



Universidade de Aveiro  
Departamento de Electrónica,  
Telecomunicações e Informática



# On Virtual and other Realities



Beatriz Sousa Santos, ErgoUX, November/2021

# It is not a new concept: Ivan Sutherland's 1965 Vision

“Don't think of that thing as a screen,  
**think of it as a window... through which one  
looks into a virtual world.**

The challenge ... is to make that **virtual world  
look real**, sound real, move and respond to  
interaction in real time, ... **feel real.**”

<https://www.youtube.com/watch?v=NtwZXGprxag>



# What is VR?

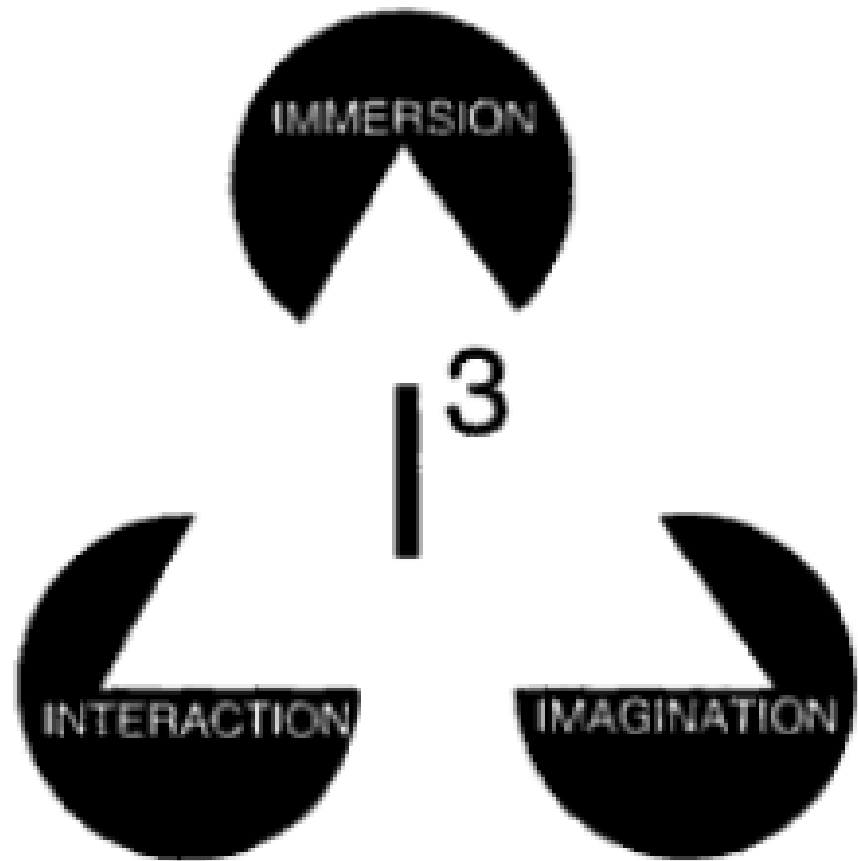
*“Virtual reality experience ...*

the user is effectively immersed in a responsive virtual world. This implies user dynamic control of viewpoint.”

(Fred Brooks, 1999)

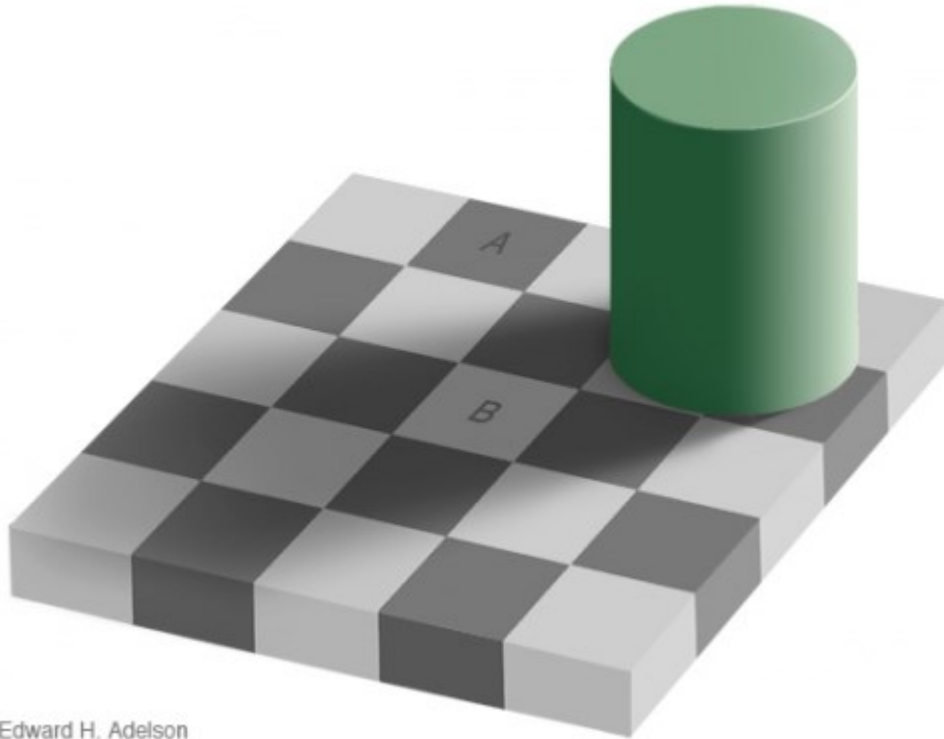
# The VR triangle

- Immersion
- Interaction
- Imagination  
(to perceive non existing things)



(Burdea & Coiffet, 2003)

# What we see is more than meets the eye...

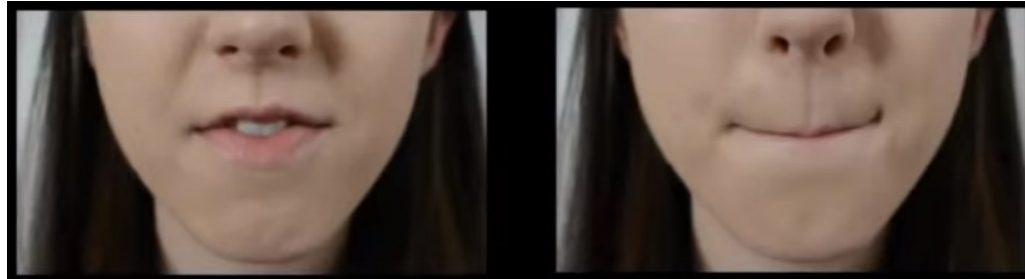


Edward H. Adelson

Virtual reality, explained  
with some illusions:

[https://www.youtube.com/  
watch?v=qD3w3cAhEYU](https://www.youtube.com/watch?v=qD3w3cAhEYU)

and the ear ...



NASA was pioneer:

“Virtual Interface Environment Workstation” (VIEW) 80’s



VR was already much used  
in the early 2000s:

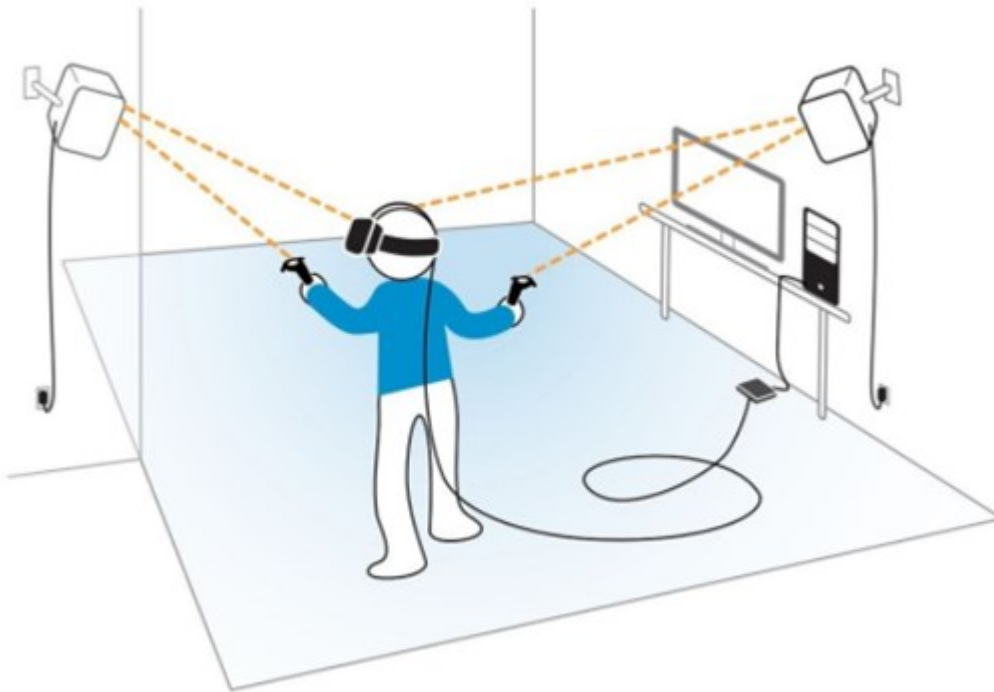
- Industry
- Medicine
- Culture
- ...

But it was very expensive!



# VR is now much more affordable

Due to H/W and S/W  
(developed by the games industry)





- Viable in much more situations
- Still difficult to develop compelling useful experiences ...
- Requiring a lot of technical expertise, and  
much more!!

VR may harm the user...



Extra care is needed with human factors

# Cybersickness

- Nausea
- Eye strain
- Dizziness
- ...



Caused by conflict between what your eyes see and what your body feels

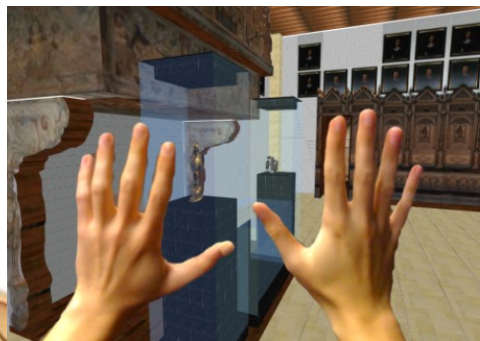
# Other Realities: Reality Virtuality “Continuum”

Mixed Reality (MR)



(Milgram et al., 1994)

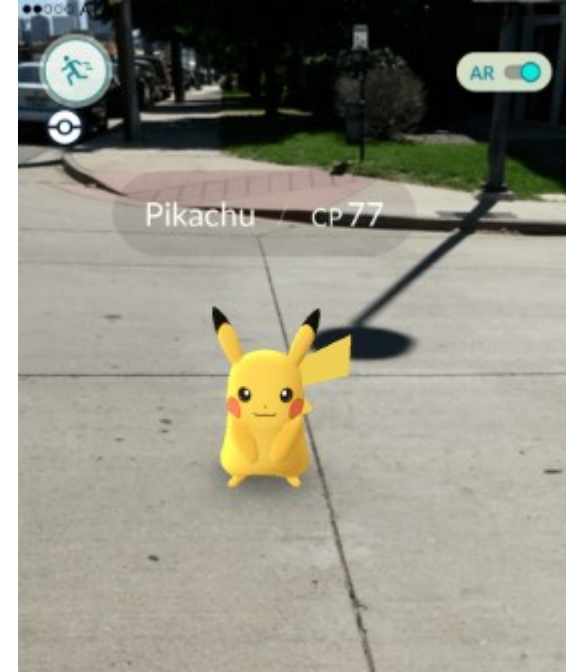
**“Real” Reality    Augmented Reality    Augmented Virtuality    Virtual Reality**



# Augmented *versus* Virtual Reality

AR enhances an existing environment rather than replacing it

Aligning the Virtual and Real worlds is technically challenging





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We propose and study  
new VR, AR systems and methods  
Useful, usable, and affordable  
Centered in the human...





# Some works

I - Immersive Virtual Environment in a Museum

II- VR for rehabilitation

III – AR for quasi-continuous experiences

IV- AR in maintenance and assembly

MUSEU DA CIDADE



**BOSCH**



**Rovisco Pais**

Centro de Medicina de Reabilitação  
da Região Centro



# I - Virtual Reality in a Museum

(in cooperation with the City Museum of Aveiro)

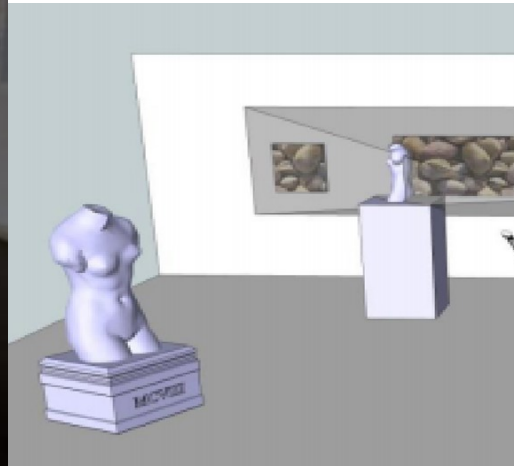
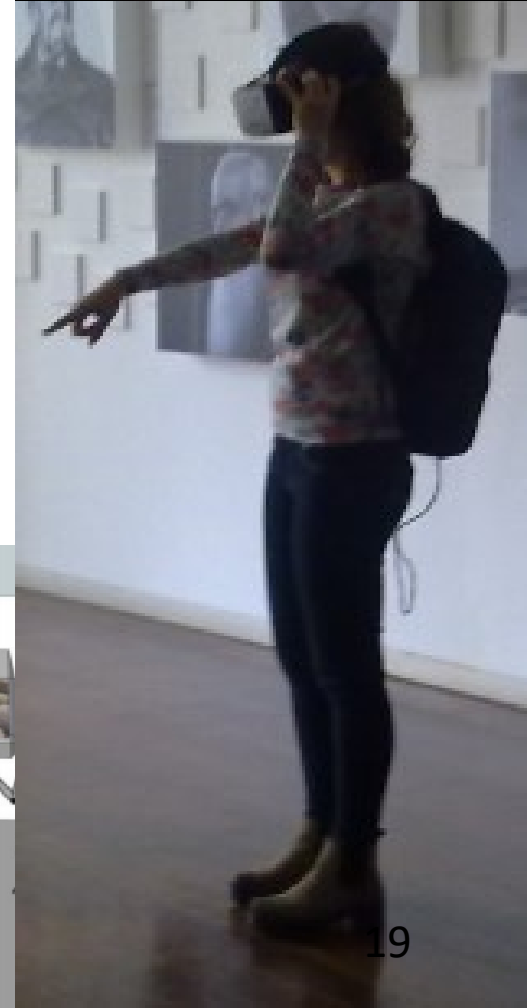
- Museums need to enhance their visitors' experience
- VR applications may be used for this purpose
- The City Museum wanted (affordable) VR experiences



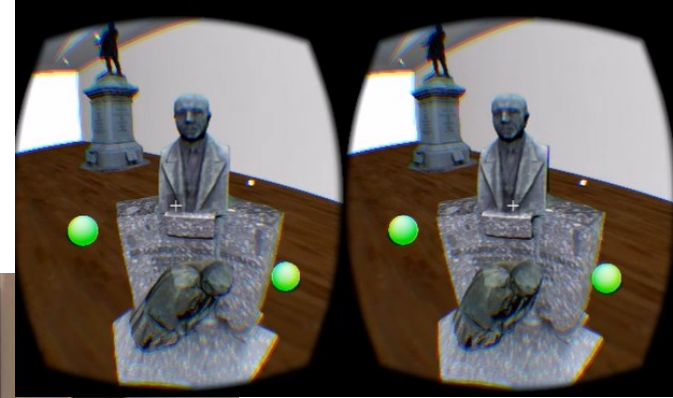
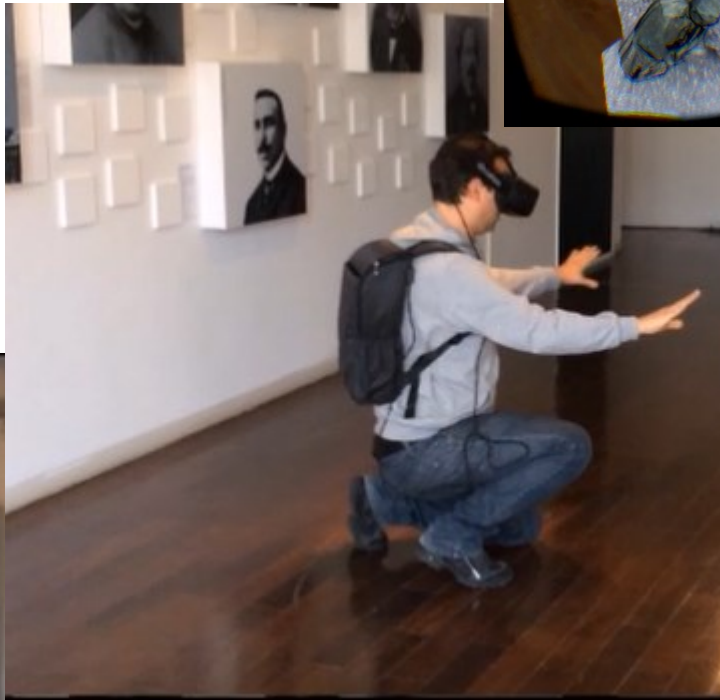


# The Virtual Museum: an interactive exhibit

- The user was immersed in a virtual replica of a room
- Could explore virtual contents
- And set their own virtual exhibits



- Placing 3D virtual objects in a virtual exhibit using spatial gestures



- While walking in the real/virtual worlds (1 : 1 mapping)

# II - Virtual Reality in Rehabilitation

(in cooperation with Rovisco Pais Rehabilitation Center)

- Stroke is a ever more common cause of incapacity
- VR applications meet fundamental principles of Rehabilitation
- The Center needs (affordable) VR applications to motivate their patients



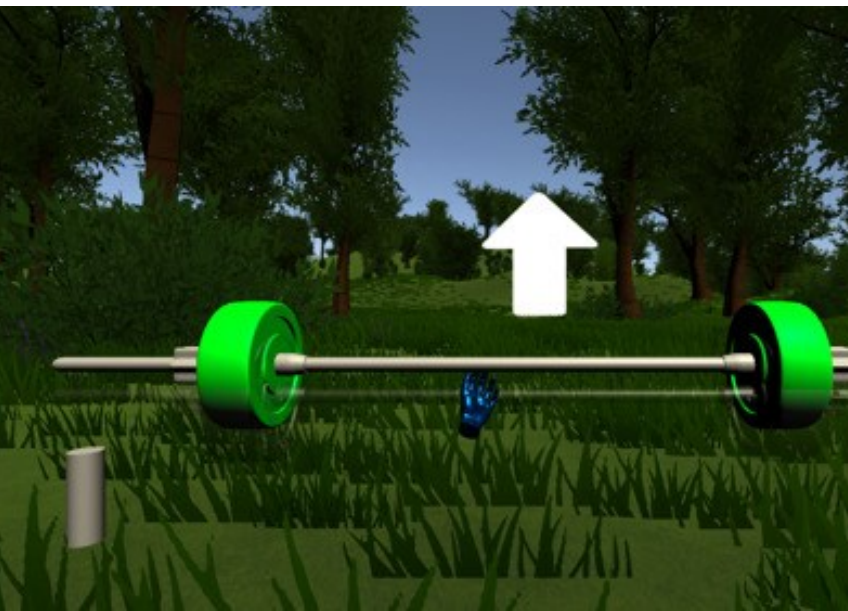
# Virtual Reality for motivation in Physical Rehabilitation

- How can we help rehabilitation using VR to motivate the patients?
- Using affordable platforms?
- At the Center (in acute phase)
- After leaving the Center at home
- Through remote monitoring and assistance



# Virtual Reality Mini-games for Upper Limb Rehabilitation

- Mini-games should:
  - motivate repetition of relevant gestures for independent life
  - evoke familiar situations for different types of patients
  - be adaptable to the patient condition
  - give only positive feedback

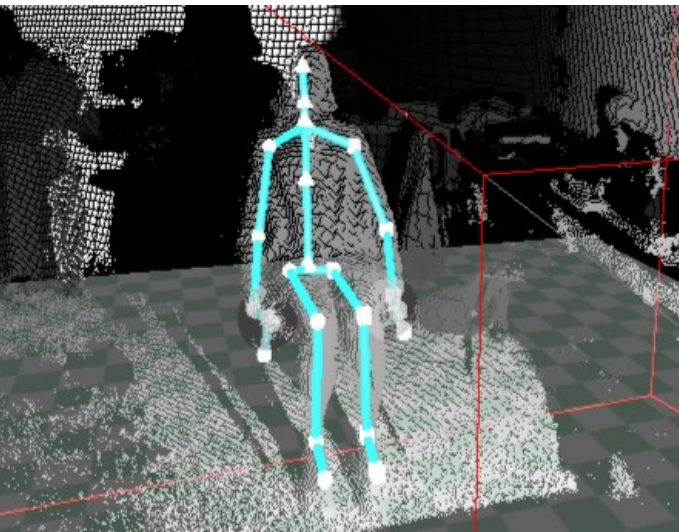


# Virtual Reality Mini-games for Balance Rehabilitation

A non immersive version of a game was adapted to motivate patients to do relevant torso gestures

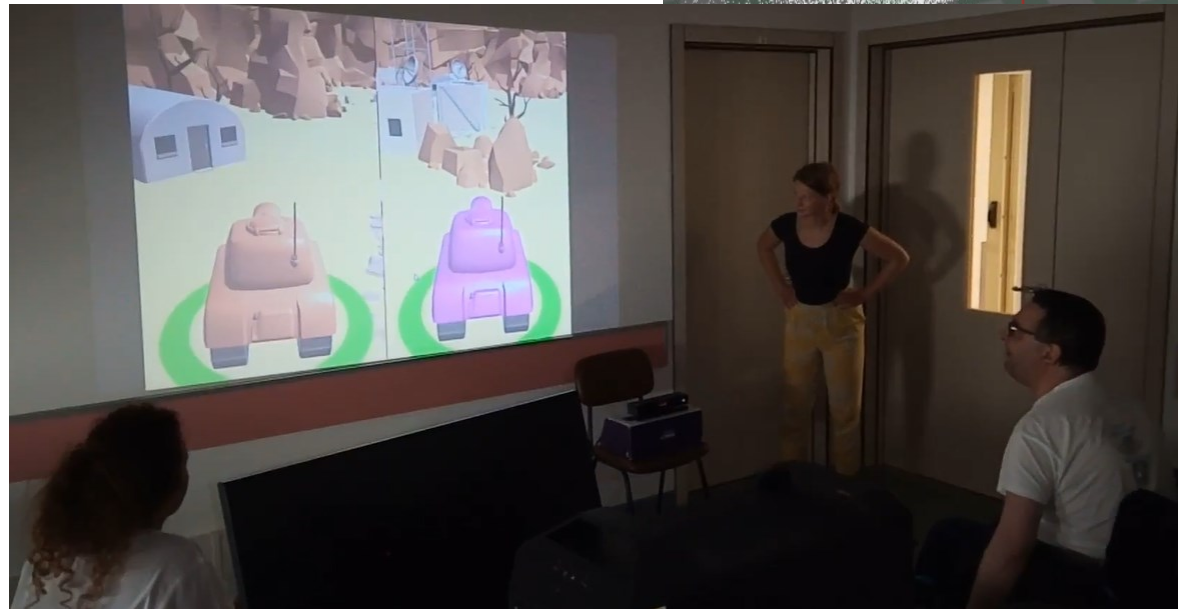
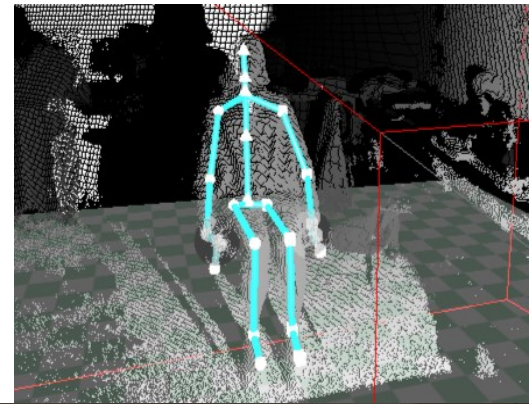
Tests with patients suggest that this type of games can help in patients' motivation to perform the therapeutic gestures

Patients asked for the game to be installed at their living room



# Virtual Reality in Balance Rehabilitation

- Used another sensor and adapted open source games
- Established participation conditions
- Tested for balance rehabilitation
- Encouraging results with patients
- Patients liked so much, they asked to install the game at their living room!

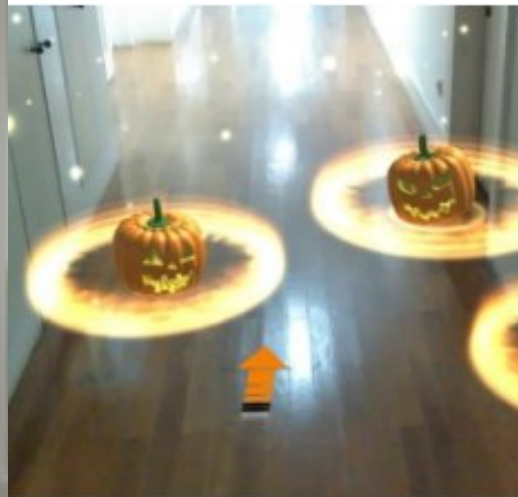


# III – AR for quasi-continuous experiences

- AR applications are generally used for very specific and localized purposes



- What if we need a more “continuous experience”?



- How to “augment” the world?



- Applications are needed allowing:
- Placing virtual objects in the real world
- Maintaining their location
- Editing In a easy way (by non-developers)



Modelos

- Rodar
- Mover
- Mudar tamanho
- Apagar

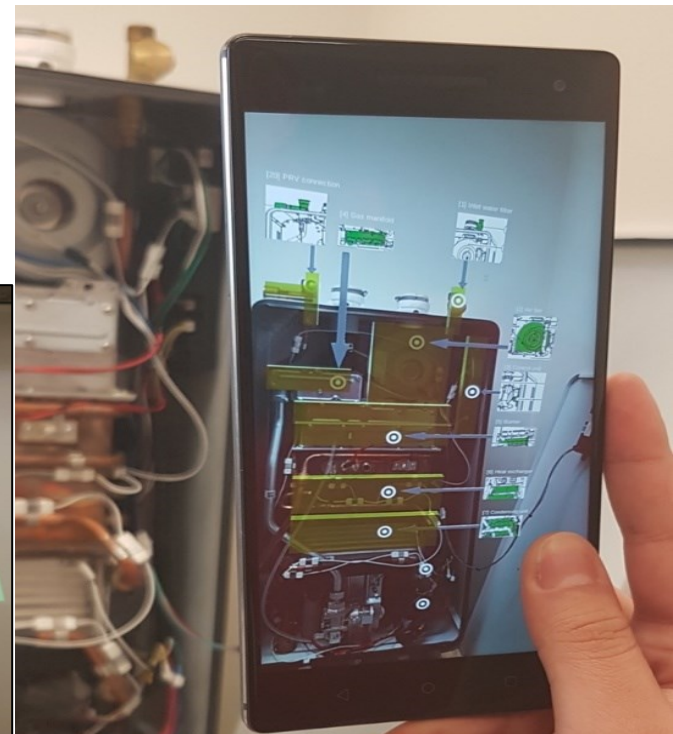
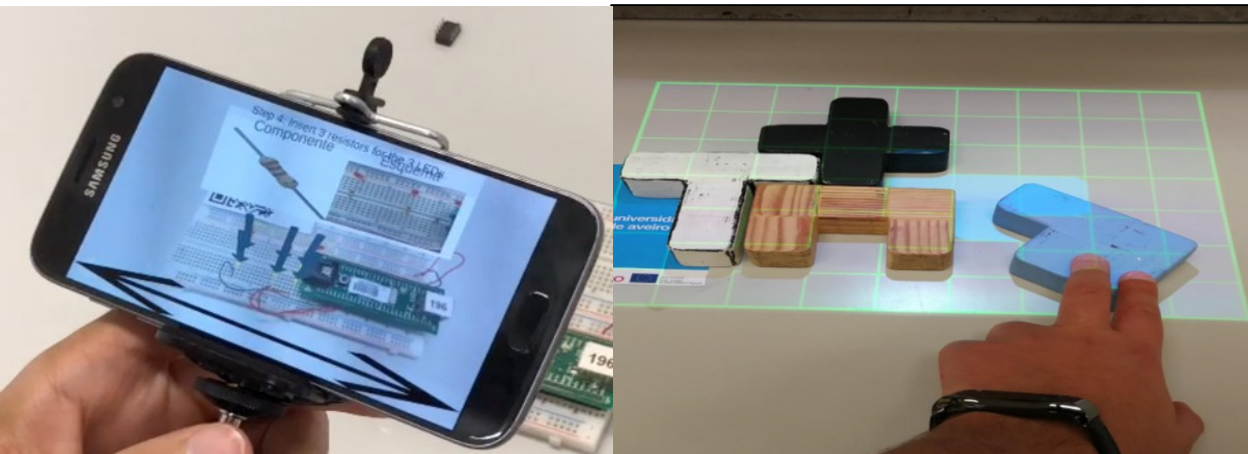
- It may be advantageous to do it remotely...
- Navigating a 3D virtual model of the world
- Expensive, but can be worth it



# IV – AR in Maintenance and Assembly

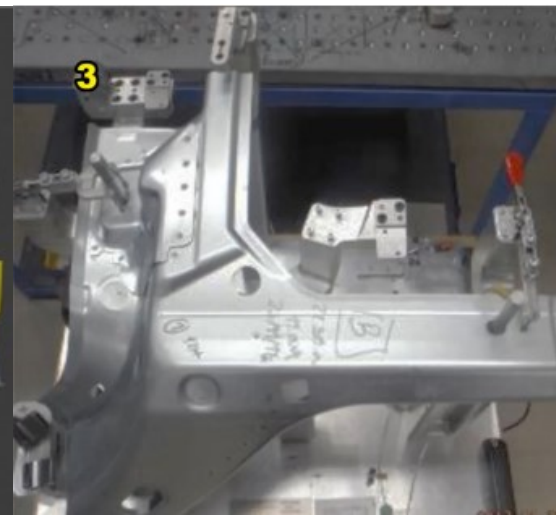
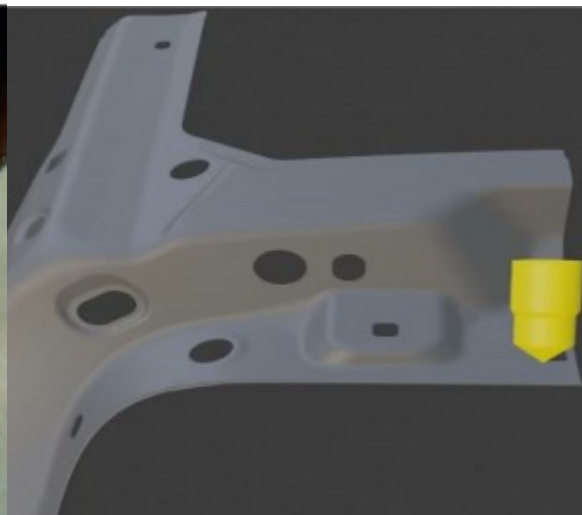
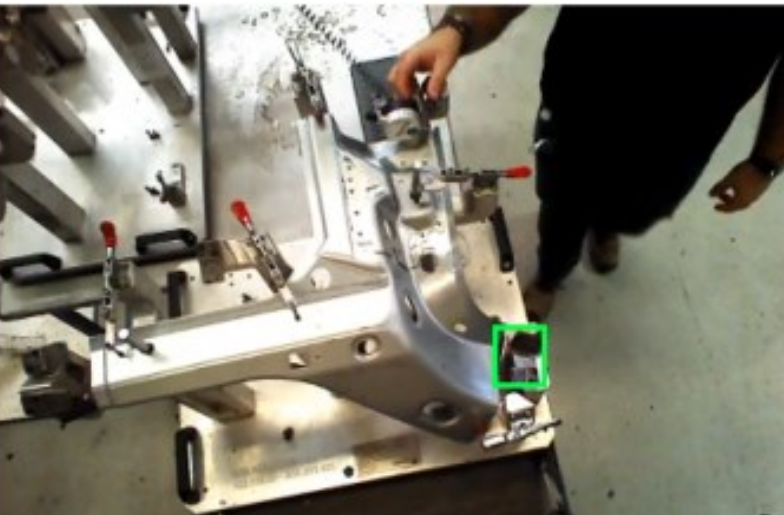
(in cooperation with the Bosch Thermotechnology and Produtech – SIF)

- Maintenance and assembly may involve complex procedures
- AR applications may be used to help in these tasks
- Overlaying instructions ...

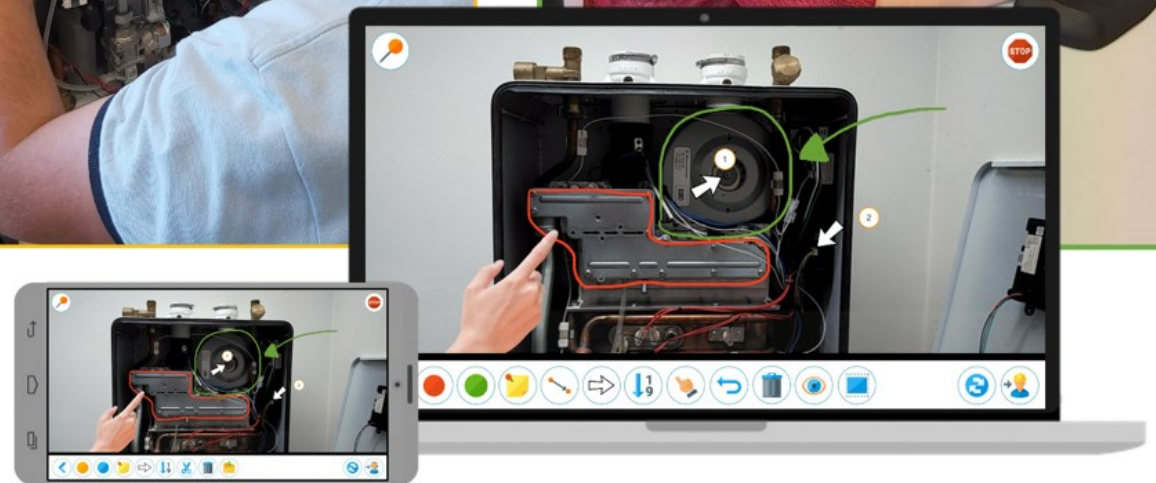
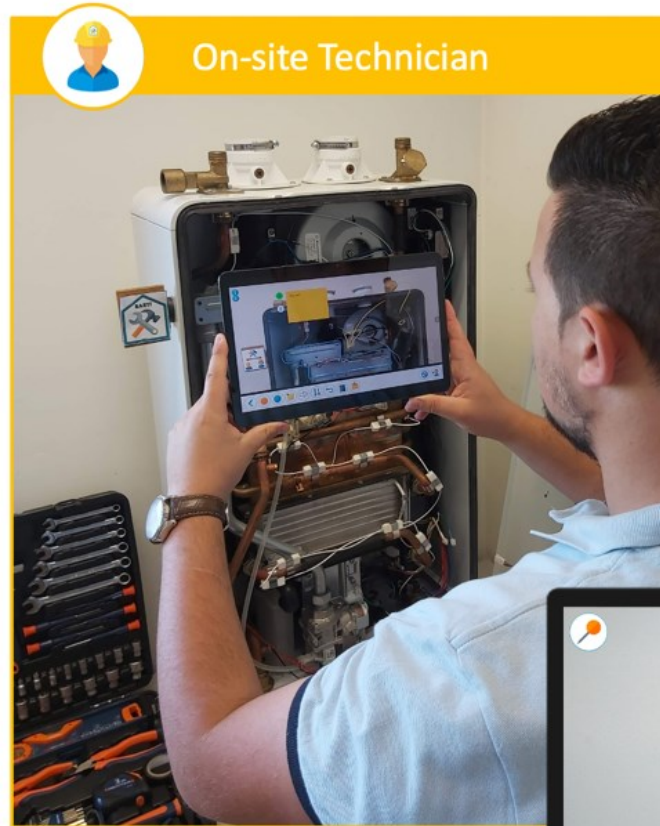


- Help with quality control
- Fostering productivity by reducing:
  - Time, waste, motion and additional work
  - Training time

contribute to a leaner approach



- Saving time and travelling costs
- By getting help from a remote expert ...





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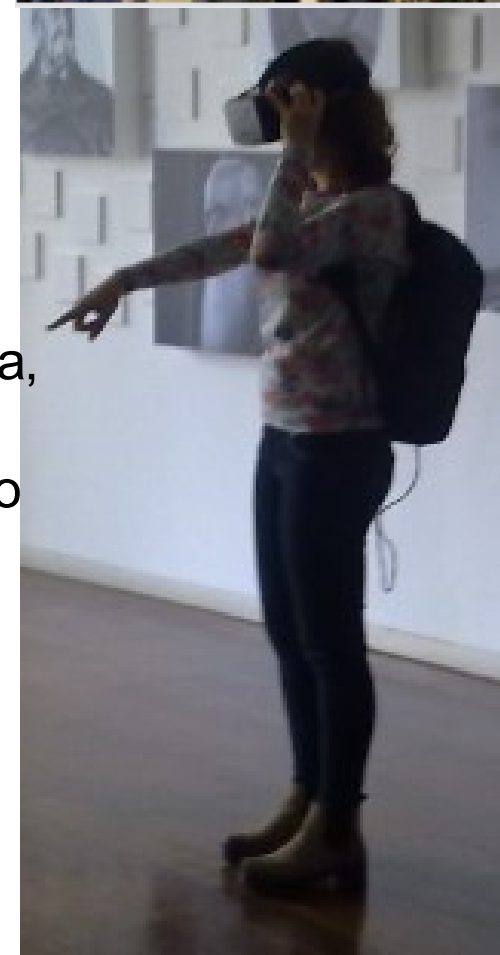
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