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An Immersive Room Between Scylla and Charybdis

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Abstract

Nello *Scill'e Cariddi* is an immersive and interactive room, in which the marine environment of the Strait of Messina was employed as first experimental scenarios to develop and test the technology. The scenarios reconstruct different settings relating to this unique ecosystem and represent the outcome of a long process of research and systematization of audio visuals available at the Horcynus Orca Foundation. The room, therefore, transforms collections of films, integrating them with the production of specific images, into virtual environments containing structured catalogues and into interactive installations for educational, playful, scientific, and popular use.

Keywords
immersive room, Scylla and Charybdis.

The Horcynus Orca Foundation

The Foundation is based in the homonymous interdisciplinary cultural park, managed by the same organization. The Horcynus Orca Park is named after the novel by Stefano D'Arrigo. Its activities involve a complex system of different fields of knowledge (literature, anthropology, marine biology, physics and chaos theory, natural sciences, archaeology, art, earth sciences) that compose the grammar and syntax of this millenary space: the *scill'e cariddi*. The Foundation thus represents an innovative bridge between creative languages, encounters between cultures, scientific research, technological innovation, experimentation with solidarity economies, ethically oriented markets, and dissemination of knowledge. The founding members of the Foundation are the Universities of Reggio Calabria and Messina, the CNR (National Research Council), the Ecosmed Research Centre and some socially and environmentally responsible companies.
The Foundation involves researchers and scholars from different disciplines and has several offices:
– in the monumental complex of Capo Peloro, north of Messina;
– in Scilla and Reggio Calabria;
– on the sea surface of the Strait, on the Kobold platform, the world's first experimental station to produce energy from marine currents, built through a project sponsored by the UN.
Currently the main areas of the Foundation's commitment are three:
– the pole of Mediterranean cultures, with the MACHO Contemporary Art Museum and the event of Mediterranean arts Horcynus Festival;
– the International Centre on Marine and Environmental Sciences and Technologies, which operates under the auspices of the main UN agencies;
– the Centre of scientific dissemination, cultural and educational tourism.
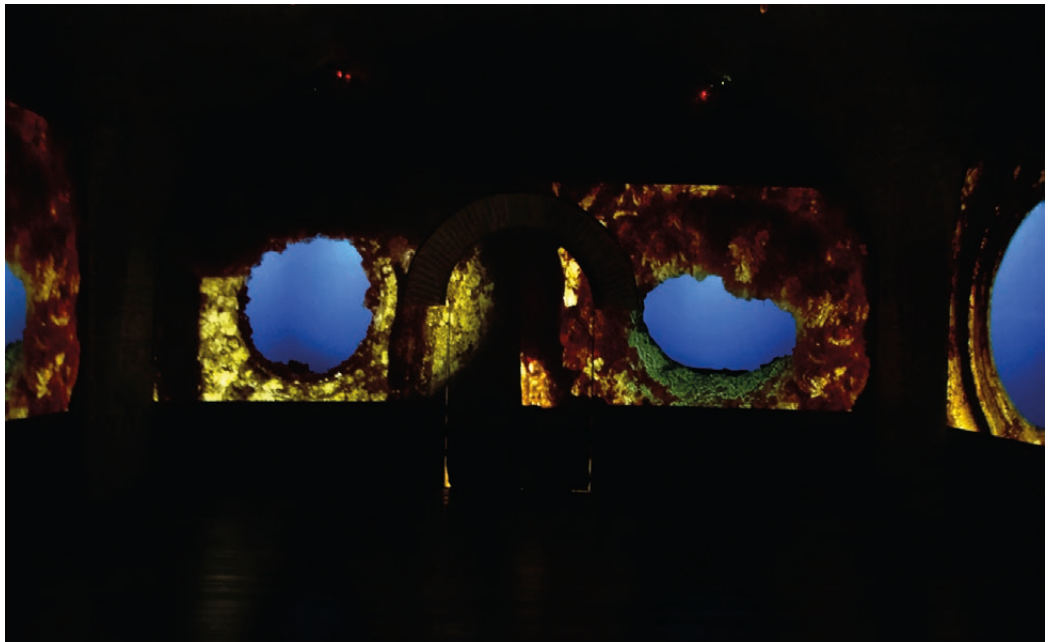

Fig. 1. Panoramic view of the "Oblò" scenario.

The Research Paths and the Architecture of the Immersive Room

The technological development of the room was started as part of the project named *Alfabeti dello scill'e cariddi*, created by the Messina Community Foundation in partnership with the Horcynus Orca Foundation and co–financed by the Italian Ministry of Education, University and Research within the Start Up Call Culture with increased impact. The experimentation elaborates and develops the technology used in the first interactive cinema experiments. The technology used supports different media (photography, video, sound) through interface logics. The system, therefore, inherits the formal grammar of cinema but it also evolves it, because it rejects the form and constraint of the frame; on the contrary, it expands the screen and integrates it with the architectural space.

The project, after a phase of pure research, focused on the construction of a prototype of great suggestion and attractiveness: the interactive immersive room, housed in the hall of the nine-teenth–century area (Bourbon fort) of the Monumental Complex of Capo Peloro, a space in direct continuity with the tour of the Horcynus Orca MACHO Contemporary Art Museum.

Multichannel emission systems are installed inside the room; thanks to the use of 3D models and the perfect synchronization of the projections, the immersive environment is smooth and homogeneous. By means of a recognition technology, vertical surfaces are touchscreen; the different ways of contact between the hand and the walls activate interactions in the video and sound effects. In this way, the audience constructs the projection, establishes its timing, and directs its development.

For the realization of the prototype room the following devices/software/systems were installed:

– a cluster of 8 video projectors, each connected to an infrared sensor and to as many computers plus a "control" machine;

– proprietary software intended for the automatic generation of masks to deconstruct the original videos and extrapolate the moving subjects which are then recombined in the recomposition of the immersive scenarios;

– a control system via internal hotspot, connected to the network for on–site control and remote system maintenance.
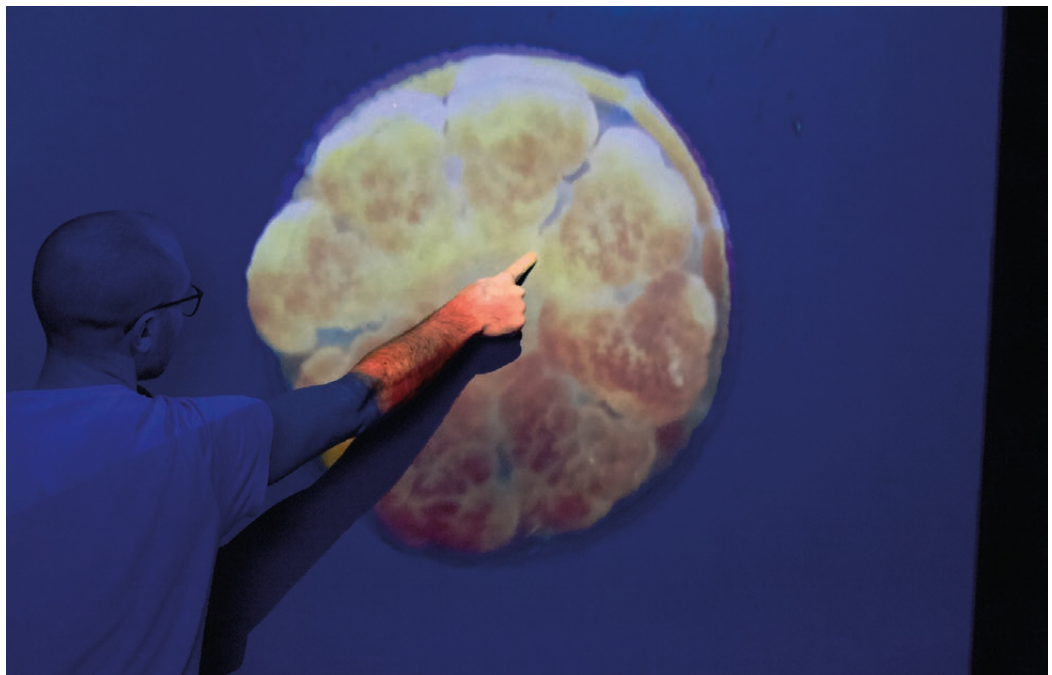

Fig. 2. Detail of the "Meduse" scenario.

The technological structure was designed in relation to the size of the room and the range of action of the sensors, to achieve complete coverage of the projection and interaction on the en-tire perimeter of the walls. Through video–mapping techniques and the use of specially designed shielding masks on the architectural elements of the room, it was possible to better integrate the video scenic effects and the perception of the historical–monumental value of the building.

The device allows to preset the number of simultaneously detectable touches (in the current setting 16 touches for each of the 8 clusters). The system reads and passes the positions of the interactions to use the data streams in the render engine. The audio, the reading and the process of flows generated by the sensors, the interaction logics, and the multi–channel video graphic production are processed on different hardware but unified by a standard communi-cation protocol (OSC – Open Sound Control protocol) which guarantees synchronization; the workload is managed in a cluster for better system performance.

An advantage of the component system is that the configuration can be quickly changed as required. For example, it is possible to concentrate all the components in the same hardware

or, in output, to compose a cluster of computers by dividing the workload and thus potentially expanding performance indefinitely. Moreover, thanks to its modularity, the developed technology is particularly versatile. The number of clusters that can be integrated into an infrastructure of this type has no predetermined constraints; this makes it possible to vary the arrangement of the individual modules and therefore the shape and overall size of the installation. So, it is possible to vary the number of screens (and video projectors), the number of sensors and computer vision algorithms connected to the system, the number of speakers and audio signals, depending on the type of interactive environment and the place where it is installed.

An *Ambisonic* audio system was installed in the room with the *binaural* technique capable of replicating the functioning of the human auditory system. This technique allows to listen to tracks with an unprecedented quality, virtually bringing the viewer into the sound field in which the recording was made.

Fig. 3. Detail of the "Meduse" scenario.

The Software Architecture of the Immersive Room

The software is structured according to a modular architecture. The individual modules are specialized, i.e. each one has a specific task. Furthermore, each module can communicate with the other modules via the aforementioned Open Sound Control protocol, which allows the implementation of additional modules without modifying the existing ones. The control computer manages the installation by receiving sensor messages at the input and sending the display commands at the output or by performing sound effects and background audio. The modules are distinguished by the following functions:
– Sensors (e.g. Kinect, Realsense);
– Logic;
– Rendering;
– Room management.
The Sensors allow users to interact with the room. For each sensor there is a specific module that manages it and makes it able to communicate with the room logic.
The Logic consists of a program that receives the sensor messages, processes them according to the interaction logics and sends the commands to a rendering engine. The logic of interaction depends on what we have defined as scenarios. Each scenario describes the set of visual and sound events that at a given moment arise from the interaction of users and the mechanisms that regulate them. The Rendering engine is the component that takes care

of visualizing the contents and effects of user interactions. Basically, he is a mere executor of the commands given by the control computer. The overall Management of the room is carried out by a module called "manager", whose task is to switch the entire room on and off, and to start and stop individual programs when necessary. Manager also provides a web interface for changing scenarios and switching the entire room on and off.

The only module that controls the status of the room and the active scenario at a given time is the one that manages the logic. The sensor modules and the rendering module have no knowledge of the room status but are limited to executing commands (rendering module) or sending information regarding user interaction (sensor modules) to the room logic.

The Prototype and Research Developments

The first prototype contains several immersive scenarios of the marine environment of the Strait; they are the result of a path based on research, organization, metadata, and optimization of archive resources.

One of these scenarios reproduces from the inside the walls of a wreck with portholes of various shapes within which it is possible to reproduce films from a collection relating to underwater archaeological sites in Sicily, made available by the Superintendence of the Sea of the Sicilian Region. Other scenarios allow the public to discover the environments and marine species of the sea surface and the abysses of the Strait; thanks to the interaction, each touch makes sea creatures appear alive and in motion, selecting them randomly from a database.

Nello Scill'e Cariddi is a prototype dedicated to underwater scenarios, but the project makes it possible to stage, at low cost, settings relating to different themes: figurative art, virtual scenography for performing arts, archaeology; scientific dissemination projects, sensory itineraries for disabled people and, more generally, educational paths. The Horcynus Orca Foundation has already created additional collections of interactive immersive environments and therefore the archive is constantly being implemented.

The first interactive art installations have already been created, including Ultrathinking by the Iraqi artist of Kadir Fadel and *La Habana Sobre Ruedas* by the Cuban collective composed of Claudia Hechavarria Segura, Juan Alberto Matamoros Nues, Elvys Ariel Urra Moreno; a first experimentation of ensemble music in which it is possible to activate with infinite combinations up to 32 instruments of a virtual orchestra curated by Luigi Polimeni; the first experiments of interactive virtual scenography through the collaboration with *Mana Chuma Teatro*. Some virtual scenarios on matter and the cosmos are at an advanced design stage, in collaboration with the National Institute of Nuclear Physics; titles suitable for children with particular types of autism spectrum disorder, in collaboration with the CNR–IRIB (Institute for Research and Biomedical Innovation) of Messina; a historical–archival project for the reconstruction and investigation of the scene of the Portella della Ginestra massacre.

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