
# FROM IMMERSIVE TECHNOLOGIES TO DIGITAL TWINS AND 3D AVATARS

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# METAVERSE AS A CATALYST FOR CREATIVITY AND PRODUCTION

The **Metaverse** integrates technologies such as Extended Reality and Artificial Intelligence, offering an **immersive experience** that mirrors the real world while seamlessly blending with it.

It serves as a **powerful driver of creativity**, enabling exploration and experimentation in ways that would be impractical or too costly in the physical world.

The Metaverse has a strong **social** and **collaborative** component: users can interact and work together through their **avatars**, creating a realistic and engaging team experience.

Its impact is already visible in the optimization of creative industries such as fashion, entertainment, and design, transforming processes and enhancing innovation.

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# Data Visualization: A Simple Approach to Exploring Complex Data

One of the key applications of the Metaverse is **data visualization**, primarily through multimedia formats.

It allows us to represent information using **3D objects**, making both understanding and utilization more engaging and effective.

This approach enables users to focus on the creative aspects of a process while **automating repetitive and time-consuming tasks**.


**Data visualization is a fundamental pillar of the creative process, as it transforms raw information into intuitive and interactive representations. By leveraging immersive technologies, professionals can analyze, interpret, and make informed decisions more efficiently, enhancing innovation and productivity**

# METAVERSE AS A TOOL FOR EXPERIMENTATION

Artificial environments, such as those within the Metaverse, enable **creative actions** and **prototyping** at a **lower cost** while allowing extensive manipulation and customization.

One example of a tool applicable in the fashion industry is **Tilt Brush**, which allows users to create 3D paintings and drawings in a virtual space.

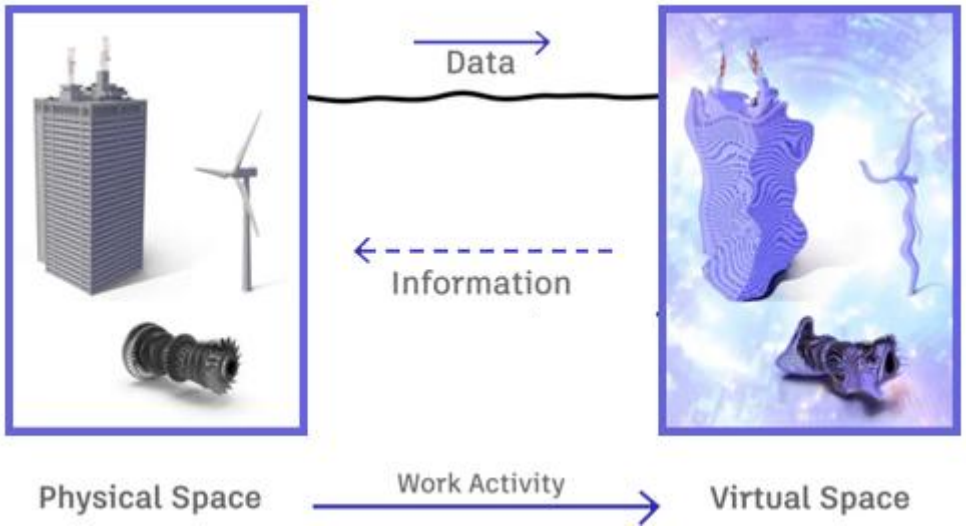
This tool can be applied across various fields. In fashion design, it helps create and conceptualize new patterns, while in the artistic and digital sectors, it serves as a platform for sketching and producing digital artwork.

**The Metaverse offers a unique space for designers and creators to experiment freely without material limitations. By integrating virtual tools, professionals can push creative boundaries, accelerating the design process and enhancing innovation in industries like fashion, digital art, and product development.**

# DIGITAL TWINS

# WHAT IS A DIGITAL TWIN?

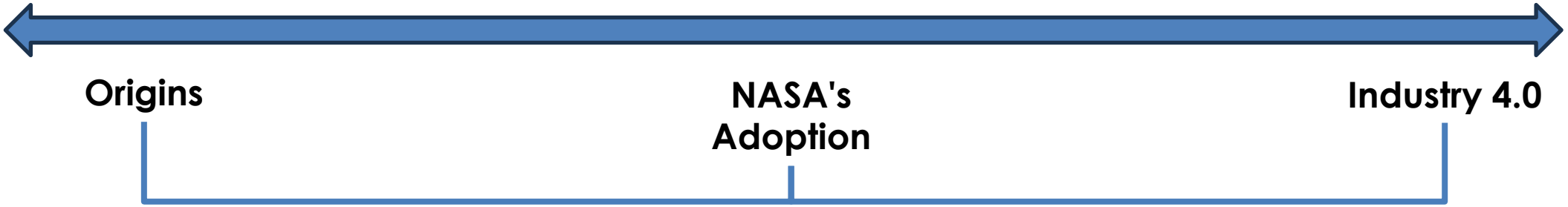
**A Digital Twin is a virtual representation of a physical object, system, or process that spans its lifecycle, is updated from real-time data, and uses simulation, machine learning, and reasoning to aid decision-making.**




**Characteristics**:

- **Real-Time Data Synchronization**: Continuous data flow from sensors enables the digital twin to mirror the current state of its physical counterpart.
- **Simulation and Modeling**: Allows for the analysis of various scenarios without impacting the actual system.
- **Predictive Capabilities**: Utilizes historical and real-time data to forecast future conditions and performance.

# HISTORY AND EVOLUTION




**Origins**: The concept of the Digital Twin dates back to a University of Michigan presentation to industry in 2002 for the formation of a Product Lifecycle Management (PLM) center. He proposed the creation of a digital informational construct to fully describe a physical product, which laid the foundation for the digital twin concept.

**NASA's Adoption**: NASA further developed the concept to improve the physical model simulation of spacecraft for mission reliability. They utilized digital twins to monitor and simulate conditions in space, allowing for better preparation and response strategies.

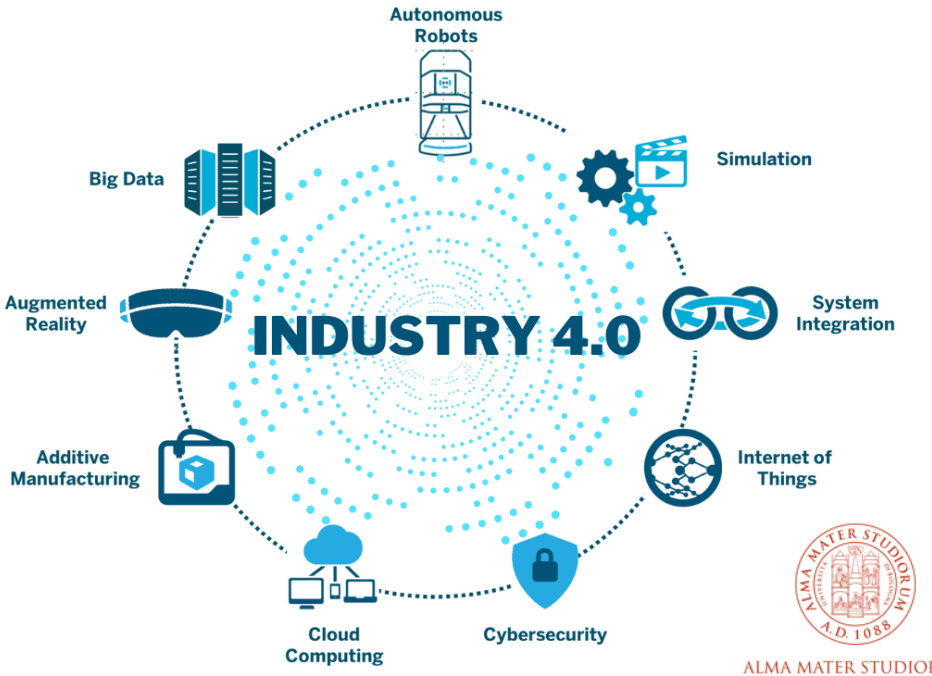
**Industry 4.0**: With the advent of the Fourth Industrial Revolution, digital twins have become integral to smart manufacturing, IoT, and data analytics, driving efficiency and innovation across various sectors.

# INDUSTRY 4.0

- **First Industrial Revolution:** Powered by water and steam, it transformed manual labor into mechanized production.
- **Second Industrial Revolution:** Introduced electricity, assembly lines, and mass production.
- **Third Industrial Revolution:** Marked the digital revolution with computers, automation, and the early use of robotics.
- **Fourth Industrial Revolution (Industry 4.0):** Combines physical systems with digital technologies (cyber-physical systems) to enable interconnected, self-optimizing production systems.

**Industry 4.0** is the integration of digital technologies into manufacturing and industrial processes to create **smart factories** where machines, data, and people interact in real time.

This digital transformation builds on the earlier **industrial revolutions** that first mechanized production, then introduced mass production and computer automation, and later led to the digital revolution.

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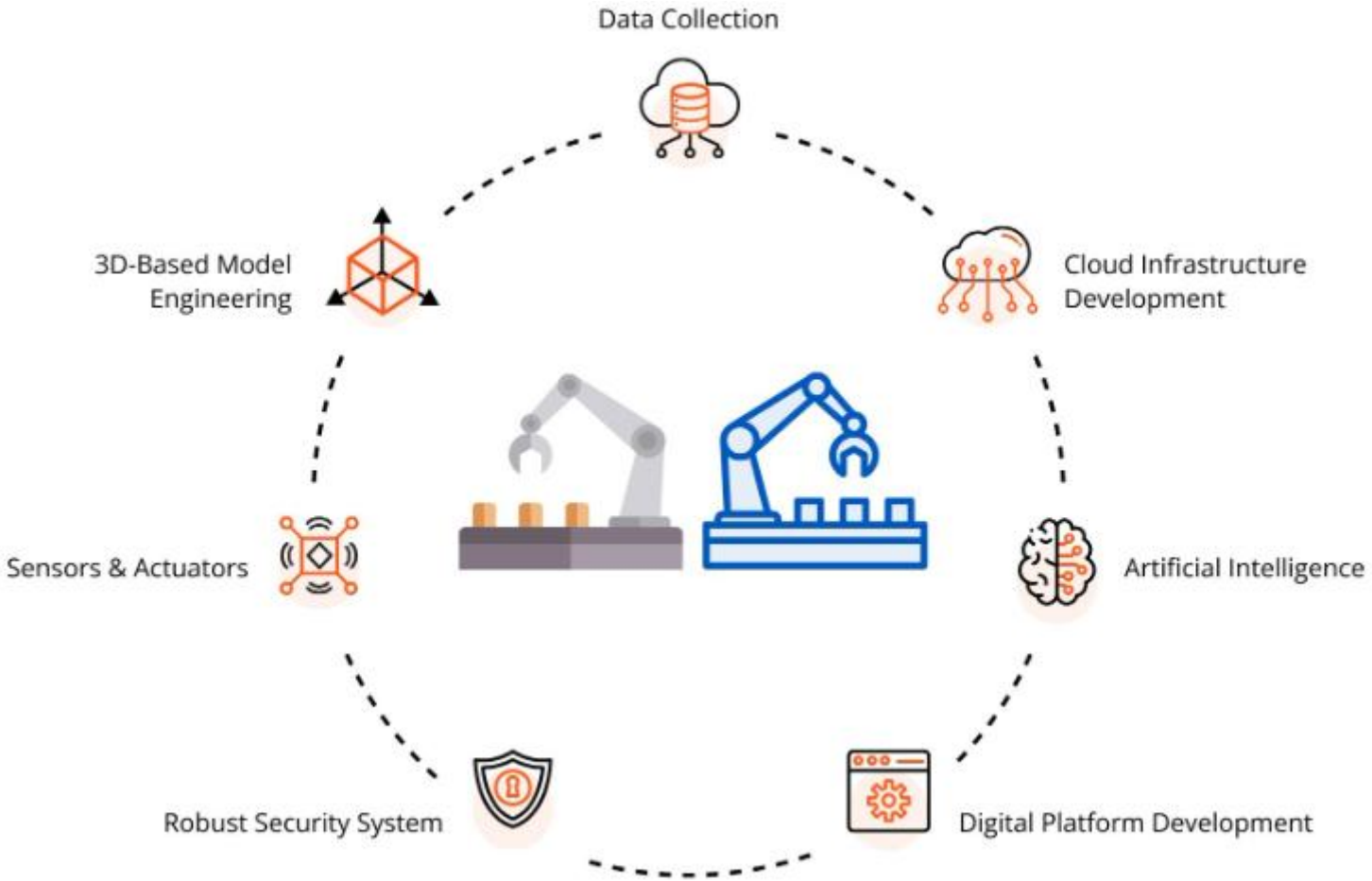
# DIGITAL TWINS



# INDUSTRIAL AUGMENTED REALITY

**Industrial augmented reality** is the application of using **highly visual**, **interactive** methods of presenting relevant digital information within enterprise and industrial environments.

The main feature of this approach is the adoption of the notion of **Situated Visualization**.

# INDUSTRIAL AUGMENTED REALITY

Most existing augmented reality applications used in an industrial context allow virtual objects to be visualized in a real-world context by exploiting the concept of situated visualization.

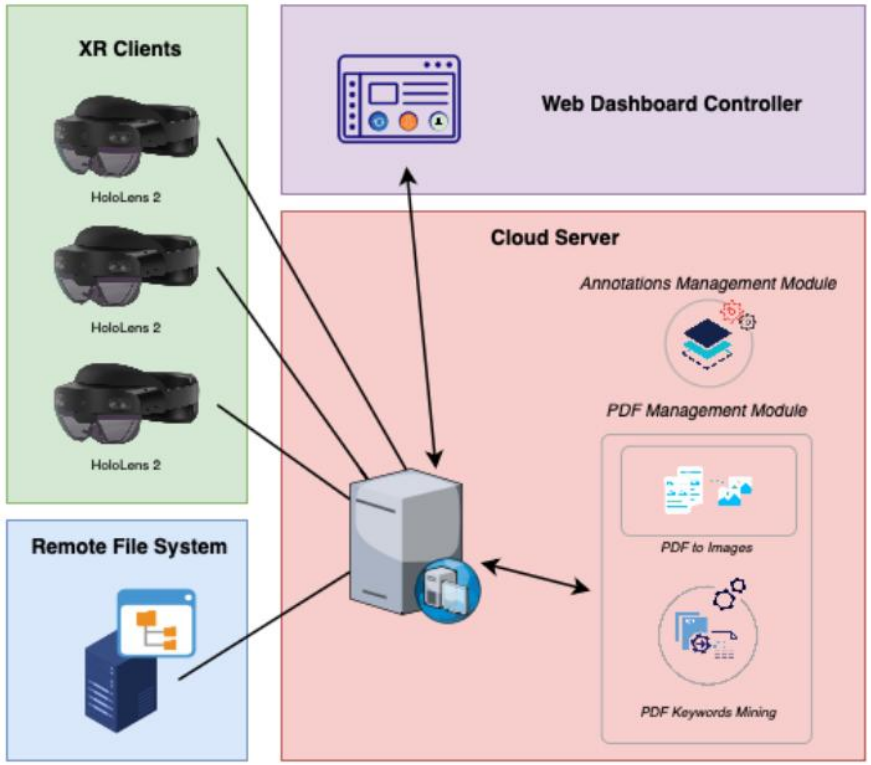
To the best of our knowledge, they do not let a user manipulate and modify the virtual representation within the augmented reality environment.

# AnnHoloTator

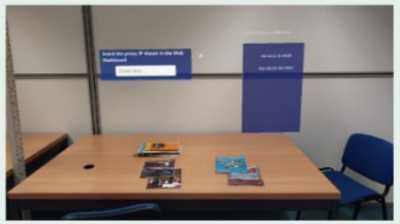
In collaboration with the company “Elettrotecnica Imolese S.U.R.L (ETI)”, whose focus is the production of industrial electrical equipment, a study was conducted on the daily activities of professional technicians to understand how to improve the tasks they perform on a regular basis.

One of their main processes is **Electrical Board Assembly (EBA)** which consists of three main steps:

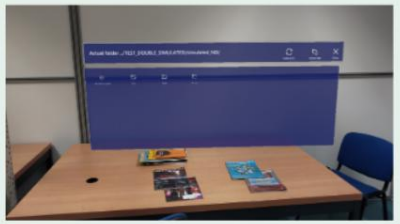
- Visualization of electrical circuit connection diagrams on appropriate documents.
- Working on the physical electrical board to set electrical connections.
- Annotation of information related to the task (e.g. completion of the task,etc.).



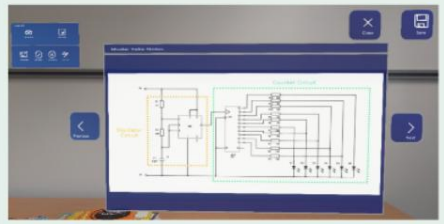
IP Address Selection



File System Navigation

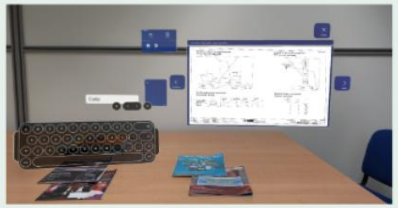


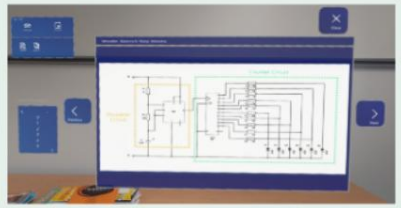
Document Visualization



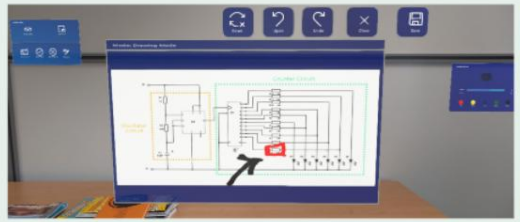
Mode Selection Menu

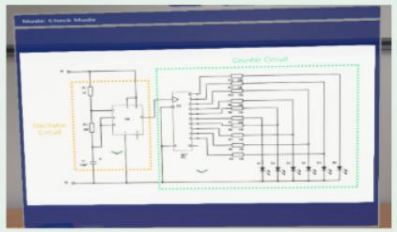
Visualization Mode

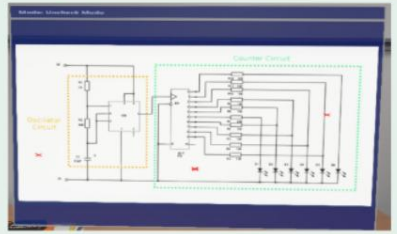




Annotation Mode

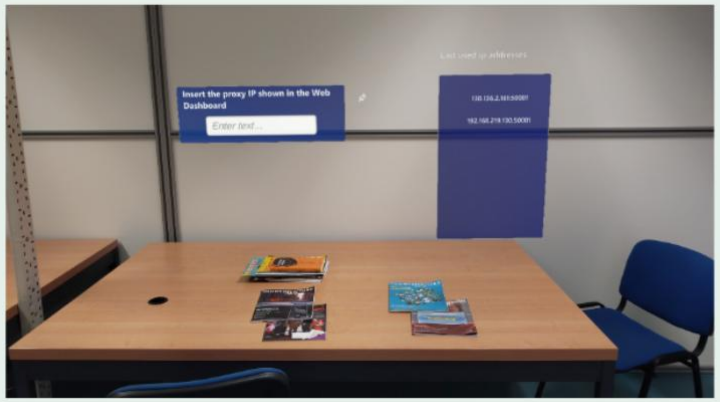


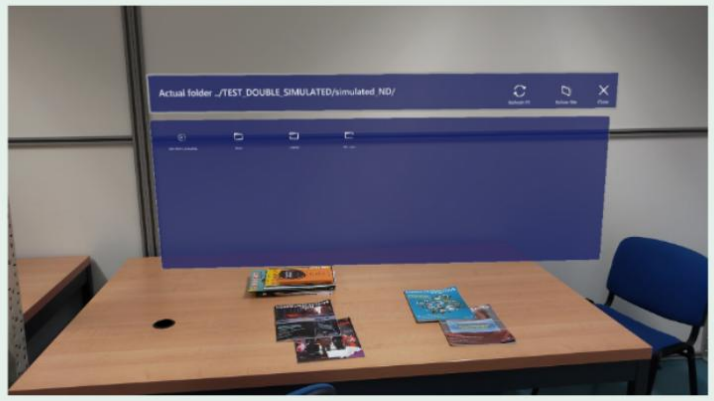


# “TWINNED” FILE SYSTEM

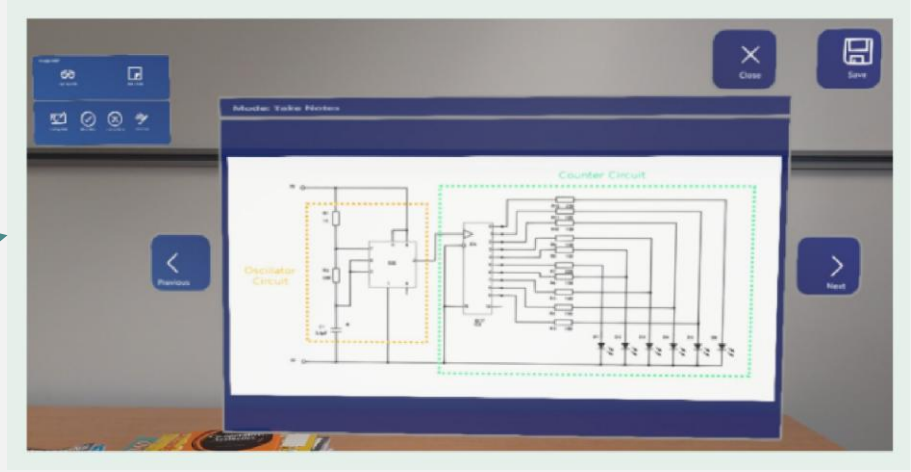
## IP Address Selection




## File System Navigation




## Document Visualization




### AnnHoloTator Web Dashboard

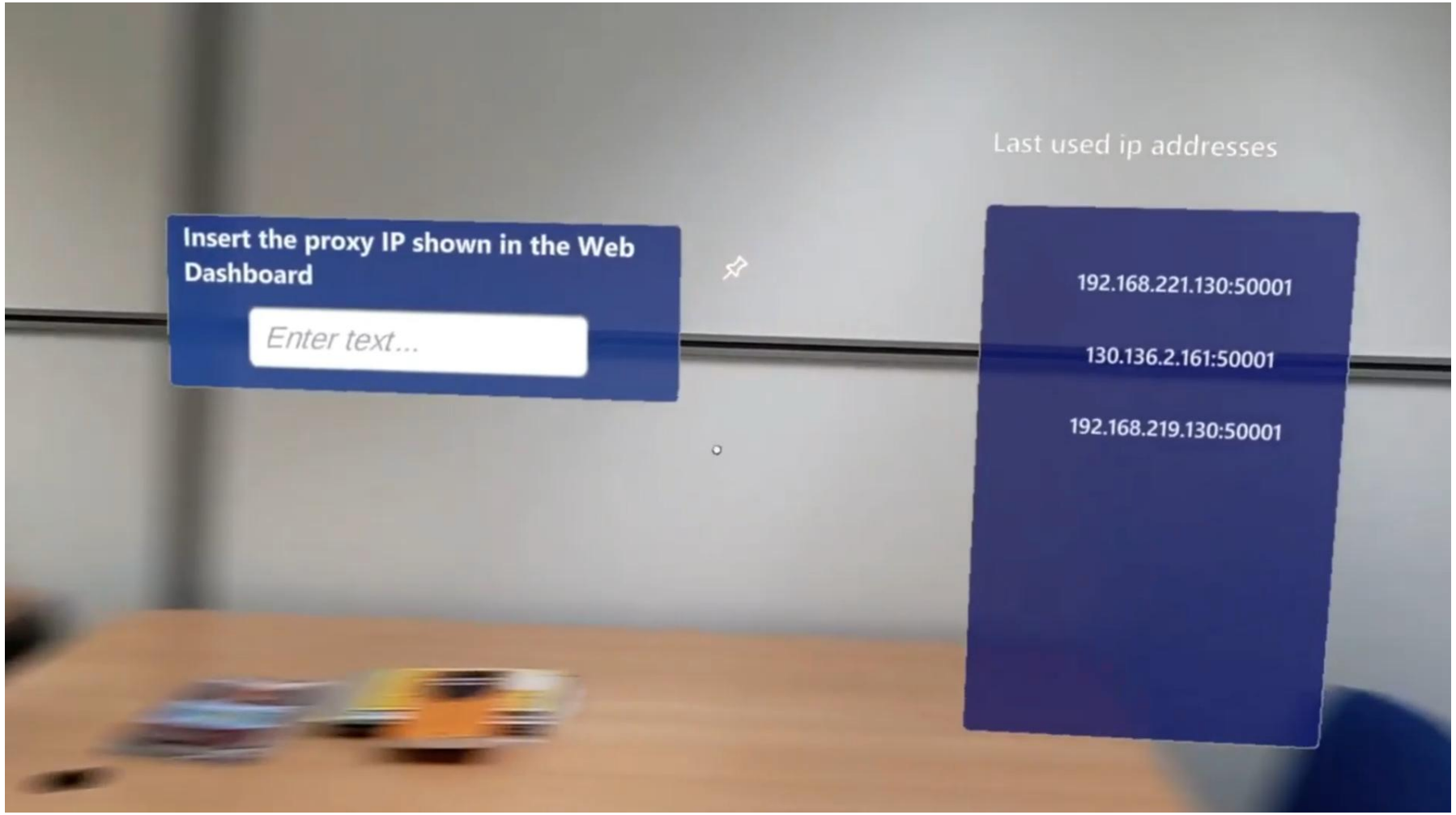
***Actual path is: "../simulated_ND/folder2/folder1_1"***

***Proxy IP: "130.136.2.161:50001"***

| Name | Type | Status | |
|---|---|---|---|
| ... | folder | | |
| PCR58746873458372_PIASTRA.PDF | pdf | Download | |
| PCR21686001_2_20210422_PIASTRA A dopo collaudo.PDF | pdf | Delete from local folder | Synchronize |
| PCR21686001_2_20210422_PIASTRA A dopo collaudo_COPY_EIT_PROJECT.PDF | pdf | Delete from local folder | ✓ |

A technician can connect to a remote filesystem, select a file, and explore it in the augmented reality environment.

# DEMO


Insert the proxy IP shown in the Web Dashboard
Enter text...
Last used ip addresses
192.168.221.130:50001
130.136.2.161:50001
192.168.219.130:50001

# 3D SCANNING SYSTEMS


# PHOTOGRAMMETRY

## Unrealistic scanning


### Portal MX

By Texel

| | |
|---|---|
| Category | Full body scanners |
| Topic | Body scanning |
| Technology | Structured light |
| Max. resolution | 1 mm |
| Country | United Kingdom |

From
**$ 34,900**

### Scanatic™ 360 Body Scanner

By TG3D Studio

| | |
|---|---|
| Category | Full body scanners |
| Topic | Body scanning |
| Technology | Laser triangulation |
| Max. resolution | - |
| Country | Taiwan |

From
**$ 20,000**

## High cost – many cameras

### BOTSCAN NEO

By botspot

| | |
|---|---|
| Category | Full body scanners |
| Topic | Body scanning |
| Technology | Photogrammetry |
| Max. resolution | 0.1 mm |
| Country | Germany |

From
**$ 200,000**

## High cost – many cameras


### Portal BX

By Texel

| | |
|---|---|
| Category | Full body scanners |
| Topic | Body scanning |
| Technology | Structured light |
| Max. resolution | 1 mm |
| Country | United Kingdom |

From
**$ 45,650**

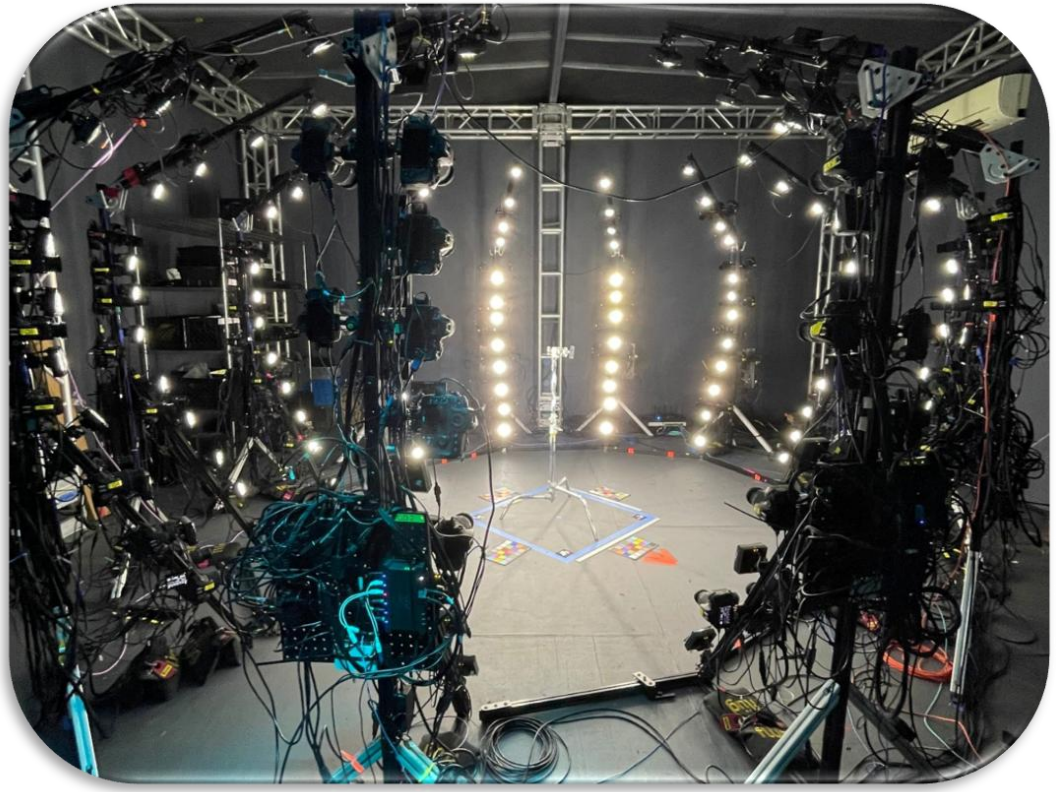

### Proscanner

By Fit3D

| | |
|---|---|
| Category | Full body scanners |
| Topic | Body scanning |
| Technology | Structured light |
| Max. resolution | - |
| Country | United States |

From
**$ 10,000**

## PROBLEMS



## SOLUTION

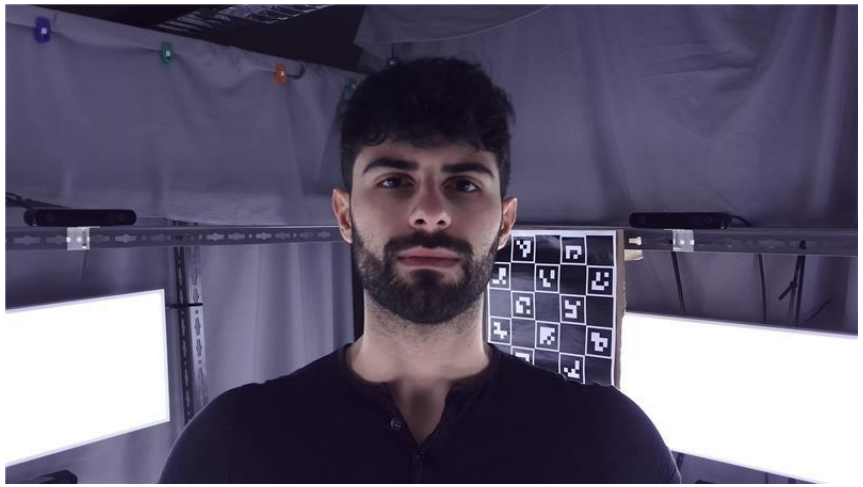
- ~10 low cost cameras
- 4 square meters cabin
- 1/2 minutes avatar generation time

## SOLUTION

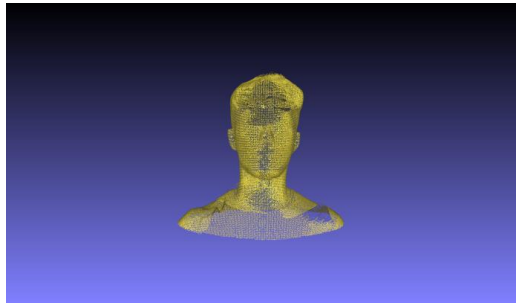
- Instant acquisition
- Photorealistic texture
- Robust system

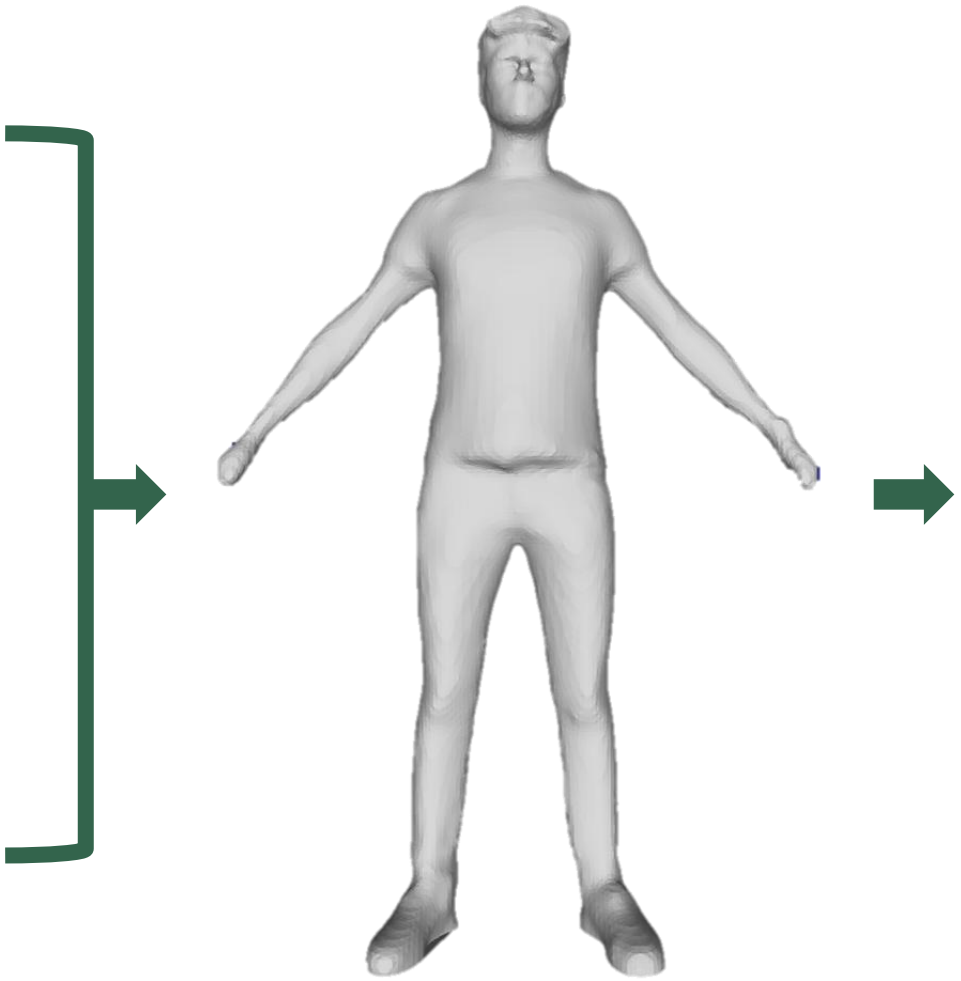
## PROBLEMS

# ACQUISITION

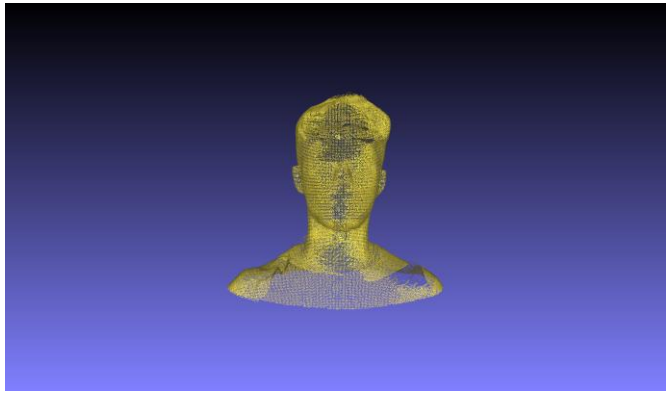


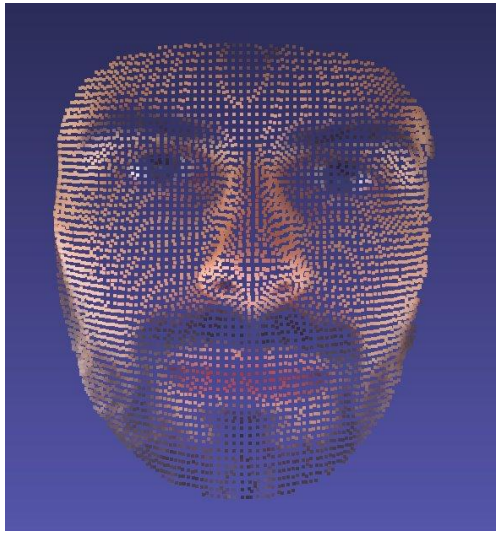
# PIPELINE SOFTWARE





# PIPELINE SOFTWARE





# FACE OPTIMIZATION

## Non-optimized textured mesh

## Optimized textured mesh

# PIPELINE SOFTWARE: TEXTURE QUALITY







# USE CASE: FASHION


**Size suggestion**

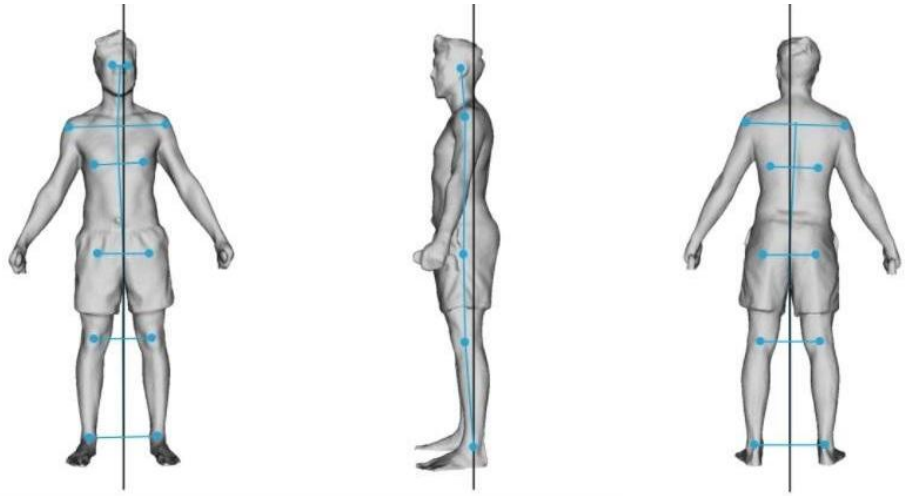
**Virtual try-on**

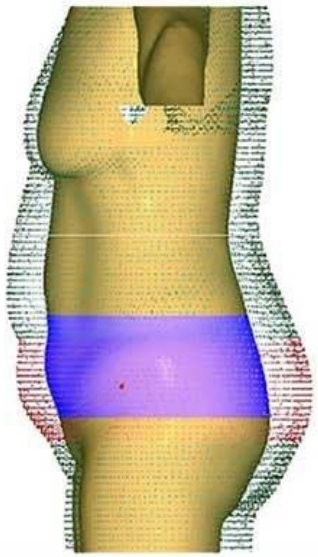
# SHOWROOM

# Sport, Fitness and Medical

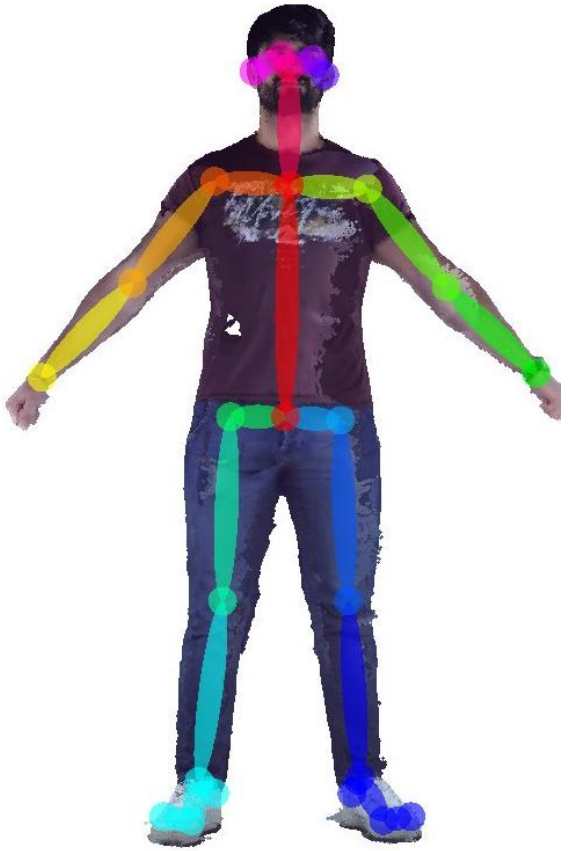
**Postural analysis with photorealistic 3D avatars and accurate anthropometric measurements enables precise assessment of body alignment and movement.**

**This technology helps identify posture imbalances, optimize training, and reduce injury risks by tailoring exercises to individual needs.**





# AUTOMATIC RIGGING ALGORITHM



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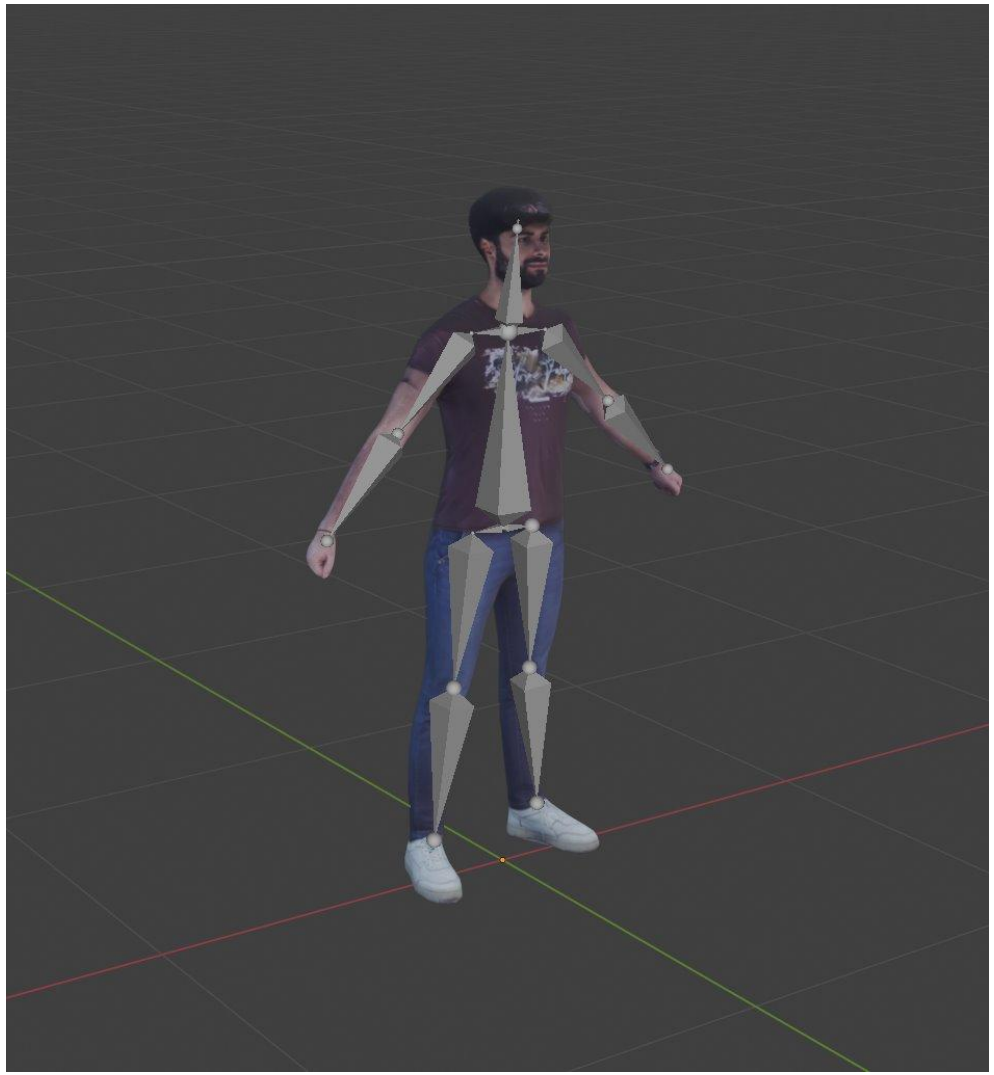
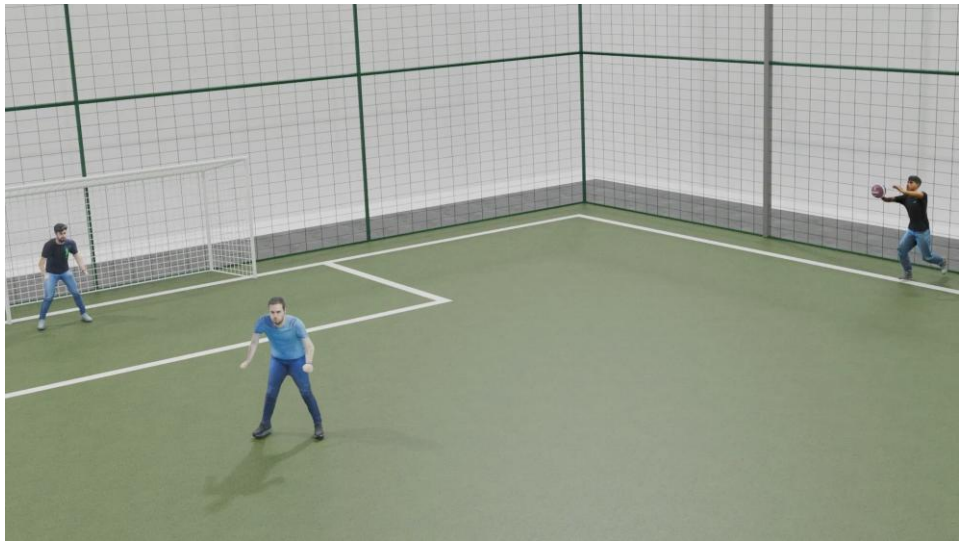


# COMPLEX ANIMATIONS



# CONVERSATIONAL VIRTUAL AGENT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