

PixelGrams:

a cultural VR Experience



Digital Heritage & Multimedia

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The Site



- Location: **Porto Badisco**, Otranto, Puglia
- Discovered in **1970** by five speleologists from the “Pasquale de Lorentiis” Salento Speleological Group of Maglie
- One of the **largest Neolithic cave art collections** in Europe
- Made **inaccessible** to the public in 1987 to maintain the **humid environment that preserves the pictograms** (any alteration could cause their deterioration)
- Aliases:
 - “**Sistine Chapel of Prehistory**”: for its immense collection of pictograms
 - “**Cave of Aeneas**”: it was believed Aeneas landed here when he came to Italy



Timeline



Palaeolithic:
initial human
presence



Neolithic:
transformation into
ceremonial site



February 1st,
1970: discovery
by the "Pasquale
de Lorentiis"
Salento
Speleological
Group



1987:
public closure



Cave used as
shelter



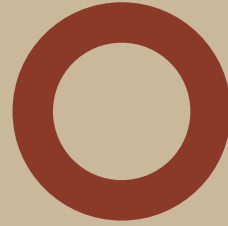
First
anthropomorphic
vessels



Bronze Age:
continued use
of some cavities



Initial
excavations



Advanced
studies



The Pictograms

- **Colours used in the pictograms:**
 - **Red Ochre (hematite):** the dominant pigment of the cave, iron oxide ground and mixed with water or animal fat.
 - **Black Guano (bat droppings):** a manganese-rich pigment sourced directly from the cave itself.
- **Geometric and abstract symbols:** spirals, concentric circles, grids, zigzags, and meanders dominate the pictographic program. A structured symbolic vocabulary, likely encoding cosmological, ritual, and social meaning.
- **Animal and human figures:** deer, anthropomorphic figures, and composite beings appear alongside the geometric forms, grounding the abstract imagery in the lived world of Neolithic Salento.
- **Phosphenic art:** many of the cave's most characteristic forms correspond to **phosphenes**: geometric visual patterns generated by the human nervous system under conditions of sensory deprivation or psychoactive substances. Their presence suggests the pictograms record what people saw during shamanic rituals.
- **A universal visual language:** identical or near-identical forms appear in caves from California to Colombia to Scandinavia to other European countries, showcasing a universal, shared language between different people.



The 3D Reconstruction

- A high-resolution, photogrammetric 3D model of the cave;
- **Goals:** digital preservation, environmental monitoring and virtual access to allow study of the cave without damaging the site;
- Carried out by the **University of Salento** (led by professor Virginia Valzano) in collaboration with the **Visual Information Technology Group of the IIT-NRC** in Canada and **CASPUR** in Rome, in agreement with the **Archaeological Superintendence of Puglia**;
- The 2D and 3D digital acquisition took place in 2005 and 2009 under **extreme conditions** (high humidity, difficult access) and required **specialised equipment**;
- As of September 2025, a **permanent exhibition** at the Castello Aragonese di Otranto includes a 3D digital twin of Corridor 2 (the corridor containing the most significant pictograms);
- **Not available to the general public** on the web.



[Watch the BTS of the reconstruction](#)



CoDesign Tool Kit

PACT Framework

1. CONTEXT CANVAS

Move the chosen cards above

AUDIENCES

STAR ASSETS

Play in turn 4 Audiences cards and 4 Star Assets cards

4. DESIGN BRIEF BOARD

Audience Goals Canvases

MOTIVATION

BARRIERS

CAPABILITIES

CONTEXT / STAR ASSETS

LEARNING ACTIVITY

DIGITAL RESOURCE

PACT TOOLKIT

People Who is the main audience?

Methods:

- Interviews
- Questionnaires
- Observations
- Social behaviours (social media)
- Cultural Probe Kits
- Focus Groups and Workshops

Context

Physical Space How is the physical space? Climate? Noisy? Echo? Dirty? Wire/Wireless? Open air? Modern/historical? Dark? Electric plugs?

Social Context Alone or together? Friends or unknown? Language? Religious? Disability? Feedback sound is acceptable?

Organisational Context The working environment? Staff? Who do people work? Role? Management structure?

Activities

Scope and Goal

Temporal Aspect

Cooperation

Complexity

Security

Content

Technologies

Media Which media?

Which digital content should be acquired and processed?

Hardware Which visualisation devices?

Which Interaction devices?

Network On line? Off Line? Local network?



Star Assets

- **Location**: located in Otranto, nearby the cave (or in one of the big museums in either Maglie or Lecce);
- Shaman pictogram, other **pictograms**, **mystery** and **rituals**;
- **Digital resource**: 3D reconstruction of the cave by Professor Virginia Valzano and the University of Salento;
- Possibility to **“access”** a **stunning CH location** that cannot be accessed by non-academics;
- **Learning activity**;



INSTITUTIONAL GOALS / ASSETS




USE ASSETS IN NEW WAYS

CONTEXT / STAR ASSETS



DIGITAL RESOURCE

CONTEXT / STAR ASSETS



LOCATION

CONTEXT / STAR ASSETS



LEARNING ACTIVITY

Goals



Institutional

- **Engagement:** let more people know about this CH treasure, not as popular as other treasures due to its inaccessibility;
- **Museum Sustainability:** allow people to visit the cave without entering it, preserving the humid environment that allows the pictograms to remain intact;
- **Diversification and Accessibility:** create a virtual environment that has no barriers and can be experienced by everyone (despite their different needs, languages, limitations, cultures, etc.)
- Increase **outreach**;



Cognitive

- **Concentration:** the cave's structure removes external stimuli so that the mind concentrates entirely on the experience;
- **Curiosity:** the inaccessibility of the cave fuels the visitor's curiosity, as we are naturally drawn to what we don't know and can't experience;
- **Embodiment:** the VR experience allows the visitor to feel like they're a prehistoric person inside the cave;
- **Storytelling:** the stories told make this exhibition not simply an educational experience, but also an emotional one - using emotions to anchor knowledge to memory.

Audience

Target

Broad audience, from people who know nothing about the cave to people who are familiar with it. Our audience should be as **wide** as the human community that once inhabited the cave and as **diverse** as the one that shared that same, universal language across caves all over the world in prehistoric times.



1. CITIZENS;
2. FOREIGN VISITORS;

Goals

Authenticity:

- **Self:**
 - Strengthen personal context → LOCAL
 - Develop sense of familiarity
 - Develop personal evolution

Others:

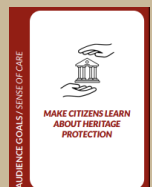
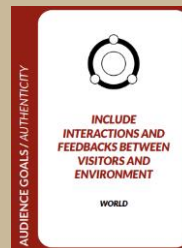
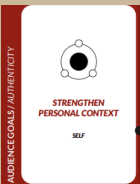
- Foster social norms among visitors
- Improve language exchanges
- Improve group familiarity

World:

- Make visitors feeling familiar with environment
- Interactions and feedback between visitors and environment
- Create the appropriate mood

Sense of Care:

- make citizens learn about **heritage protection**;
- make citizens learn about the **importance of coloured collections**;
- boost **enchantment**;
- extend **knowledge**;
- encourage **personal growth**;
- use universal concepts to **trigger ethical behaviours**;

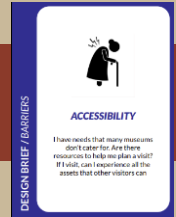


Motivations



- The **history** and **mystery** of the cave;
- The fact that it's **unknown and inaccessible to most** people and digital means are the only way to explore it;
- The **scarcity of findings and remainings of the Neolithic** (and the cave is rich and full of pictograms from the time, representing the interests and beliefs of the people of the time).

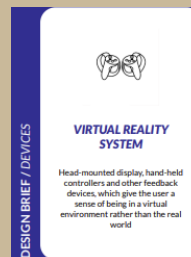
Barriers



- **Inaccessibility** of the cave;
- **ACCESSIBILITY issues**: difficult to get to the cave entry / visual exhibition not fully accessible to blind people (though it can be solved through sounds and sound description);
- **EDUCATIONAL gap**: not everyone knows about the Neolithic Age;
- **AGE restrictions**: Head-mounted set can be used from 13 up and themes are not fit for children (ex. drugs, heavy and complicated themes);
- **Physical S'TRAINS**: back pain when standing too much, motion sickness, eye strain.

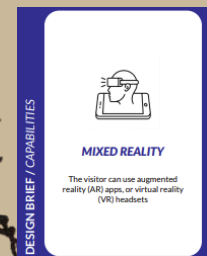
Devices

- **VR System** (4 headsets + controllers);
- **Interactive LED Display** : for hand prints
- **Chairs**: for accessibility;
- **Local Server**: to ensure communication between devices.



Capabilities

- **Virtual Reality**;
- **Computer gaming**;





Project Concept

Problem?

- The cave has been **inaccessible since 1987**: impossible to visit, photograph, or experience even for most researchers; →
- **Unknown to the general, non-academic public** despite being one of Europe's richest Neolithic painted sites; →
- **Audience disengagement**: tourists (and locals) in Salento are interested in the sea and the slow, fun life, so the challenge is also motivating them to look for cultural experiences; →
- Risk of feeling like a **passive museum visit** rather than something genuinely immersive; →
- **VR barrier**: physical discomfort, low digital literacy, need for trained staff. →

No Problem!

- **Location**: hosted at **Aragonese Castle in Otranto**, already a CH destination that can be accessed and has rooms for virtual exhibitions;
- **Branching narrative**: **interactive experience with different character roles**, so that each visitor engages at their own pace and at their learning speed;
- **Choice architecture**: groups are encouraged to choose different characters, explore the cave and **compare experiences** after, creating **social motivation through fun activities**;
- **Interactive activities**: creates a **bridge between ancient and contemporary times**, making the experience personally relevant regardless of background or education;
- **Staff presence**: guides visitors who haven't used VR before;

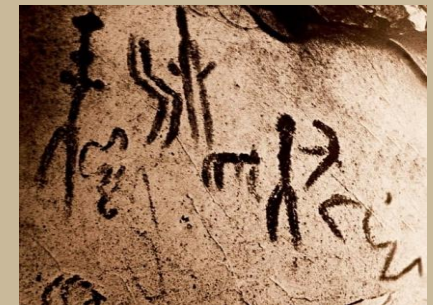
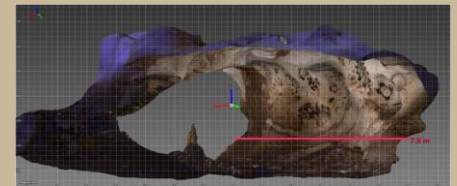
Project Concept

Case Study Themes



Deer Cave, Porto Badisco, Italy

- **Phosphenic art** and altered states of consciousness;
- The **Shaman figure** as ritual organizer of **community life** (a varied group of people entering the cave, with different demands);
- The cult of the **Mother Goddess**: fertility, cosmology, rebirth, guidance;
- **Artifacts and pintaderas**: a testimony of the offerings of devotees in search for solutions and answers;
- The **cave's 3D reconstruction**: a way of preserving CH by using digital technologies to make it available to everybody in its most accurate form;
- **Worldwide connections** & the **universality of abstract imagery**: a shared system of beliefs and prehistoric visual language across the Mediterranean and beyond (e.g. California, Colombia, etc.). In an era defined by AI, digital isolation and individualism, this project proposes something different: a genuine human encounter and conversation with other people.



Cosma Cave, Santa Cesarea Terme, Italy

Moodboard

[Check our Pinterest board!](#)

“A walk through the cave...”

<https://waveplayinteractive.com/>



RNA Museum, VR interactive experiences

DDR Museum, A/D experiences



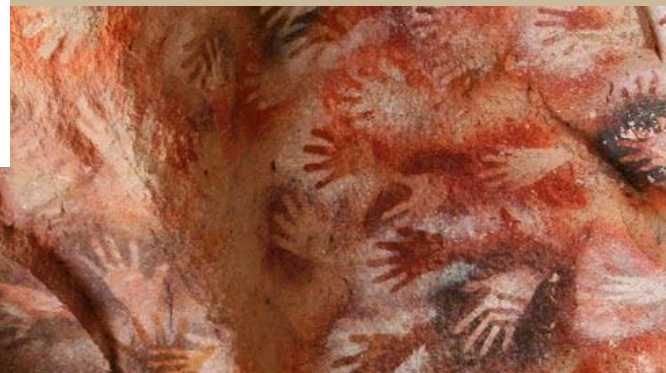
- **Red Ochre** (iron oxide / hematite)
 - HEX: #8B3A2A
 - RGB: rgb(139, 58, 42)
- **Black Guano** (bat guano, manganese-based black)
 - HEX: #1C1A17
 - RGB: rgb(28, 26, 23)
- **Warm beige** as a neutral background:
 - HEX: #C9B99A
 - RGB: rgb(201, 185, 154)

IM Fell English

Designed by [Ignacio Merino](#)

Whereas disregard
and contempt for
human rights have

[3d reconstruction](#)



MASSIMO
TROISI ROBERTO
BENIGNI



**Non ci resta
che piangere**

PA
PMS
D6
PAN
PMS 4
212

PANTONE®

18-1442 TCX
Red Ochre

Requirements (MoSCoW)

MUST

- **Historically and archaeologically accurate** content;
- **VR headsets** installed in a **dark room** at the **Otranto Castle**;
- **Five playable character roles**;
- **Closing pictogram drawing activity** with global visitor comparison;
- **3D model** by Professor Valzano;
- **Physical station** with infographics, warnings, and guidance;
- **Staff presence** for assistance;
- Possibility of playing the experience **from a seated position**;
- **VR side-effect warnings**;

COULD

- **Multiplayer layer** during the experience;
- **Adjustable text size** for visitors with visual impairments;
- **Kids' version** - that is not a diluted version of the adults' one, but a version on its own (following one of the **TIP'S** = Tilden's Interpretative Principles);
- **Background music**.

SHOULD

- **Accessible features** throughout;
- **Handprint interactive LED display** at the exit;
- **Multilingual support**;
- **Sounds** of the cave.

WON'T

- **Physical access** to the cave;
- **Direct reproduction** of pictograms;
- **No staff presence**;
- **Graphic violence** or **explicit content** in the potential future kids' version.



User



Personas

ANNUNZIATA 56 - Galatina, Italy	
GOALS	ISSUES
<ul style="list-style-type: none">• Cultural identity• Curiosity• Time travel• Wonder• Social interaction	<ul style="list-style-type: none">• Low self-esteem• Educationally disadvantaged• Complicated technology• Physical strain

DILETTA 32 - Verona, Italy	
GOALS	ISSUES
<ul style="list-style-type: none">• Memorable cultural experience.• Learn something surprising about ancient rituals• Immersion with no prior knowledge• Be stunned	<ul style="list-style-type: none">• Mental overload• Experience for experts only• Not understanding what she sees.

DANIEL 27 - Shanghai, China	
GOALS	ISSUES
<ul style="list-style-type: none">• Understand prehistoric people• Experience CH immersively• Connect archaeology and human stories• Learn something meaningful	<ul style="list-style-type: none">• Closed CH sites• Exhibits that show items with no context• Overly-technical info• No immersivity

Journey



User Journey



User Persona: Annunziata, 56, Catholic, low-tech literacy, carpal tunnel, chronic back pain.



After a beach day in Porto Badisco, Annunziata and her family, decide to visit the Otranto Castle for a visit. Here, she finds herself in a dimly lit room with some panels about the cave and a VR station.



Annunziata is convinced by her family to do the experience. She sits comfortably in a chair for her back pain. A staff member shows to her how to work a VR headset and controller.



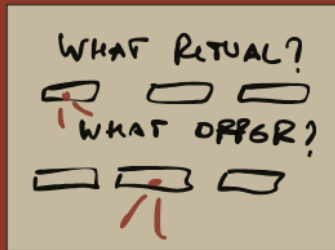
The VR display turns on, showing a 360° panoramic view of Porto Badisco at sunset. Annunziata looks around, recognises the place. Once done, she points the laser cursor at the button saying "Approach the Cave".



Annunziata has entered the cave and is asked a question: *who are you in this cave?* She has been thrown back in time and is now a woman of the Neolithic. Annunziata points the cursor at the button "Devotee II", as she is a strong devotee in her real life.



Inside a narrow cave corridor, Annunziata sees a wall covered in Neolithic drawings. Some are surrounded by a border. Annunziata hovers her pointer over one and an informational card pops up directly next to it, explaining its history.



Now she finds herself in the Sanctuary. A Shaman asks her what ritual she needs and demands the right offering. Annunziata points at "Healing" and "Obsidian Pintadera". She is convinced it's the right choice. After, she is in the dark, but then she looks up: handprints on the wall, of children and women. She is mesmerised.



The cave is collapsed, she can no longer continue. She is given a choice: to continue to explore or to exit the cave. She is tired so she exits the cave. Once out, she finds herself in front of a starry sky and pictures from caves around the world, showing similar drawings.



Before leaving, she is asked a question: *how would you draw a phone as a pictogram?* With her controller, she draws a rectangle with some dots in it. To her surprise, other people drew that. She is asked a final question to reflect on after the experience: *are we still one big community?* She then removes her headset.

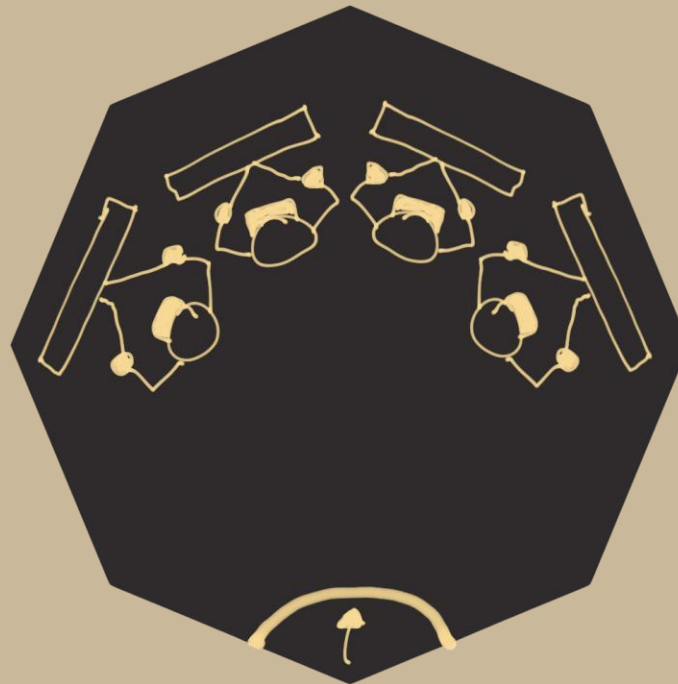
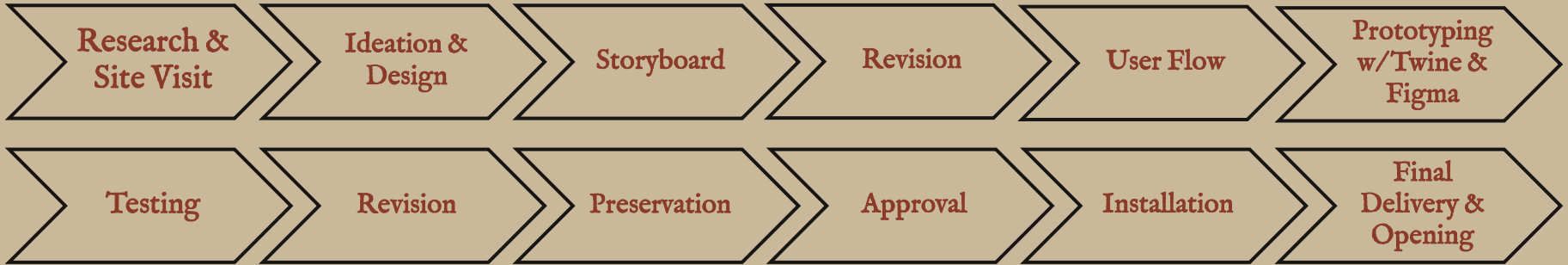


The experience is not over yet! Annunziata sees the LED Display, leaving her digital handprint on it, along with those of other tourists. Just like in the Sanctuary of the cave. She feels part of a community.



After the experience, Annunziata exchanges experiences with her husband and kids, talking about what she learnt, obstacles and challenges faced.

Workflow & Set-up

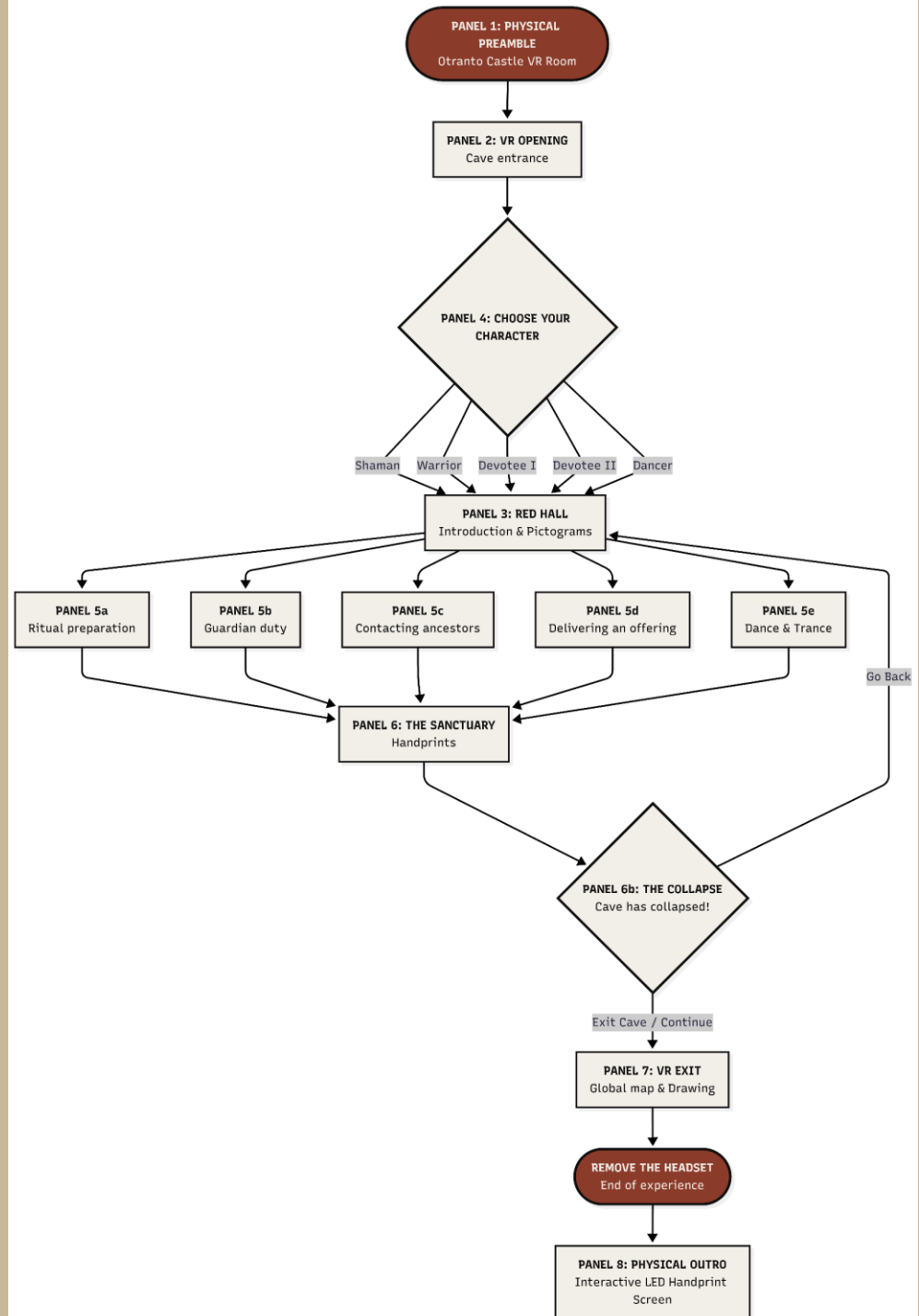


User Flow

A **dataflow diagram** to represent all the steps that are logically required for the completion of the interaction.



You can check the extended flow [at this link](#).



Figma: Lo-fi Prototype

[LINK
PROTOTYPE](#)

Aesthetics & Layout

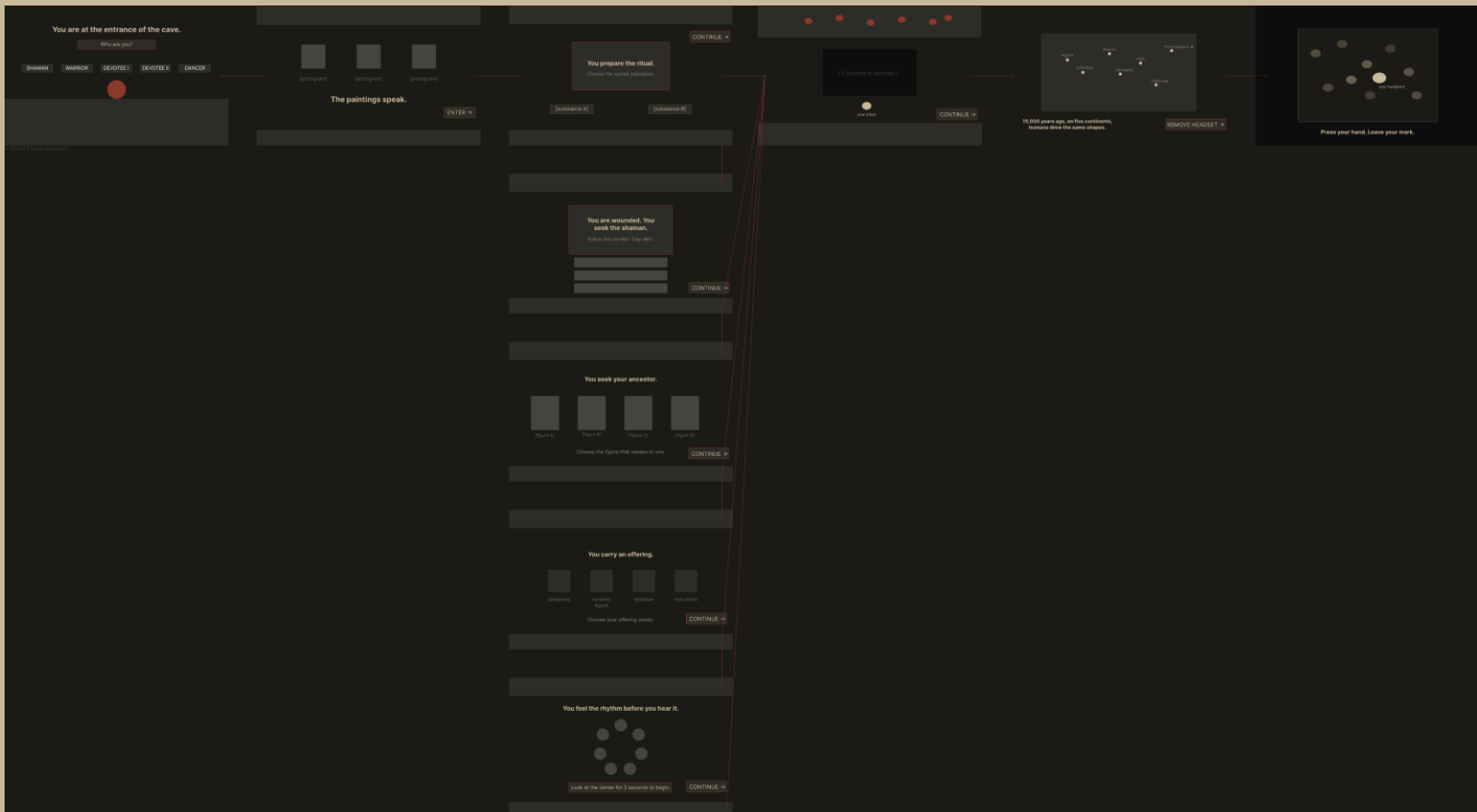
Definition of colour palette, aesthetics and layout suitable for a dark, dim-lit cave.

Flow Blueprint

Structural map which defines the order of the screens before any complex art or graphics are added.

Basic Grid

Set up of boxes and buttons to make sure the interface is clear even for beginners.



Figma: Hi-fi Prototype

[LINK
PROTOTYPE](#)

Realistic Visuals

Upgrade from the simple layouts into high-quality screens featuring real photo backgrounds, text windows, and realistic button designs.

Branching Paths

Maps out the active paths for all 5 characters, showing exactly what happens when a user chooses a specific role.

Clickable Prototype

Connects all the interactive hover states, buttons, and drawing screens together to simulate the real experience from start to finish.



Website & GitHub



You can check our [website](#) [at this link](#) for more and complete information, and look at the material we used and created on our [GitHub repository](#) [at this link](#).

PixelGrams

HOME

DESIGN BRIEF

TWINE

FIGMA

CASTELLO ARAGONESE DI OTRANTO 2025

PixelGrams

PIXELS · PITTOGRAMMI · PATRIMONIO

*A virtual journey into one of Europe's most extraordinary Neolithic sanctuaries —
a cave sealed from the public for fifty years, now open to all.*

SCROLL

Disruption



Problem?

- High production and installation **costs**
- **Permission and copyright issues** with the 3D assets
- VR-induced **discomfort and health risks**
- **Low digital literacy** among target visitors
- **Technical failure** during the experience

No Problem!

- The Otranto Castle is a highly-visited cultural landmark by tourists. By funding the experience, the Apulia region would show **innovation** and **promote ethical tourism** and CH exploration;
- By giving permissions, it would showcase the **power of the collaboration** within the **academic community**
- **Features within and outside of the game for comfort** are implemented and taken into account to make the experience as comfortable as possible
- **Simple interface** and experience, with additional help from the **staff**
- Regular technical **maintenance, backups** and **daily checks**

Thanks for your attention!

