Università di Genova | DIPARTIMENTO INFORMATICA, BIOINGEGNERIA, ROBOTICA E INGEGNERIA DEI SISTEMI

**Computer Science Workshop**
*PhD program in Computer Science and Systems Engineering*

# Mixed Reality Environment Enhanced by Self-Avatar

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## Introduction

When immersed in a Virtual Reality (VR) environment, the real objects surrounding the user could represent both obstacles to be possibly avoided to prevent injuries [2], both entities with which one could interact [1]. In [3], we have proposed a system that is able to create a virtual scenario consistent with the 3D structure of the real environment where the user is acting. Also the user was able to sit on a chair. In this work, we present some new features of the system we are working on, with the goal of achieving a coherent interaction with objects present in the real environment, adding new scenario and improving the sense of presence with a self-avatar [4].

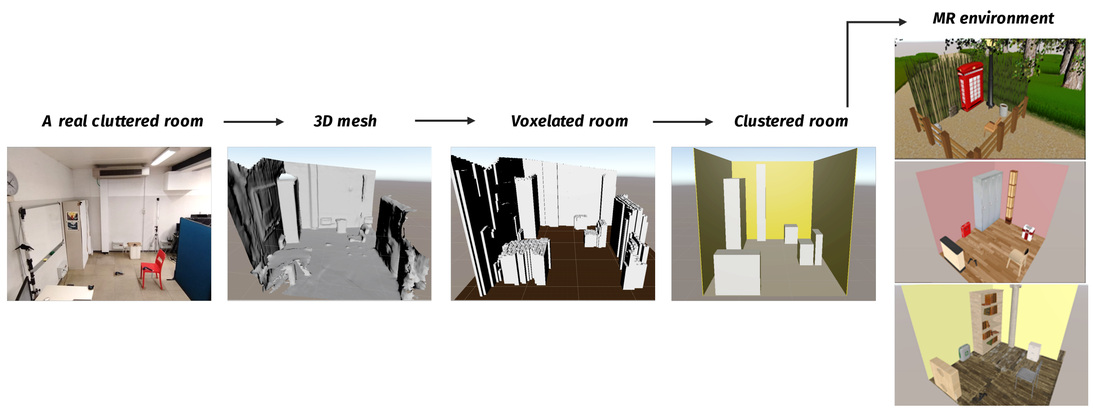


**Figure 1:** From the real world to the mixed one: the old setup

## Main Objectives

1. Understanding the benefit of self-avatar for obstacle avoidance.
2. Understanding the benefit of self-avatar for sitting on a chair.
3. Improving quality of real objects substitution.
4. Adding more VR environments for the substitution.
5. Using Photogrammetry instead of RGBD camera.

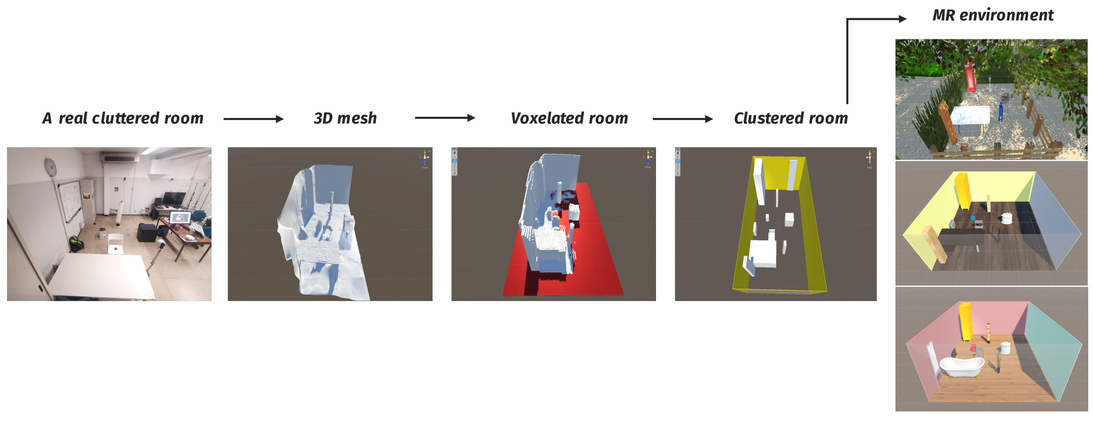


**Figure 2:** From the real world to the mixed one: the new setup

## Materials and Methods

1. Photogrammetry to reconstruct the model of the room using Recap Photo.
2. The two models of the avatar (man and woman) are taken from Ready Player Me, a platform to create simple avatar models.
3. The self-avatar is made with FinalIK plugin for Unity that allow to use inverse kinematics to recover position and rotation of all the human joints knowing 6 points (head, two hands, two feet and pelvis).

**Figure 3:** The male and female avatar. A snapshot of the female avatar sitting on a chair.

## Procedure

Aligning the model with the real world is performed by scaling, translating, and rotating the reconstructed world to match the real one. These transformations are done by overlaying selected keypoints with a known position in both the model and real room reference frame. We calculate $\frac{d_{real}}{d_{model}}$ for every combination of the keypoints. The scale factor s is computed as the median of the ratios $\frac{d_{real}}{d_{model}}$. To compute the rigid transformation between the room model and the real room, we use the least-square rigid motion using the Singular Values Decomposition (SVD) technique.

## Results and Conclusion

Currently we are fixing the last problems and preparing the experimental session in a between subject design in order to avoid the users to perform too many experiments. The expectations are that the self-avatar will increase the sense of presence in the virtual environment, allowing a more natural interaction with the objects in the virtual world.

## Forthcoming Research

Interesting future research would be to studies technologies and technique to also track the movement of the real objects and reproduce this movement in the virtual environment in order to interact with them exploiting different hand tracking technologies [5]. Other work could be done in the self-avatar field adding for example avatar customization.

## References

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