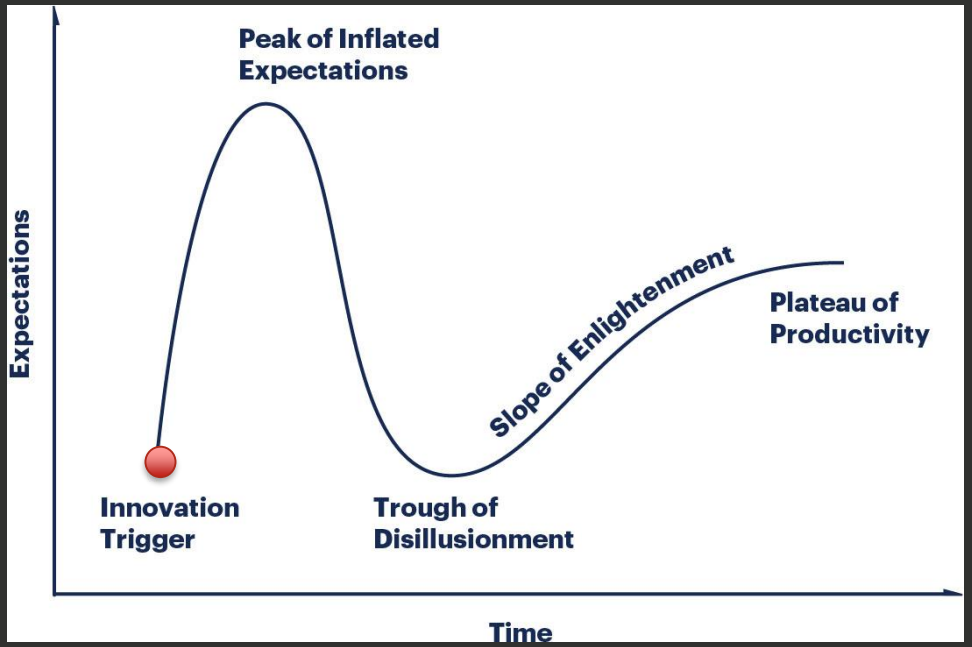

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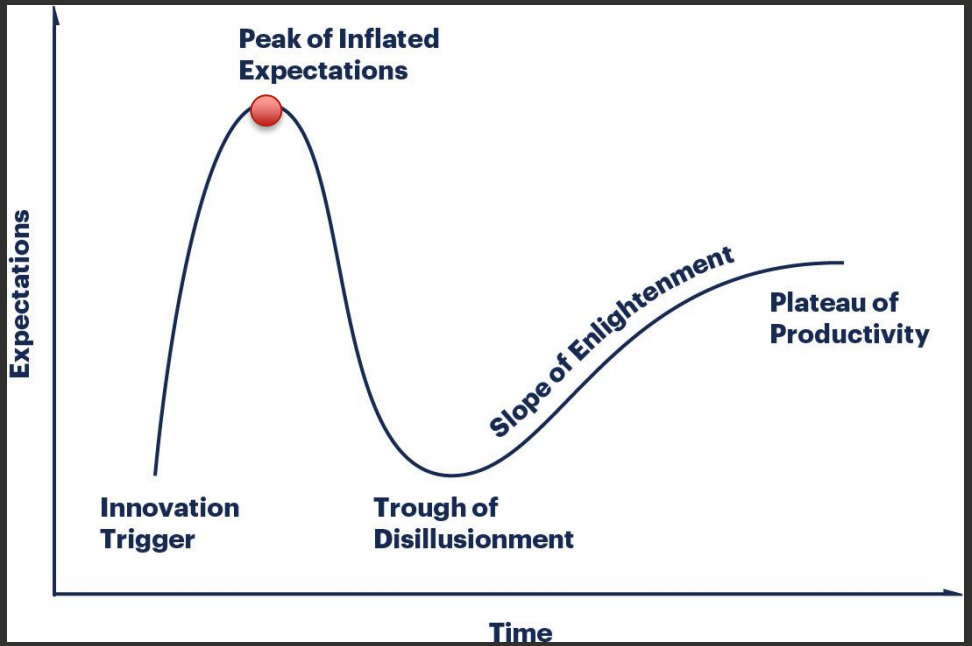

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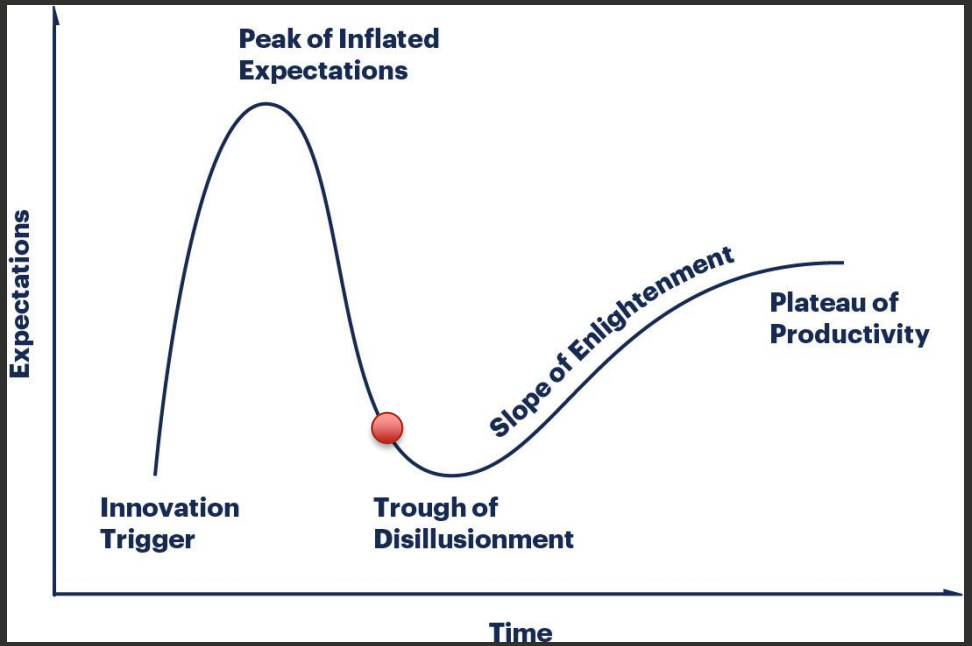

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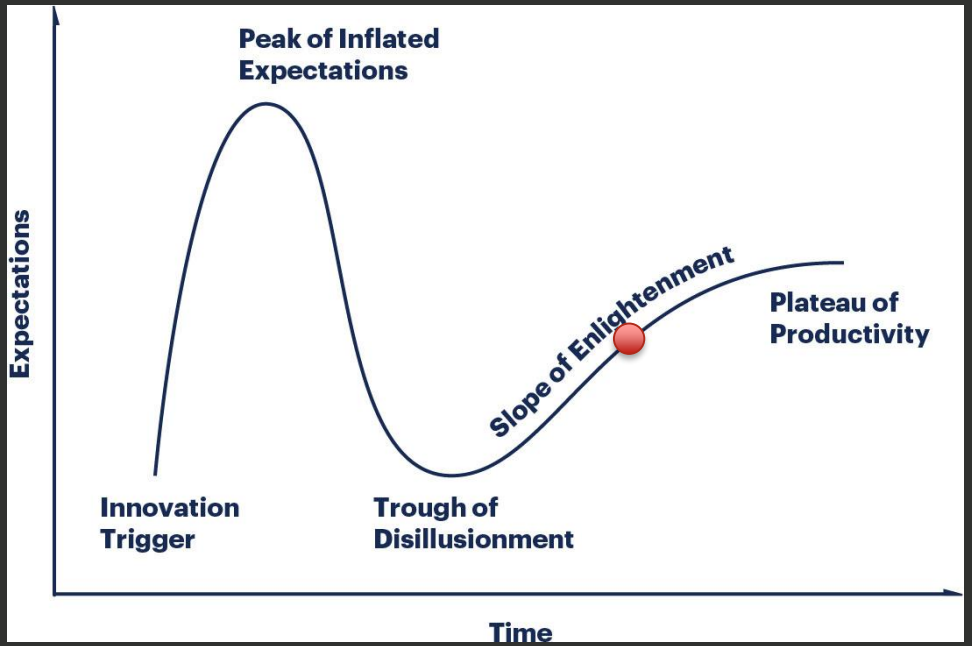

Gartner Hype Cycle

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THE VISION FOR AUGMENTED REALITY

- **The vision for Augmented Reality**
- **Where are we today?**
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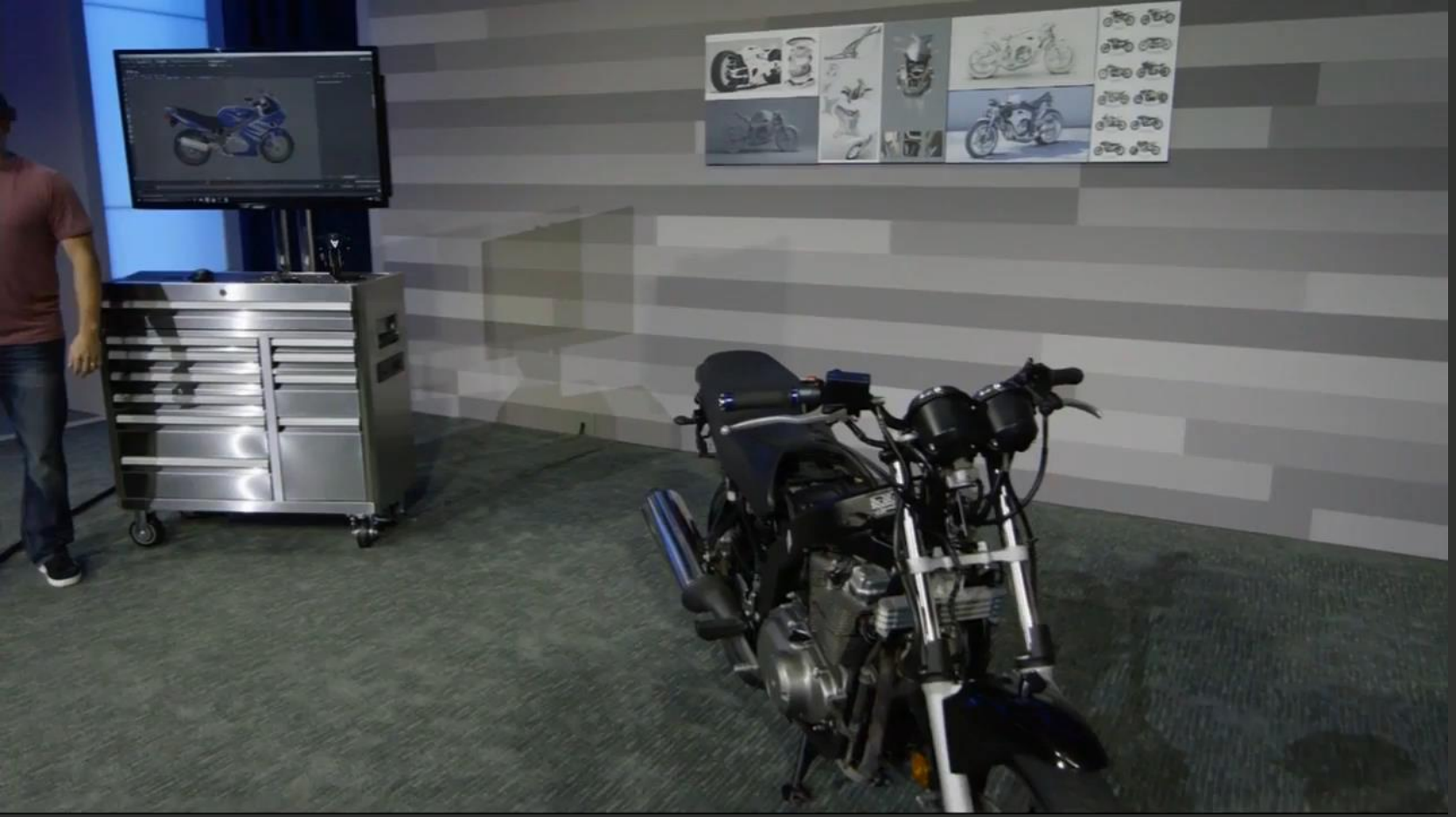
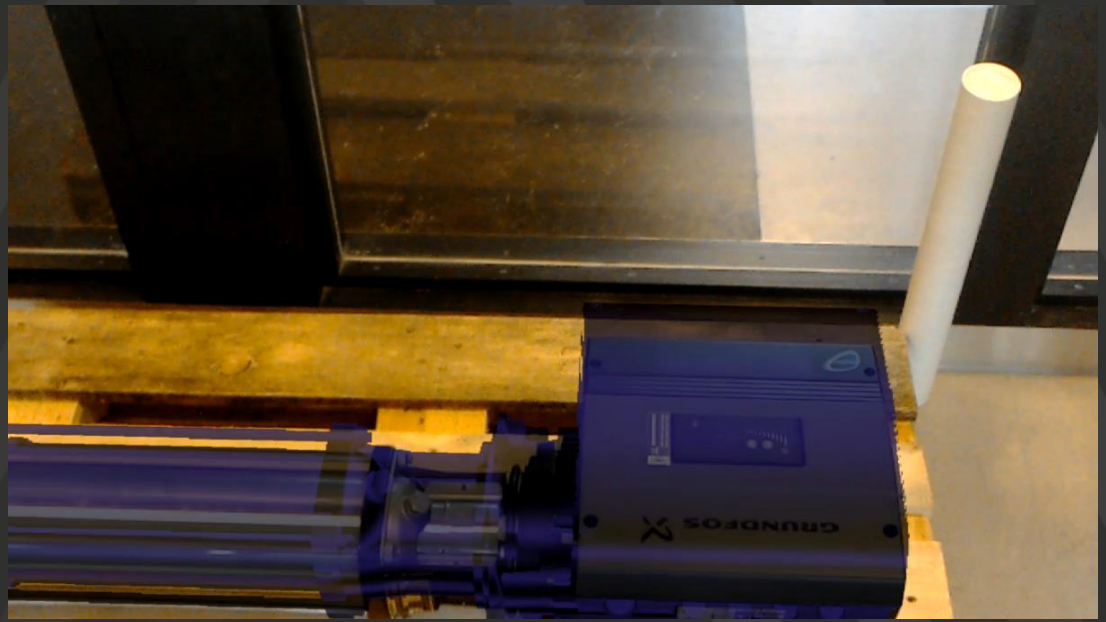
Remove the lid
MADE
Assembly
Inspection
MADE
EPAL

Image: Minority Report



Microsoft HoloLens: Partner Demo with Maya by Autodesk

WEATHER STATION DEMO



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WHERE ARE WE TODAY

- The vision for Augmented Reality
- **Where are we today?**
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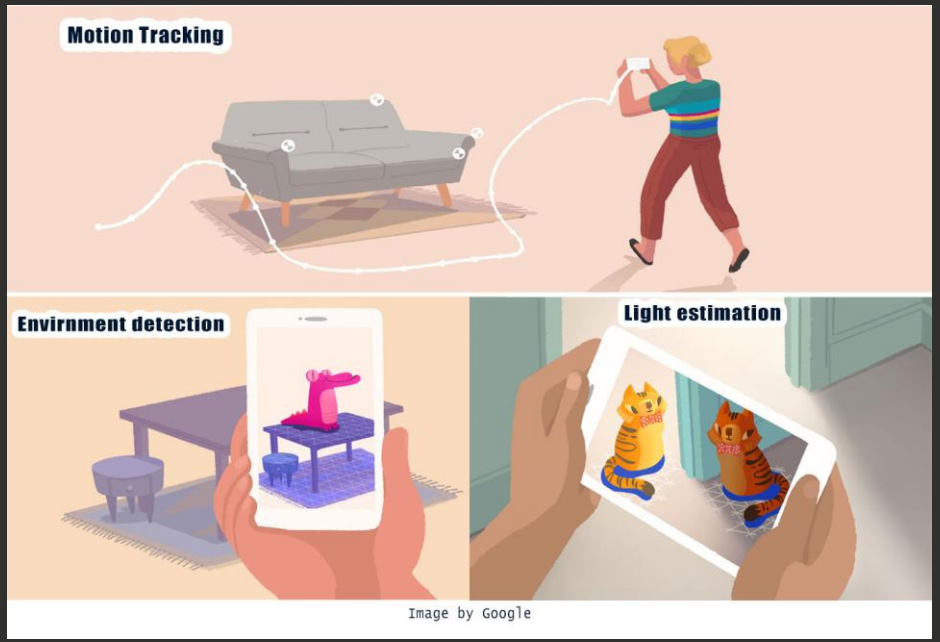
WHERE ARE WE TODAY

- Some hard problems have been solved in standard solutions
- Enabling technology is available to the masses



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WHERE ARE WE TODAY

We can make virtual windows float in air and stick to walls

Microsoft Hololens

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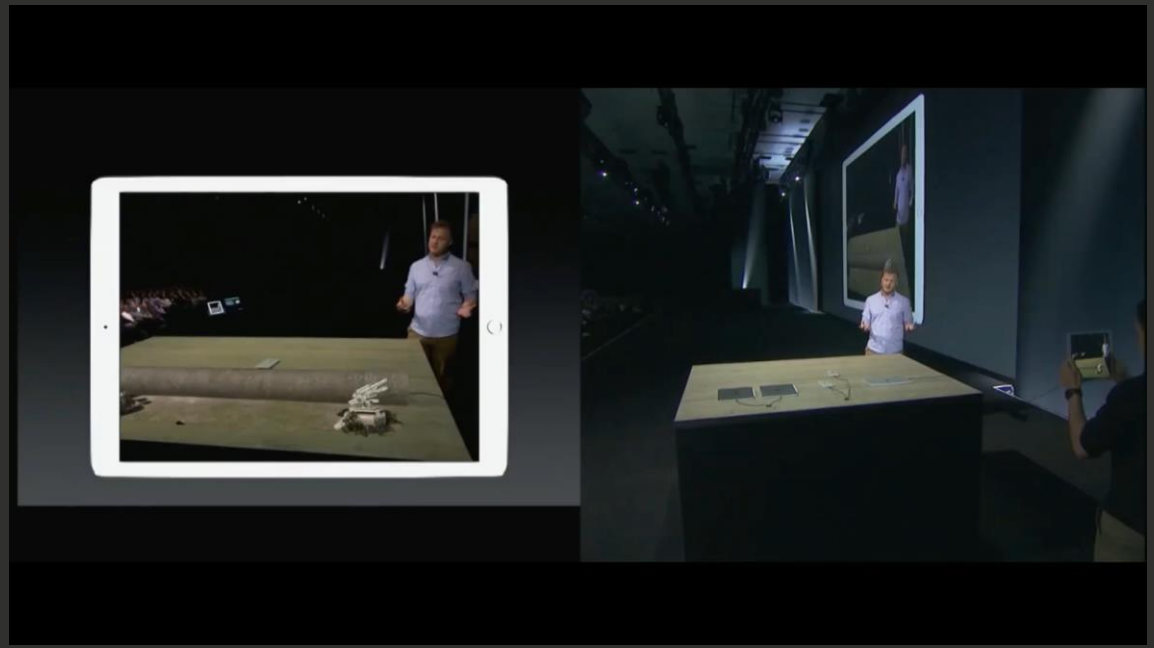
PLACING THINGS ON A TABLE

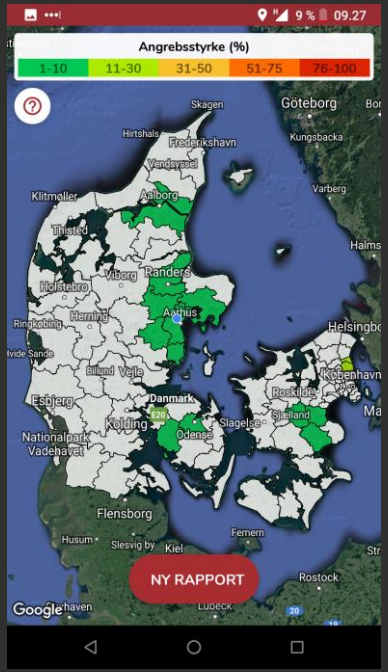
- We are very good at putting things on a table



Wingnut AR Unreal Engine Demo on iOS | WWDC 2017

WHERE ARE WE TODAY

- Lets view our data in AR
  - Then it will probably be way better



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WHERE ARE WE TODAY

SnapChat

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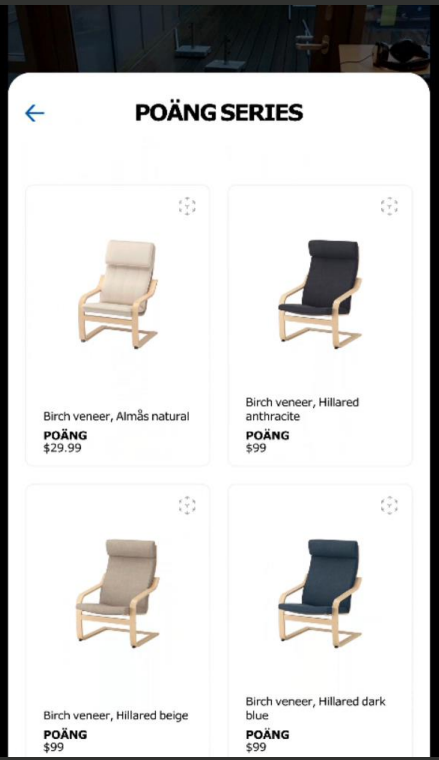
PLACING THINGS IN A ROOM



Ikea Place

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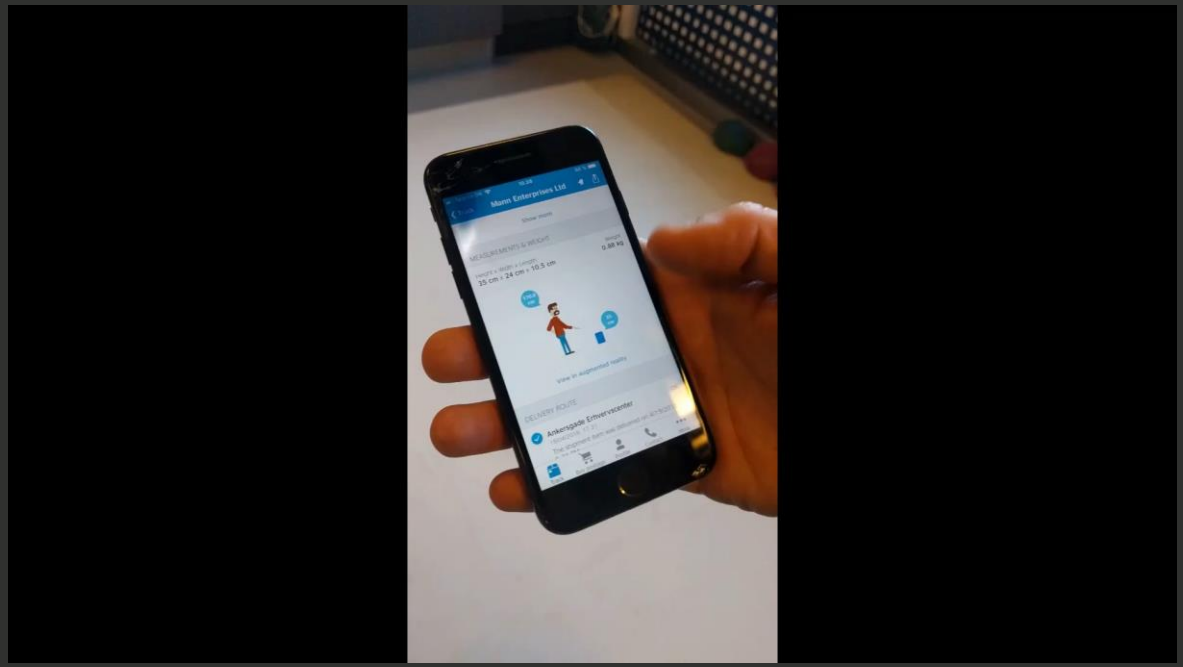
CTRL+C CTRL+V



PostNord App

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WHERE ARE ALL THE AR APPLICATIONS?

WHAT IS HOLDING US BACK?

- The vision for Augmented Reality
- Where are we today?
- **Where are all the AR applications?**
- Working around current limitations
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EXTENT OF WORLD KNOWLEDGE

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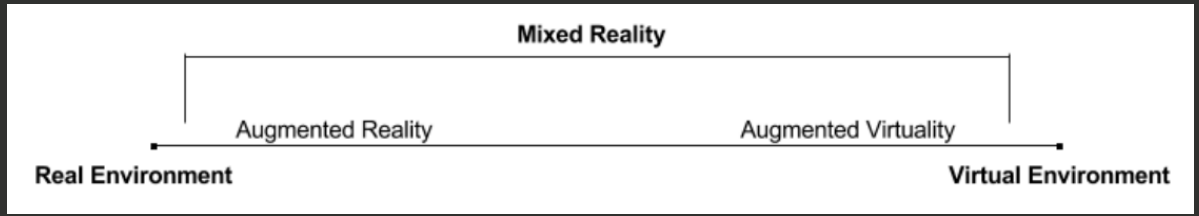
EXTENT OF WORLD KNOWLEDGE



Augmented Reality: A class of displays on the reality-virtuality continuum
Milgram et al.

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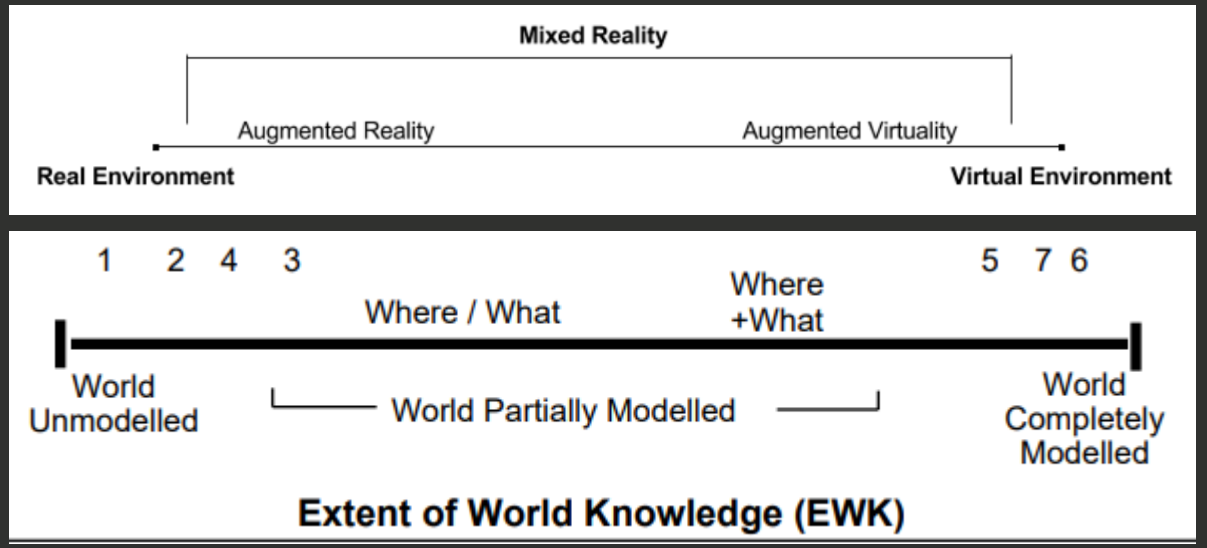
EXTENT OF WORLD KNOWLEDGE



Augmented Reality: A class of displays on the reality-virtuality continuum
Milgram et al.

EXTENT OF WORLD KNOWLEDGE

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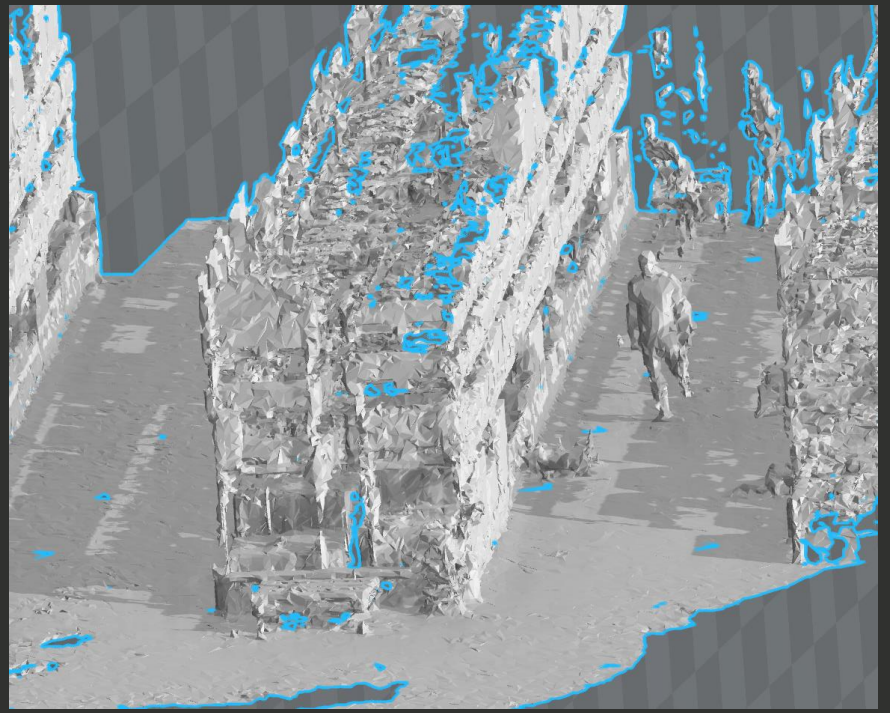
EXTENT OF WORLD KNOWLEDGE

- The world understanding is often of very low granularity



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GRANULARITY OF WORLD UNDERSTANDING

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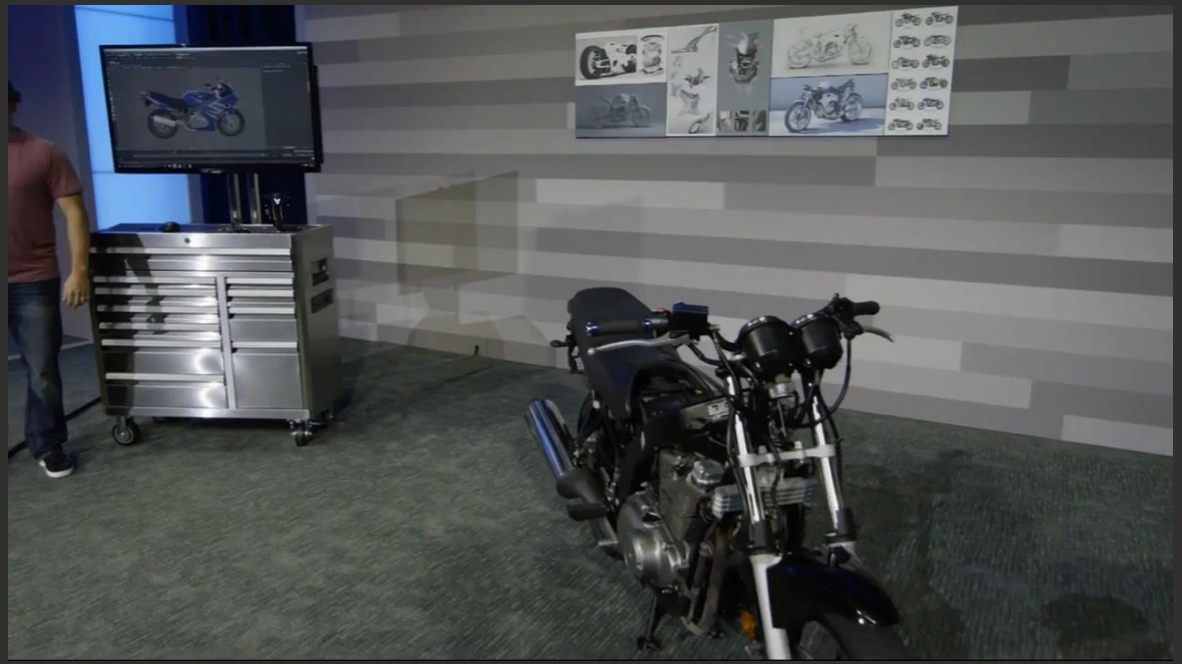
EXTENT OF WORLD KNOWLEDGE

- We are very capable of detecting camera motion
  - We can align virtual and physical content
- We are good at detecting markers
  - If we stop to look at them
- We are rather good at detecting the overall environment surfaces
- We are somewhat capable of tracking specific objects

EXTENT OF WORLD KNOWLEDGE

- Tracking objects in 6DoF
  - Key to augment specific physical objects with aligned virtual content



Microsoft HoloLens: Partner Demo with Maya by Autodesk

INTERACTION

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INTERACTION

- Natural interaction is one of the arguments for Augmented Reality

INTERACTION

- Natural interaction is one of the arguments for Augmented Reality
  - However even the basic interactions in AR often has to be explained

Image: Minority Report

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CONTENT CREATION AND DATA QUALITY

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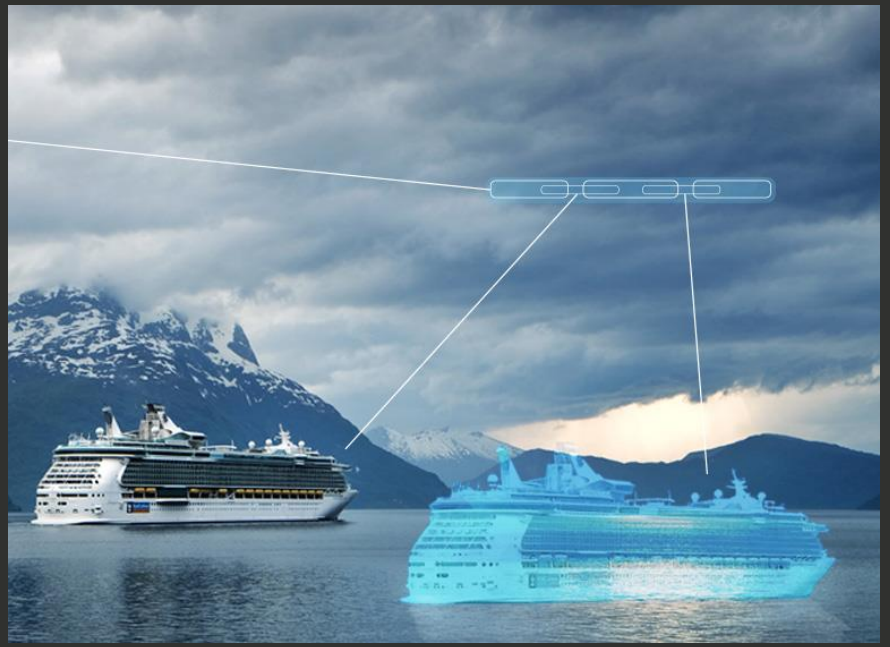
CONTENT CREATION AND DATA QUALITY

- We now have the technology to display data associated with physical objects
  - Now WHAT should we show?
- Generating content for an entire product portfolio is not an easy task



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WORKING AROUND CURRENT LIMITATIONS

- The vision for Augmented Reality
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KEEP IT SIMPLE

But create value

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COOLING PAD MOUNT ASSIST

- No requirement of content creation
- Limited requirements to world understanding
- Super limited scope
- The co-existence of virtual and physical information is critical

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COOLING PAD MOUNT ASSIST

- No requirement of content creation
- Limited requirements to world understanding
- Super limited scope
- The co-existence of virtual and physical information is critical

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USERS CAN PROVIDE WORLD KNOWLEDGE

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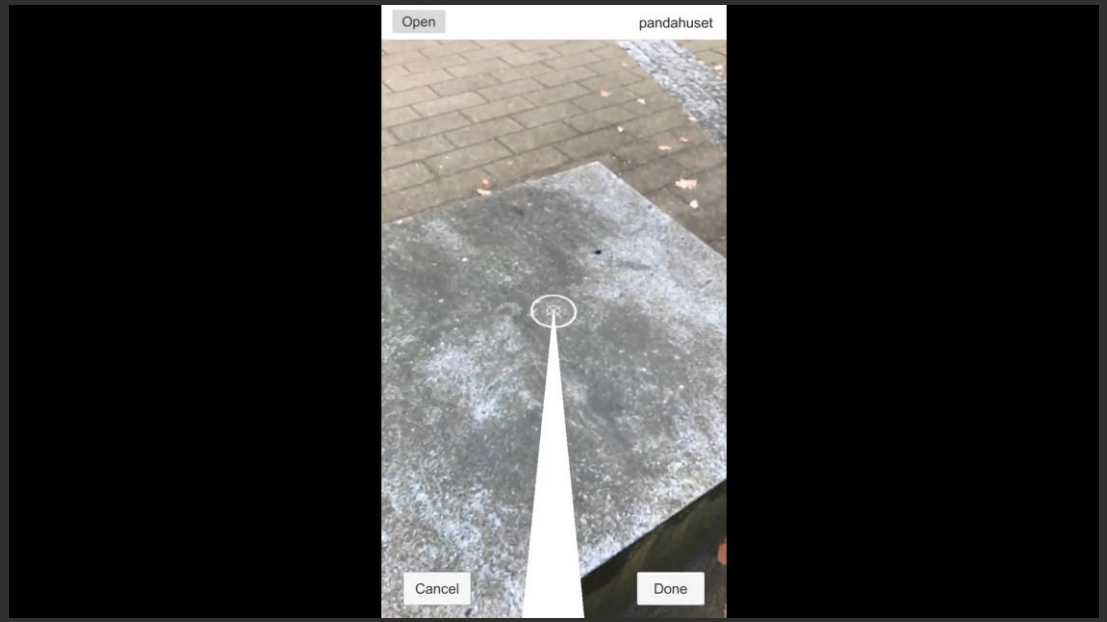
FULL SCALE VISUALIZATION

- We can display the content on a surface
- How do we visualize the content in correct scale and location?



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Open
pandahuset
Cancel
Done

REMOTE ASSISTANCE

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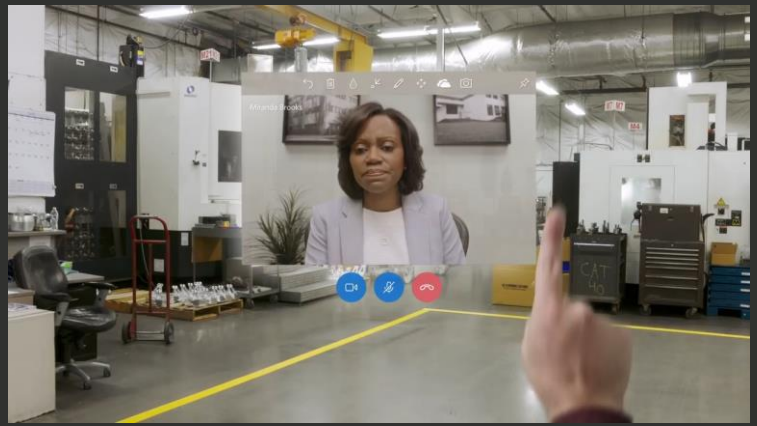
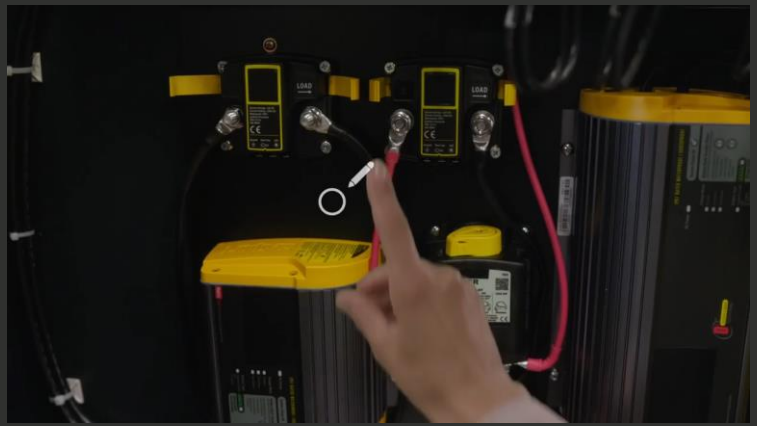
REMOTE ASSISTANCE

- The system do not need to understand the world
- No requirement of content creation
- Highly generalizable use case





Microsoft Dynamics 365 Remote Assist

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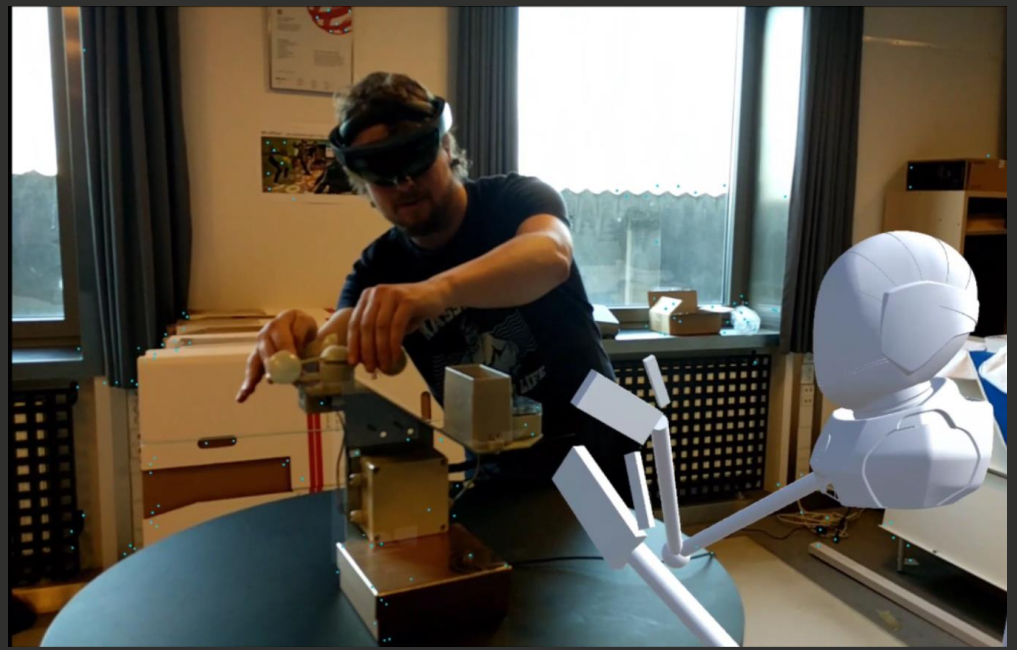
REMOTE ASSISTANCE

- Virtual assistant
  - Allow for real time gesturing and pointing
  - Very low bandwidth requirements
  - View independent



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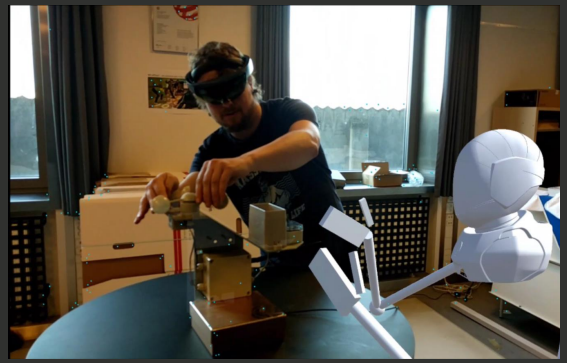

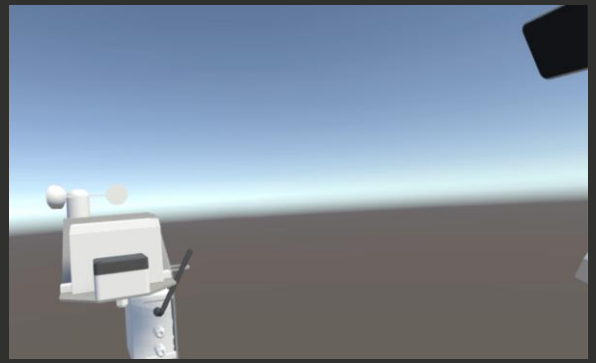

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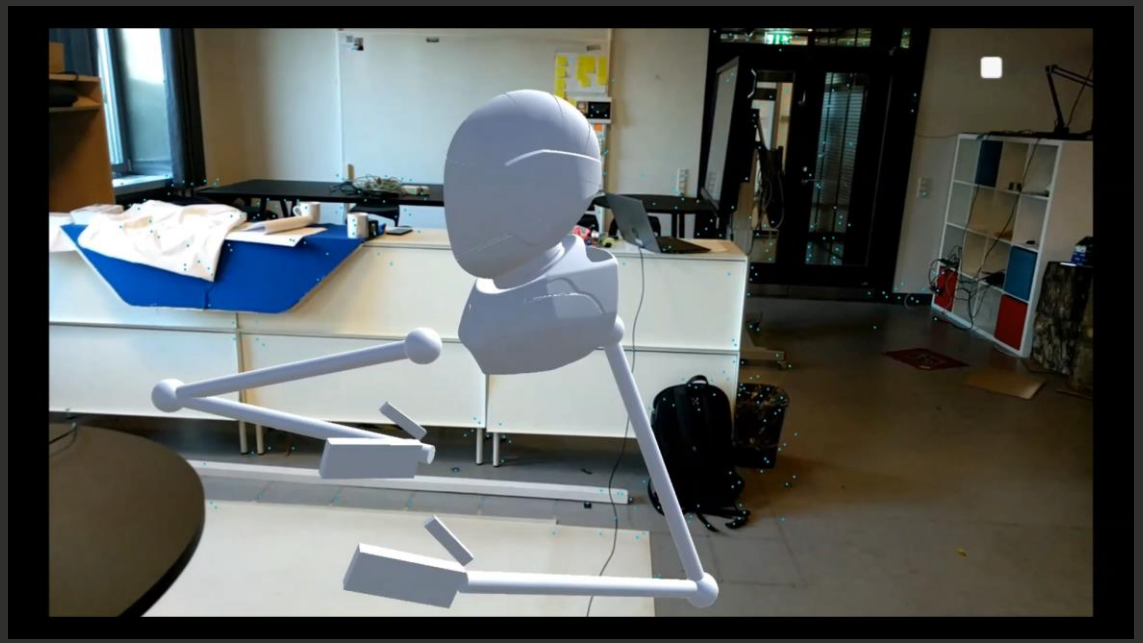

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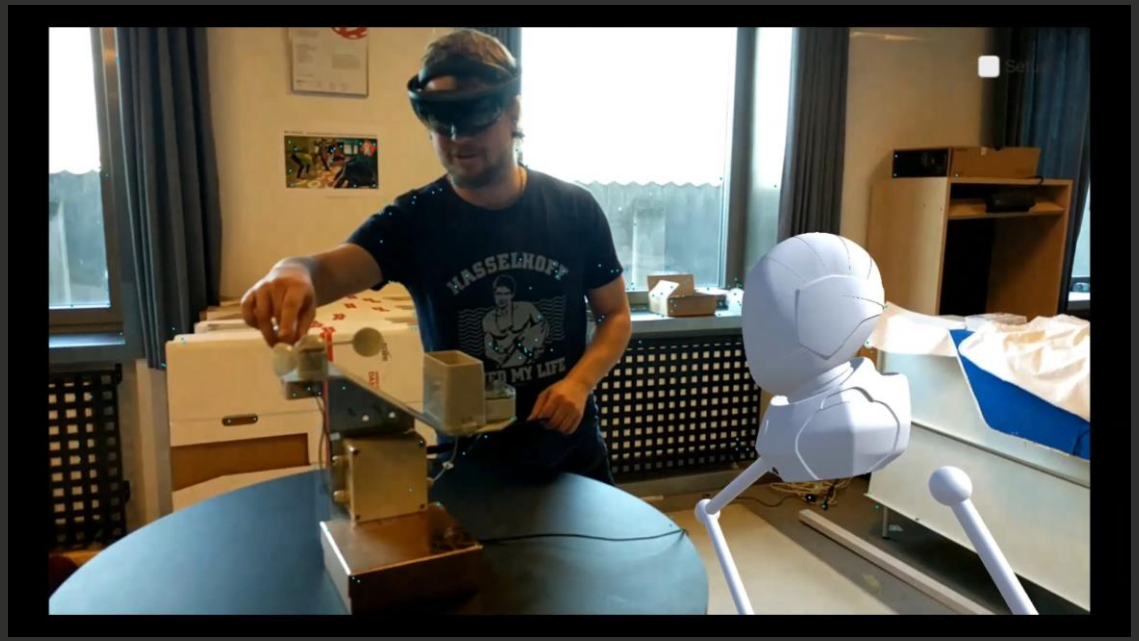

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MOVING BEYOND VIRTUAL OBJECTS FLOATING IN PHYSICAL SPACE

- The vision for Augmented Reality
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HOW TO IMPROVE EXTENT OF WORLD KNOWLEDGE

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EXTENDING THE SYSTEMS UNDERSTANDING

Think beyond your device?

- Use external sensors
- Outside-in tracking with depth sensors
- Use knowledge of room topology

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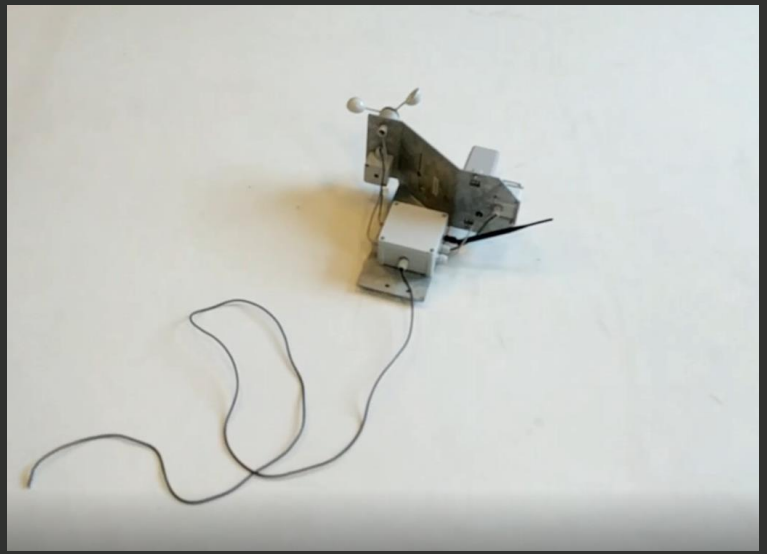
Velt: Andreas Fender

EXTENDING THE SYSTEMS UNDERSTANDING

- Understand the images of what the system is looking at
  - Computer vision is key
  - Currently the “silver bullet” is deep learning
    - It requires large amount of training data
    - Often trained to only work for very specific targets



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SCALING TO PRODUCT PORTFOLIO

- Train on synthetic photorealistic images
  - Render images of objects from CAD files
  - Random viewing angle and distance to camera
  - Random lighting conditions

Tetris controller

Motor

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OBJECT CLASSIFICATION

- Results
  - Robustly distinguishes between
    - Tetris controller
    - Motor
    - Background (anything else).
  - Only recognizes what it has seen during training
    - When motor is too small, it is classified as background.

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OBJECT DETECTION

- Results
  - Works well on both synthetic and real images.
  - Detects multiple objects in same image.
  - Real-time performance.

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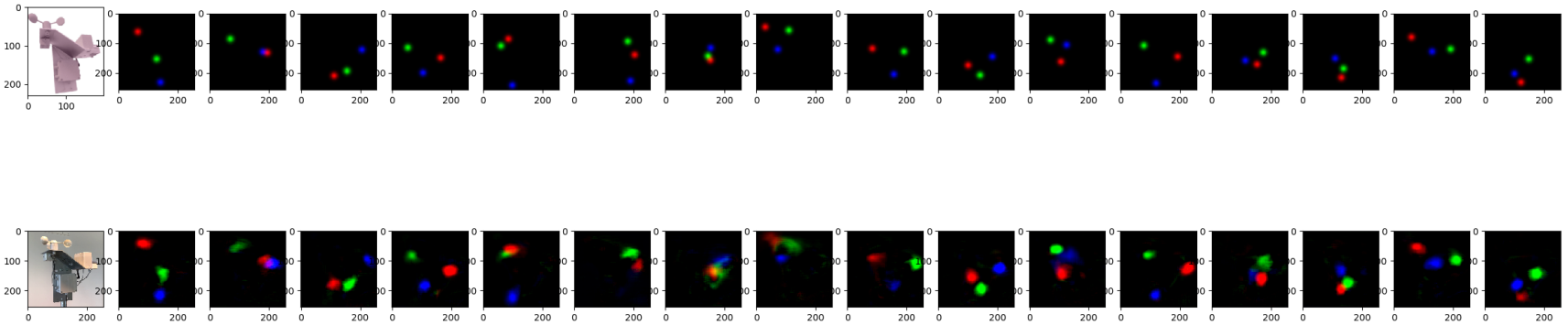
6DOF TRACKING



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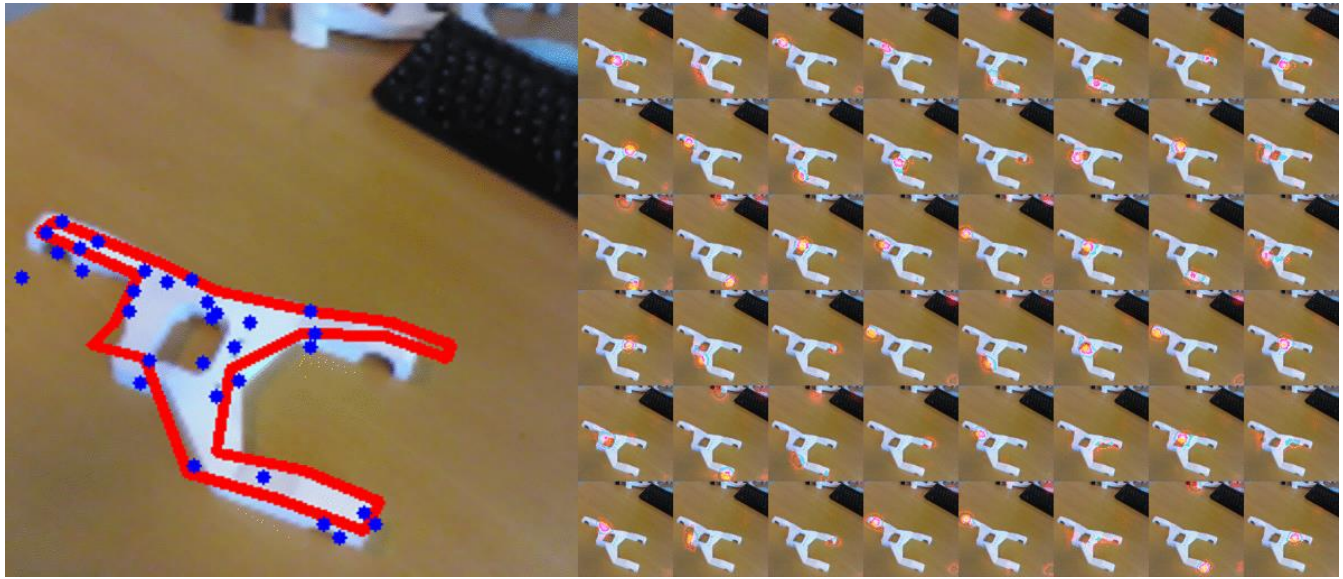
6DOF TRACKING

- Tracking of 48 object key points



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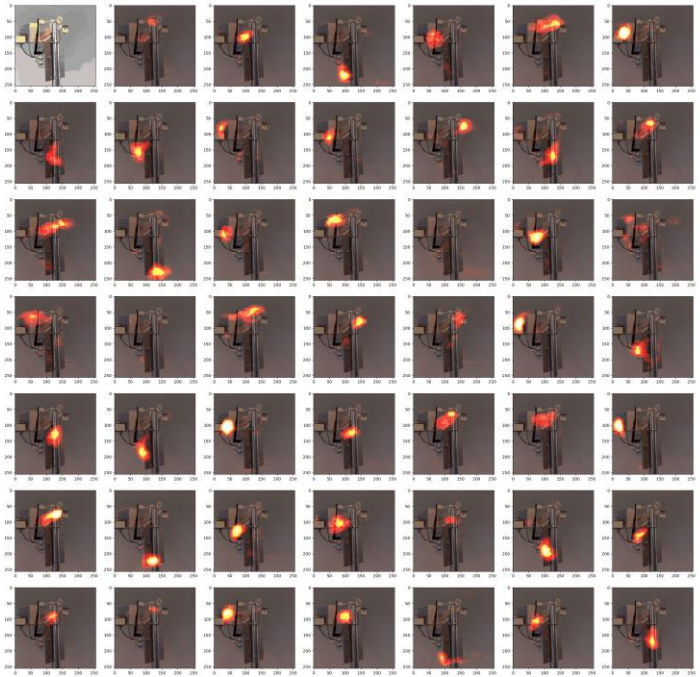
TRACKING THE WEATHER STATION



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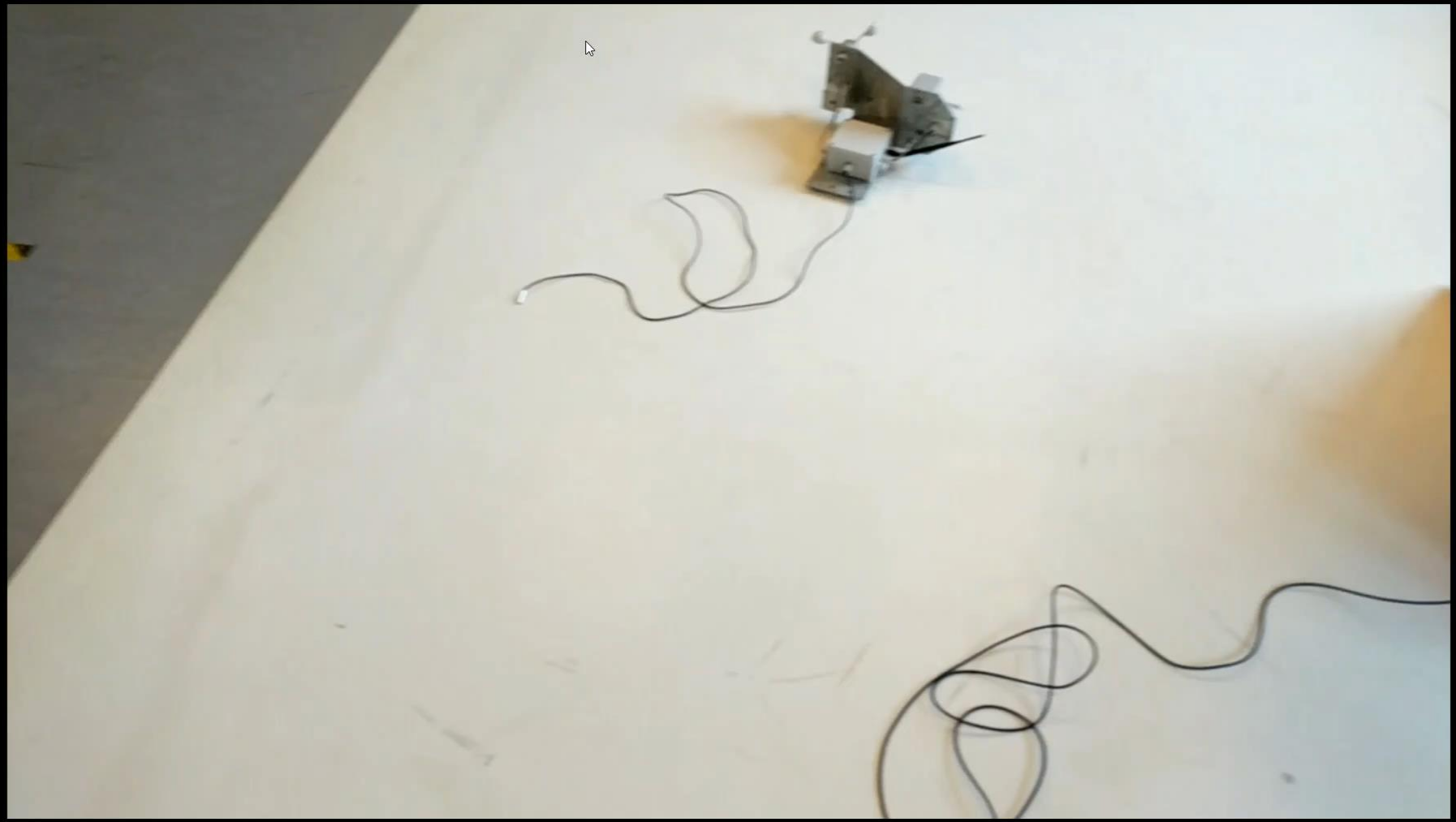

SUMMARY

Identify a suitable problem,

Keep it simple,

Provide value,

Think twice before throwing random virtual windows on walls

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THANK YOU

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