



Dipartimento di Ingegneria dell'Innovazione
Università del Salento



Augmented and
Virtual Reality Laboratory



eXtended Reality Cultural Heritage – lecture 2

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***Agnano RiVive: a Virtual Reality*
application for the cave of the
Archaeological and Naturalistic
Park of Santa Maria d'Agnano**

Federica Faggiano



Agnano RiVive: a Virtual Reality application for the cave of the Archaeological and Naturalistic Park of Santa Maria d'Agnano

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Immersive Virtual Reality and state of art

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Historical research: the site of Santa Maria d'Agnano

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Archaeobotanical studies: the Upper Palaeolithic site of Santa Maria d'Agnano

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3D models creation

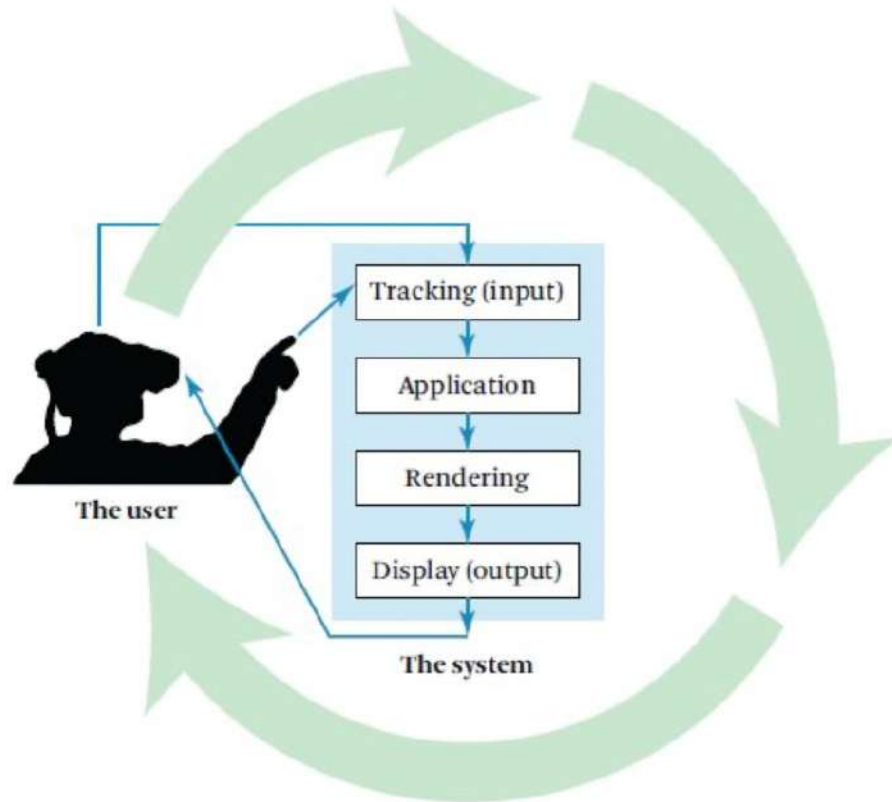
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Virtual world implementation on Unity

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User testing

Immersive Virtual Reality and state of art

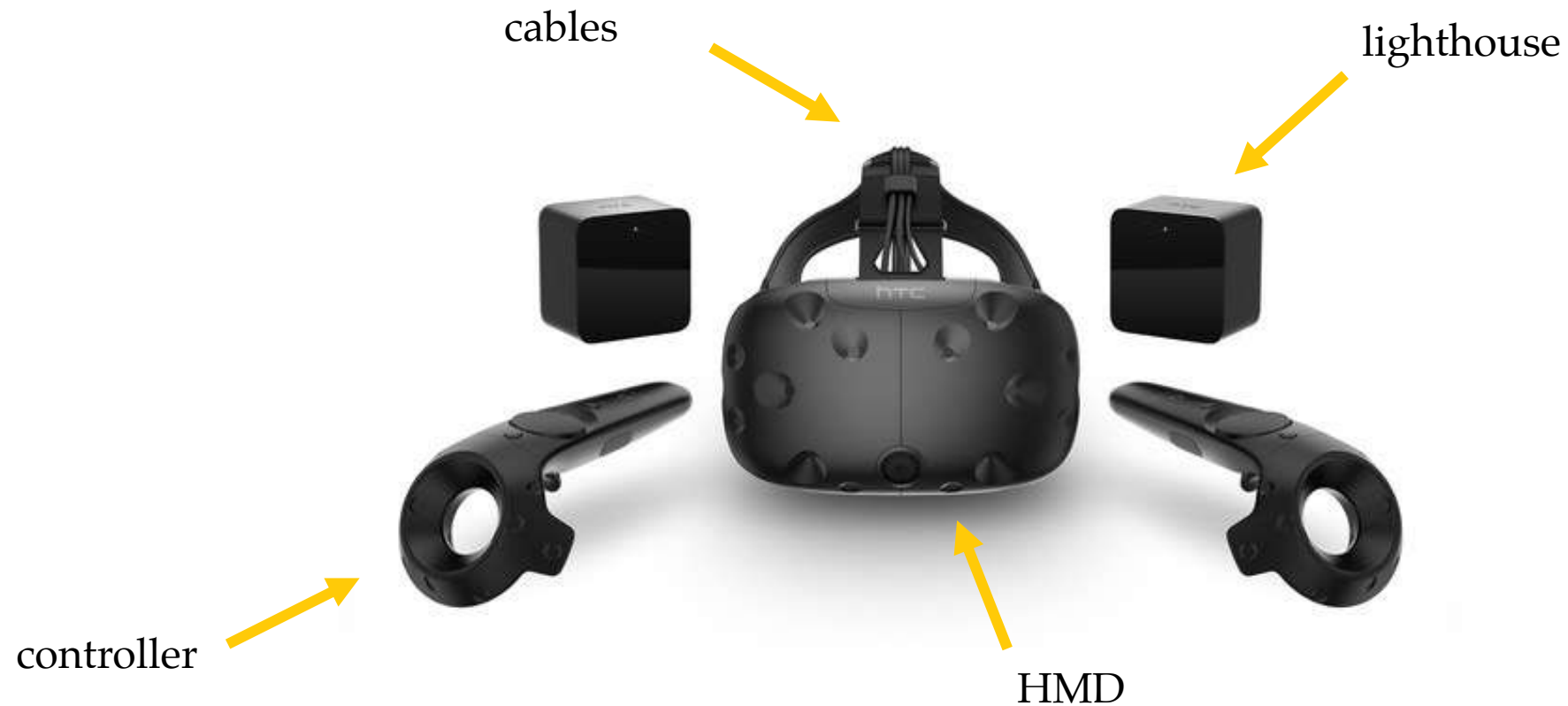


The user is completely immersed in the virtual world, involving the sensory organs of sight, sound, touch, smell and even taste.

Immersive Virtual Reality and state of art

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HTC Vive



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State of art

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Among the most recent experiences, important are those developed in Europe, including Italian ones such as the Virtual Reality Museum or the applications created by ETT. Here are some examples:



The Viking World – Stockholm



Virtual Reality Museum – Bologna

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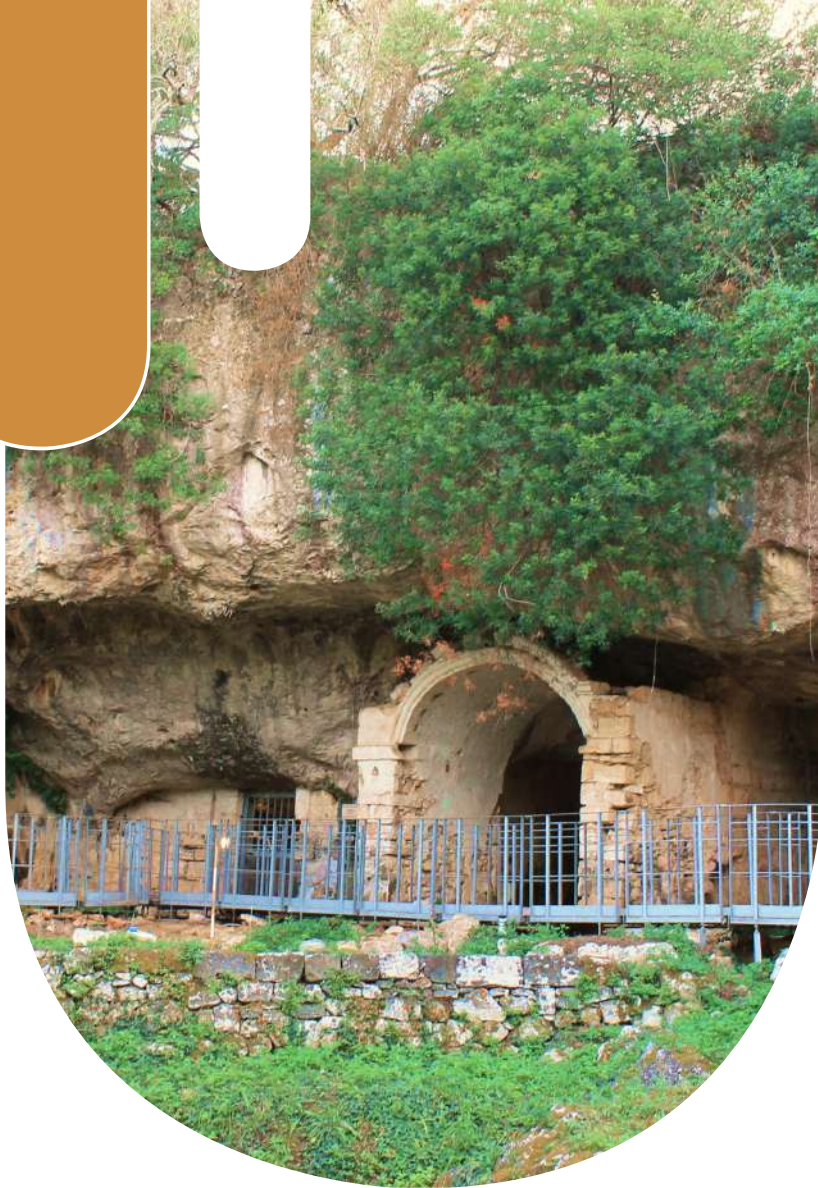
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Historical research: the site of Santa Maria d'Agnano



- The site of Santa Maria d'Agnano in Ostuni, now an Archaeological and Naturalistic Park, was frequented from the Upper Palaeolithic until the end of the 18th century.
- Among the most important findings was the world's oldest pregnant woman, brought to light by Prof. Donato Coppola in 1991.

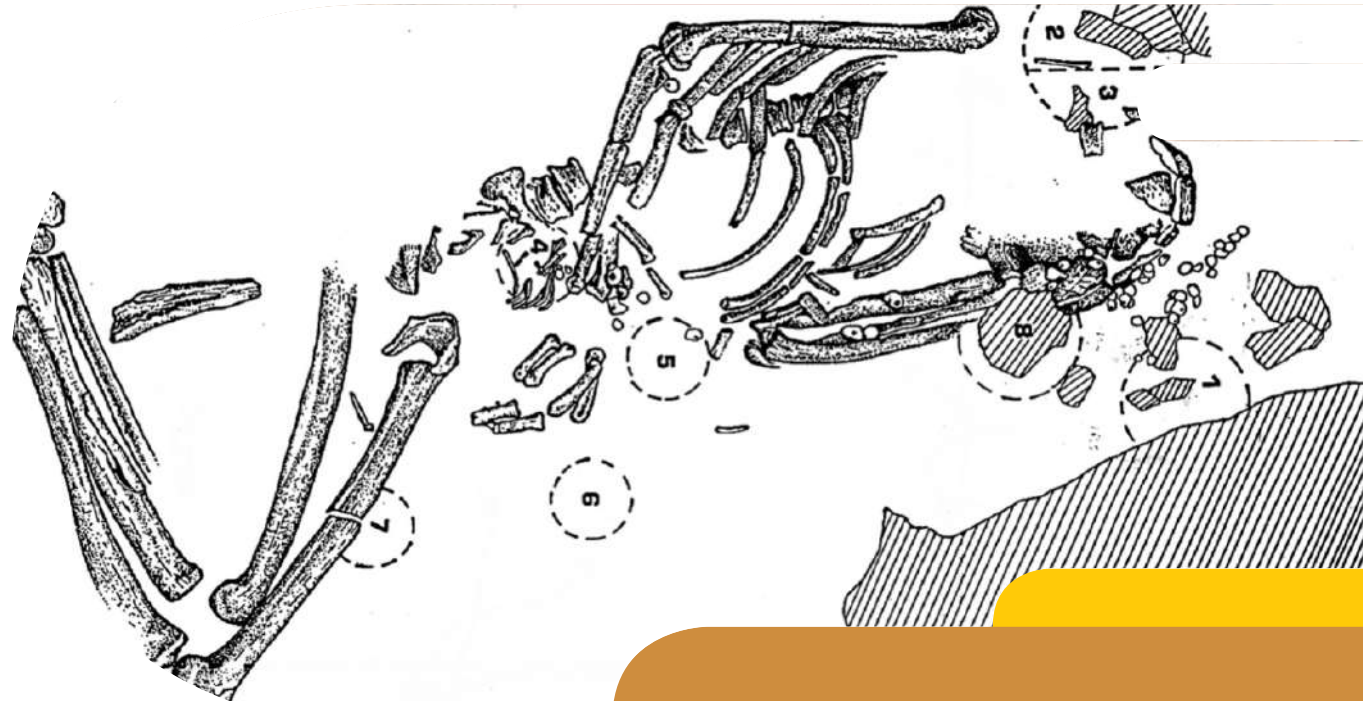
Historical research: the site of Santa Maria d'Agnano



- Named Ostuni 1, this woman passed away some 28,000 years ago due to complications from pregnancy.
- To her, the hunting community to which she belonged dedicated a special burial ritual aimed at deifying the woman and her unfulfilled motherhood.

Archaeobotanical studies: the Upper Palaeolithic site of Santa Maria d'Agnano

- Palynological and anthracological analyses were conducted on the Ostuni 1 burial site, which allowed the palaeoenvironment of the site to be reconstructed.
- In the Upper Palaeolithic, this area was characterised by a steppe landscape with pre-forest vegetation typical of open spaces.



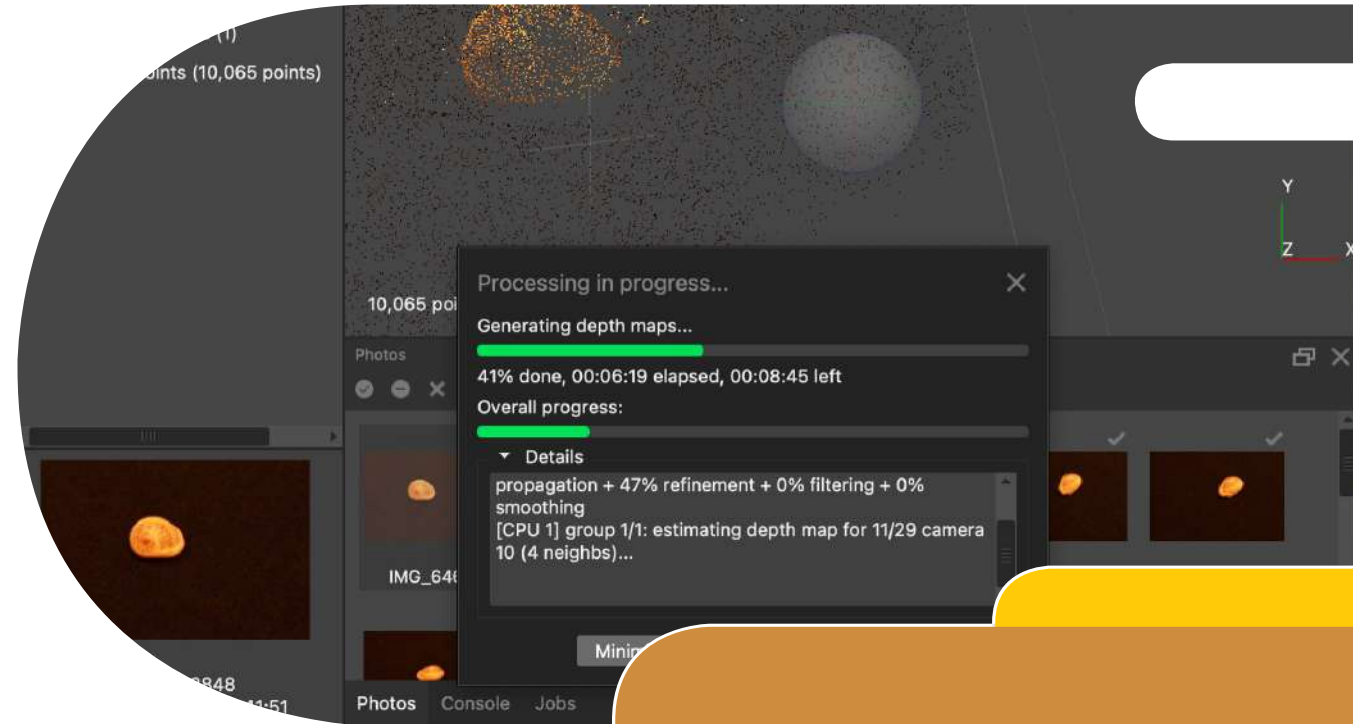
3D models creation

- The first model created was Ostuni 1, taking as reference the reconstruction of the woman in the Ostuni Civic Museum.
- Among the woman's ornaments were numerous *Cyclope neritea* shells. The model of this shell was reconstructed through photogrammetry.



Photogrammetry

- Photogrammetry makes it possible to create three-dimensional models of objects of different sizes from photos taken from different angles.
- The association of points in common between the photos - identified in the variations of colour and shape of the object - was carried out using the Agisoft Metashape software, which is capable of rendering detailed meshes and texture shadings.



Photogrammetry

- First photos were taken for the upper part and, subsequently, more photos for the lower part of the shell - specifically, 21 upper and 17 lower photos taken with a Canon EOS 1100D fixed zoom camera physically circling the object. In addition, pointed lights were placed, all against a black background.
- This was necessary because the object is very small: 2.3 cm.



Photogrammetry

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The steps for both the upper and lower parts of the shell were:

- photo alignment;
- point cloud construction;
- mesh construction;
- texture creation.

The joining of the meshes was done in Blender.



3D models creation

- For the reconstruction of the cave, the laser scanning technique was used. The operating principle is based on how long the emitted signal takes to return to the instrument; the distance allows the position of the point within a Cartesian system (X, Y, Z) to be determined.
- A point cloud was obtained, then converted into a mesh, from which all post Upper Palaeolithic elements were removed.



3D models creation

- The paleoenvironment was reconstructed using models of plants such as pine, oak, lentisk, apple tree and shrubs.
- The social context was recreated through models of flints, torches, hearths, bones, huts and five characters that were animated on Adobe Mixamo.



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Il Parco Archeologico e
Naturalistico di Santa Maria
d'Agnano, nel Paleolitico
superiore, era caratterizzato da
un paesaggio steppico con una
prevalenza di conifere, fra le
quali i giperi (*Juniperus*) e i pini
(in maggior parte *Pinus tipo*
pineae-halepensis o *Pinus tipo*
sylvestris-nigra).

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Virtual world implementation on Unity



- First, a Terrain was inserted to build the ground plane of the virtual world and the sky texture was set. From there, all 3D models were inserted.
- This was followed by the animation of the fires and characters and the insertion of lights, general sounds and information panels with background and paleoenvironment information.

Virtual world implementation on Unity



- Once the graphics part was finished, the SteamVR plugin was installed via the Asset Store. Thanks to it, it was possible to implement controller operation and movement in the world.
- In order for the user to move, nine Teleport Points were set up to trigger the Teleport action.

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Virtual world implementation on Unity



- At this point, work was done on the code to allow user interaction with the objects and the activation of an audio once in front of the burial.
- Thus, it is set up that the user can pick up two flints from the ground, make them collide twice and ignite a fire. Leaving the flints on the ground, the visitor can pick up the torch and ignite it with the flame.

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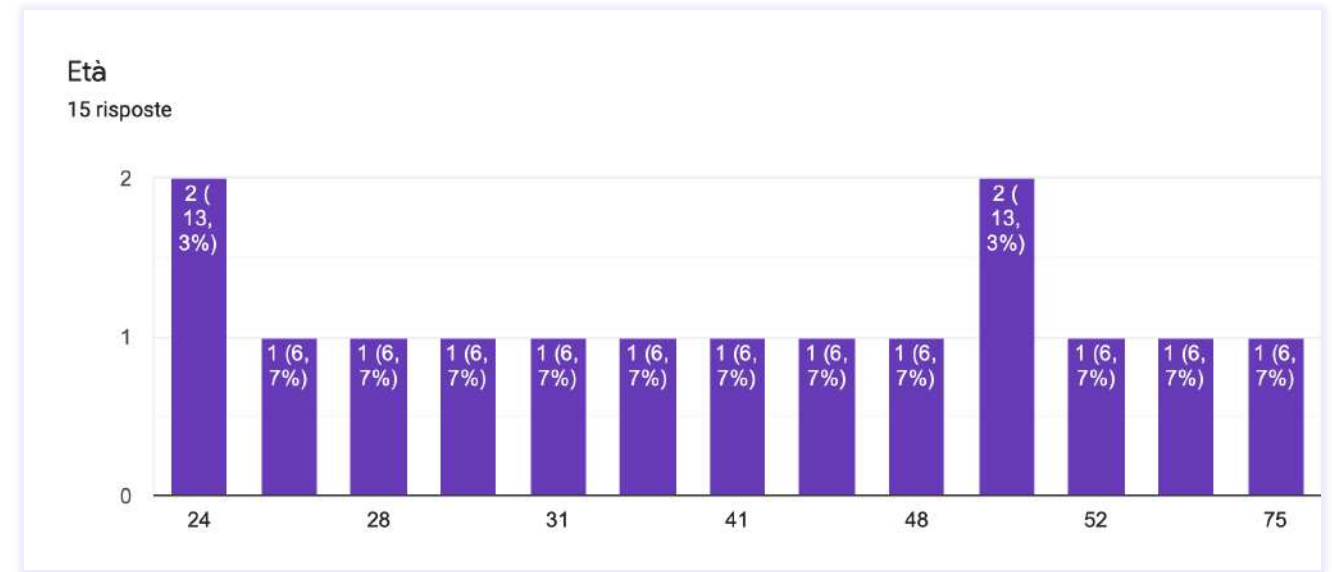
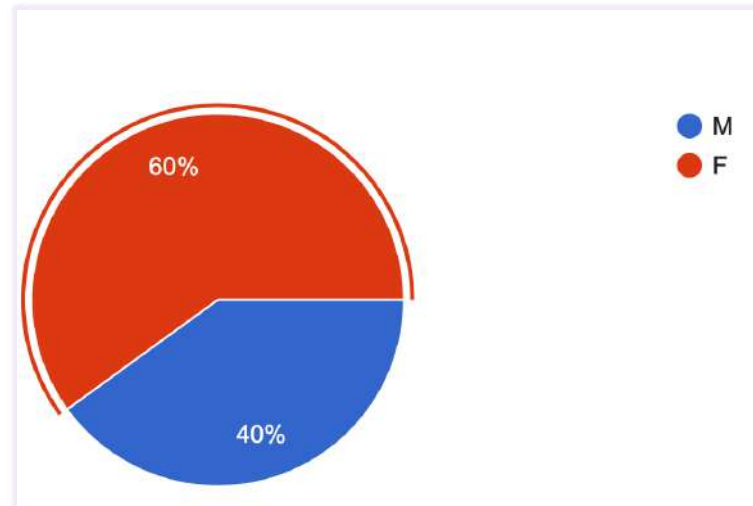


Virtual world implementation on Unity



- Once in the cave, it was set up with a C# script that the user could hear the audio of Prof. Donato Coppola in front of the burial. His words explain the ritual of Ostuni 1 and the importance of the find.
- The virtual experience ends with a view of the cave at its innermost point, illuminated by the torch in the user's hand, who can continue to move further into the virtual world.

User testing



Sei stato in grado di controllare gli eventi? *

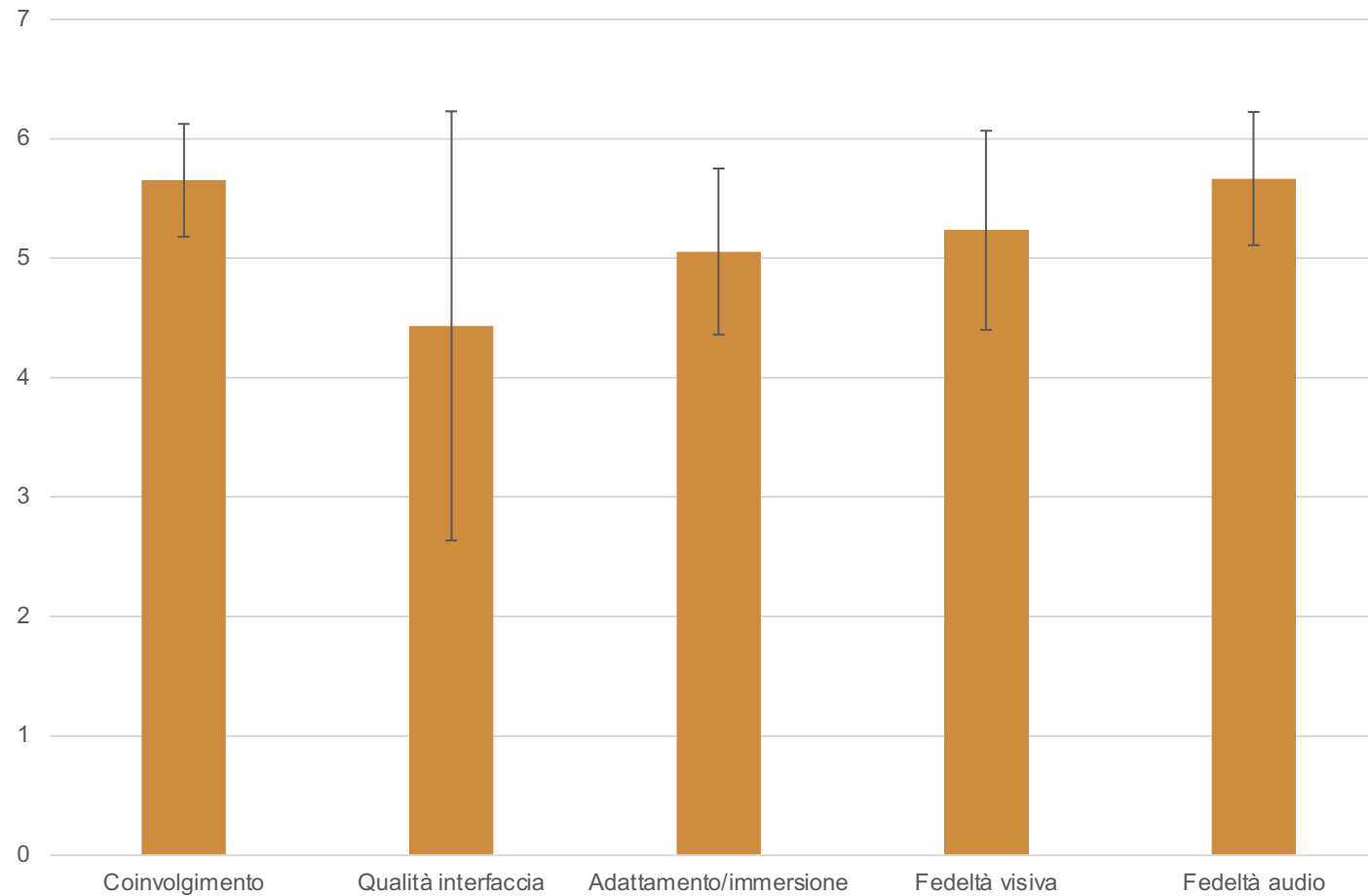
1 2 3 4 5 6 7

Per niente ☐ ☐ ☐ ☐ ☐ ☐ ☐ Perfettamente

User testing

	Coinvolgimento	Qualità interfaccia	Adattamento/ Immersione	Fedeltà visiva	Fedeltà dell'audio
Media	5,651851852	4,433333333	5,055555556	5,233333333	5,666666667
Dev. standard	0,4729152504	1,79691093	0,695665593	0,8339997335	0,557773351
Coefficiente di variazione	0,08367438899	0,4053182548	0,1376041832	0,1593630064	0,09843059136

User testing



Insights



Digital Applications in Archaeology and Cultural Heritage

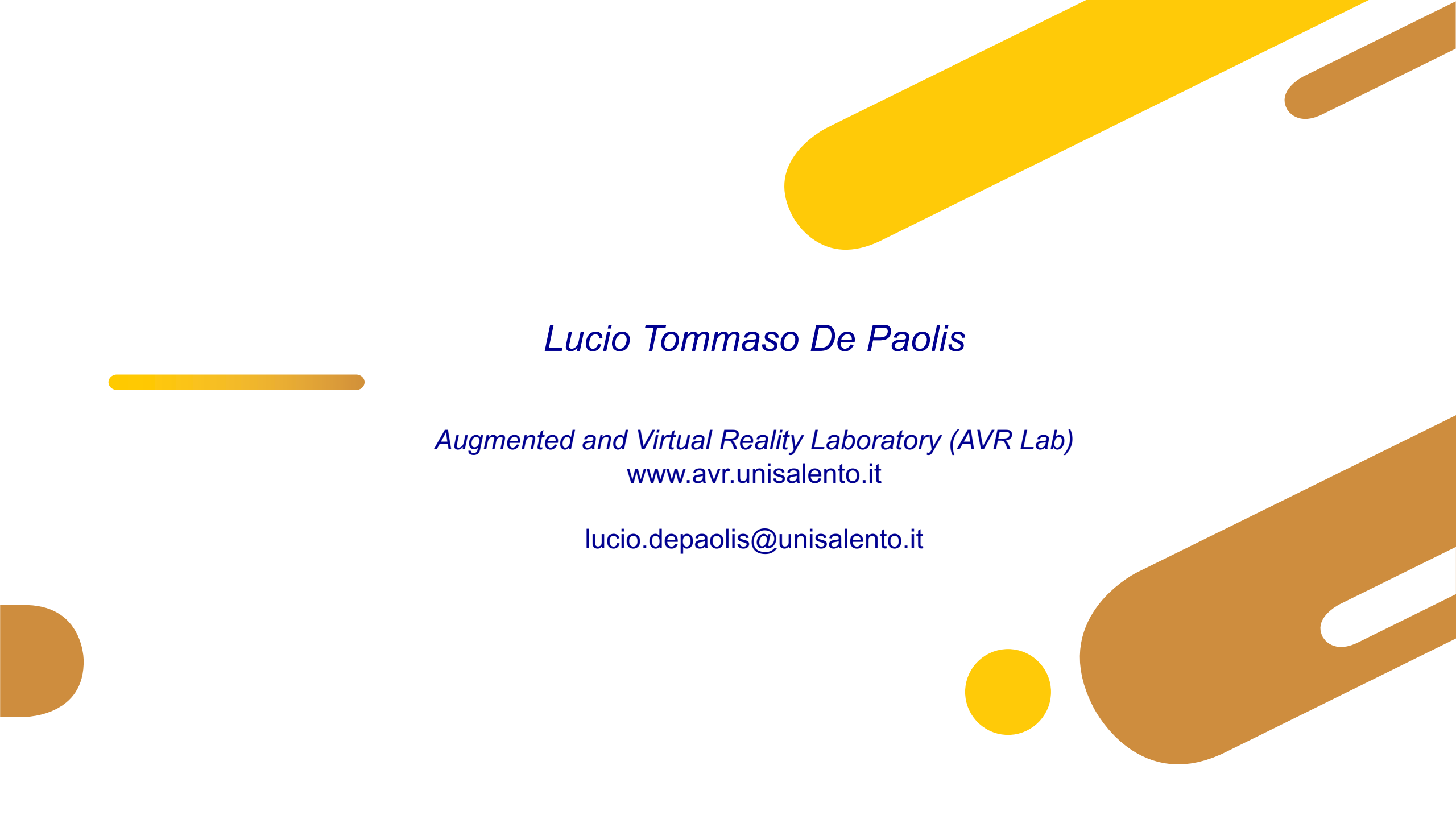
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Immersive virtual reality for the fruition of ancient contexts: The case of the archaeological and Naturalistic Park of Santa Maria d'Agnano in Ostuni

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