UMI3D

Unified Model for Interaction in 3D

White Paper

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UMI3D: A Unified Model for Interaction in 3D

Introduction

The objectives of the UMI3D project are to simplify the collaboration between multiple and potentially asymmetrical devices in Augmented and Virtual realities, and to enable the design of collaborative applications without a prior knowledge of user devices.

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What is the problem ?

One device is not enough

In complex cooperative situations, the tasks diversity is very high. The main limitation to support this kind of situation with AR or VR is that one device can be at the same time very performant for some tasks, but unusable for some others. That is why one device is not enough to support complex cooperative situations. Examples of such situations are multiple in industry, particularly when they involve actors with different roles and trades.

New devices are coming ever faster

A fierce competition between the device's manufacturers leads to an ever faster progression of hardware. As a result, we regularly re-develop our applications from the beginning with new devices. This issue slows the validation of the use cases, and is aggravated by the need to support several devices.

The existing approach

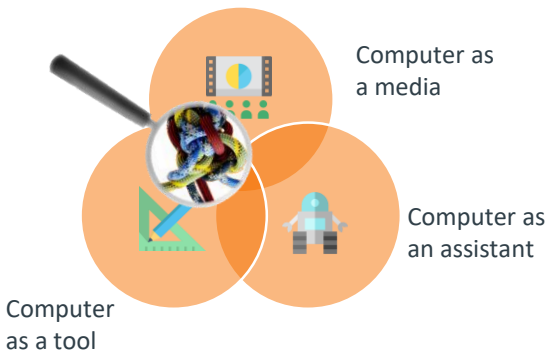
The existing approach to develop VR and AR applications regardless of user devices is the one taken by some programming APIs like WebXR. This approach consists in creating a generic code API to access the main device's features (position and rotation tracking, pattern detection, 3D controllers). It also allows to run the same code on all the device that implements the standard API. The advantage of this approach is that it is possible to write a unique code that will run on different but similar devices (like concurrent HMDs). But if we wants to support very different (but complementary) devices, it becomes hard (even impossible) to exploit the specificities of each device. That is why we believe that we need a complementary approach, based on the 3D environment's available interactions rather than the devices features, to solve our problem. Moreover, this approach allows to exploit the now unknown features of future devices in existing environments.

UMI3D approach: A total separation between the 3D environment development and the user devices

Take a step back: What makes up traditional AR and VR applications ?

In a traditional AR or VR application, the connections between the three paradigms of interaction are hard-coded.

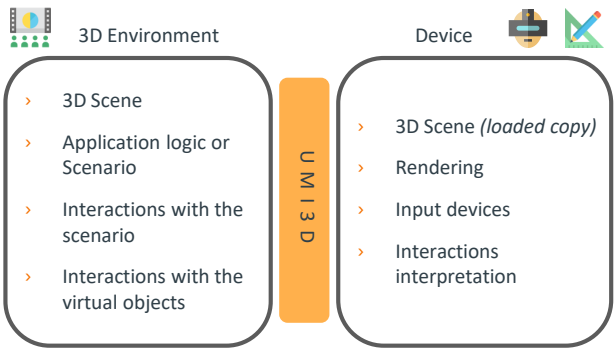
The 3D virtual content is by definition a media. The input devices are tools that allow to manipulate this media. Finally, the environment's virtual agents and the device's vocal assistants are the 'computer as an assistant' part of the application.



The approach of UMI3D is to entirely separate the media from the tools and to let them communicate using a generic interface. About the assistants, the virtual agents will be integrated to the 3D media because they are part of the environment when the vocal assistants will be directly integrated to the tools.

How to build a generic interface between the 3D environments and the devices ?

To achieve this, we are building an abstraction layer between the 3D environment and the device. This allows to run the environment on a separated computer. The communication between the environment and the devices is possible using a network connection.



As a result, the only requirement to support all the existing environments on a new device is to develop a dedicated browser for this device. To sum up, UMI3D allows to integrate very quickly new devices in the existing applications and to focus on the usages, which is a big advantage for AR and VR adoption in the industries.

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What is already done ?

We have implemented and demonstrated the concept validity

We have implemented an abstract layer that allows the 3D environment to describe its interactions to unknown devices. To achieve this we only use degrees of freedom. The environment describe an interaction by a 1 to 6 degrees of freedom movement. The device's browser defines how this movement can be produced by the user. When the device informs the environment about the move it has produced, the environment associates a reaction and submit the changes to the connected users. As a result, the environment developer is free to associate the reaction of his or her choice for a given movement. It allows to implement complex interactions with a very reduced number of geometrical operators.

UMI3D in SPIE Photonics Europe 2018

Our demonstration of collaboration between asymmetrical AR and VR devices has encountered a fantastic success in the Light Culture exhibition. At this event, we had the chance to show the UMI3D browser dedicated to the augmented reality headset prototype of our partner SL Process.

Example of existing UMI3D browsers

Touchscreen & ARToolKit | Desktop | Oculus Rift

Publications

› Julien Casarin, Dominique Bechmann, and Marilyn Keller. 2017. A unified model for interaction in 3D environment. In *Proceedings of the 23rd ACM Symposium on Virtual Reality Software and Technology* (VRST '17). ACM, New York, NY, USA, Article 23, 7 pages. DOI: https://doi.org/10.1145/3139131.3139140

› A publication about collaboration design using UMI3D is currently submitted

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What is next: Making UMI3D a standard together

If the UMI3D concept has been demonstrated and is very promising for industrial applications, it remains a lot of work in order to make this model a standard. To achieve this, we are looking for open research collaborations with academics as well as industrials. Our conviction is that working together is the only way to create a widely used standard.

Important points :

- The UMI3D specification will be an Open Standard.
- We are looking for industrial use cases and research collaboration to complete UMI3D and/or to create development tools for it.
- The Intellectual Property will be shared depending on each ones participation.
- Our goal is to unlock new usages for AR & VR and to favor their adoption in the industry.

In order to make UMI3D a standard, we are currently working on the following points:

VIRTUAL AGENTS

Chatbots & virtual humans integration

DESIGN METHODS

Quick prototyping
&
run time development

ANALYTICS

Data as a service platform for devices,
UX & Group Experience evaluation

And we will address the following points in the future:
(But not limited to)

CLOUD

Deployment of UMI3D environment
in the cloud

AI

Group & Individual context understanding

TRACKING

Shared & standardized features tracking in Augmented Reality

COLLABORATION

Semantical malleability
of the cooperative-work mechanisms

LOD

Multi-resolution & progressive loading for models, textures, lights

IOT

IOTs data visualization
&
interaction

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Use cases (any other proposal is welcome)

Decision-Making Tools

Multiple actors with different trades can visualize 3D data (from PLM, BIM, etc.) in collaboration.

Different contents and interactions filters can be applied depending on the user roles. The users are able to navigate in cooperation in the data to build impact assessment or shared business views.

Virtual assistants can be integrated to the environment to help the users understand the data, or to let them modify the way they are making decisions.

Multi–Resolution CAD

An engineer modifies a CAD model by drawing new components and changes it's curves with a high precision device.

A product designer can see changes applied in real-time in immersion in VR, in AR to point out or annotate the next modifications to proceed.

Finally, the changes can be visualized in a progressive photo-realistic rendering.

Collaborative & Immersive Product Discovery

A family can test family products (at home or in the shop) in a VR simulation or in AR.

Each family member can have different interactions with the products depending on their age. This makes it possible to try the products in a realistic way with the social interactions that their use entails.

Finally, a virtual or real seller can add, remove or replace products within the simulation.

Progressive Prototype Validation

During the conception of an industrial prototype, the prototype's future interactions can be validated in VR by future users or designers before the components fabrication starts.

The components are progressively fabricated and physically integrated to the simulation.

It allows to pass progressively from a VR simulation, to AR, and finally to the reality during the prototype design.

Process Training

UMI3D allows to design training scenarios with multiple actors.

The actors are collaborating in AR or VR depending on the scenario.

They can use different devices if their real equipment are different in the simulated situation.

Remote instructors can trigger events in the simulation.

Remote Support

Using a desktop, a remote designer can assist a distant technician handling a complex procedure in Augmented Reality.

The designer is able to annotate the technician reality and to provide him documentation and 3D animations about the task to proceed.

On the same time, the technician can achieve the task with the hands free.

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