Realism, Art, Technology and Audiovisual Immersion into the Environment of the Ionian Islands

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ABSTRACT

This paper refers to the audiovisual recording, transformation and projection of natural spaces, describing the technology and methods for capturing panoramic sound and image, and the technologies and processes involved in projecting the recorded material through the mobile immersion environment *A.R.T.E.* (Artificial Restoration of Transmuted Environments)[1]. The project 'optic-acoustic ecology', coordinated between 2012-2014 by the TEI of Ionian islands, Greece, involved the seasonal recording of natural outdoors environments, aiming at the documentation and study of the natural heritage of the Ionian Sea, and the utilization of current digital technology for synchronized audiovisual capture and projection, which enhances our experience of the natural environment. During such a process, a number of decisions need to be made regarding proper planning, choice of field recording equipment, techniques applied and a series of problems to be solved. At a later stage, projecting the material through a mobile immersion platform such as A.R.T.E. engages combined knowledge in the fields of mechanical structuring, creative design, audio/visual processing and projection through specialized software and hardware. Through the practical experience gained by the above, a number of conclusions can be drawn regarding the advantages of the achieved enhanced experience through audiovisual immersion, technical issues, difficulties and potential applications and developments for future reference.

1. INTRODUCTION

The natural environment of areas such as the Ionian Sea offers unique natural beauty and a rich variety of optic-acoustic elements, which can serve as the basis for artistic exploration but also as a common ground for interdisciplinary research in fields such as acoustics, biology, information technology, environmental learning etc.

The role of technology regarding the above is very important. The current and continuously developing audiovisual digital media allow us to capture the above elements in high detail in order to experience the environment in different time and space, and/or to study it in detail in the framework of scientific research. Moreover, it allows for more artistic exploration through new mediums and techniques, and brings new potentialities and ideas in the development of artistic projects.

A.R.T.E., a mobile prototype platform has been created -and being developed- to materialize these needs: firstly, it creates an immersive experience of natural landscapes via panoramic projection in multiple screens, combined and synchronized with surround sound to achieve a realistic reproduction. Moreover, this setup can be utilized as a creative medium offering new formats for experimentation and convergence between arts such as sound/video art, electroacoustic music, digital photography, VJing, and possible development in interactive applications where space, sound and image are combined.

The environmental audiovisual recordings used to materialize these initial ideas (realistic/artistic immersive reproduction) derived from the Ionian Sea as part of the "optic-acoustic" ecology project at the TEI of Ionian Islands in Cephalonia, Greece. During this project, selected areas of the islands of Cephalonia and Zakynthos were recorded in two different seasons of the year (early winter - early summer) at the exact spot and direction, using surround microphones / recorders synced with a system of multiple video cameras to record the space panoramically. The concept was to create realistic recordings where one can observe the changes between seasons/areas and natural varieties in terms of sound and optic content. Artistic creation based on these recordings was another part of the project, thus a number of audiovisual works (video art and electroacoustic music) were produced by collaborating artists, through transforming the material. For the audiovisual projection of the created content, A.R.T.E. platform was constructed, of which the specifications were the basis for coordinating the recordings at the early planning of the project.

In the following paragraphs a more analytic explanation is provided for the outline of the "optic-acoustic ecology" project, describing the content of the recordings, audiovisual capturing methods and equipment, structuring of A.R.T.E. and projection issues, and finally, conclusions that can be drawn so far through the whole process.

[1] http://arte270.com

2. THE "OPTIC-ACOUSTIC ECOLOGY" PROJECT

2.1 Project description

"Optic-Acoustic Ecology" is a project under completion that runs at the Technological Institution of Ionian Islands / Department of Sound and Musical Instruments Technology / Section of Applied Technology since early 2012 [Project #D12/MIS35600, EU funded]. The project involves the recording of certain aspects of select ecosystems of the Ionian Islands as a step towards the preservation of the regional natural wealth and consequently as an advent to promote local sustainable development. Joint partners in this effort include colleagues from the Ionian University, Leeds Metropolitan University (UK), the Managing Organisation of the Ainos Mountain Natural Park and the Dept. of Environmental Engineers of the local institute at Zakynthos. At this initial phase, the islands of Kefalonia and Zakynthos (Zante) are merely considered to be within project scope.

There are two main courses of action, one is the *preservation* and the other is *exploitation*. The preservation work package includes all the actions that stem from the necessity of preserving the aspects of the natural environment that satisfy a set of criteria such as danger risk factors or outstanding beauty etc. Actions of this kind mainly include soundscape recordings, nature filming and photography shooting. Selected sample noise measurements may also be taken. In terms of exploitation, typical actions of work include a multimedia database on which visitors can browse through the collected material ("environmental museum"), a list of audiovisual pieces of artistic work (most of which were composed especially for the A.R.T.E. platform), as well as an accompanying education course for local schools.

At the time of writing this paper, the project team has just completed its final task, the Zakynhtos artistic presentation event. The playlist included among others the audiovisual tetralogy "The Fog" as well "Portrait Z", an electroacoustic music synthesis made out of solely Zakynthos sounds. Typical project deliverables have included: (a) the audiovisual samples database (b) a set of artistic pieces of work produced out of the collected media files like the ones mentioned above (c) performance of those pieces in special room settings in concerts or festivals (d) an environmental education course for schools that engages the related project technology.

In an era where human interaction with the environment is a major issue of concern and the preservation of natural and cultural heritage is a central worldwide goal, research on the acoustic and visual environment is of great interest and importance. On the Ionian Islands, a region with a handful of environmentally protected areas, projects like the one described here are of high value. The social and economic benefits of such an effort are considerable, since the generated database of samples ("digital museum") will be permanently available to visitors at the premises of the Technological Institute of Ionian Islands. Moreover, the environmental course will serve as a reference point for community actions. Finally, the research team will actively participate in all publicity activities, such as organizing meetings , workshops, information web visibility, etc. Nevertheless, the immediacy with which a natural "local product" after receiving technological processing returns to the local community in the form of an audio or audiovisual artistic work is remarkable. Additionally, the blowing aesthetical outcome serves as a redeeming added value. This whole process is an exportable cultural product as it moves over to creative paths and pioneering aesthetics. It can certainly be considered as a globally applicable recipe. Recognized by the project team is a range of possible future actions which could be a continuation of this effort. The extension of the scope to all areas of the Ionian Sea and the inclusion of underwater recordings are two obvious future targets.

2.2 Environments

The recorded environments during this project can be divided in 3 categories:

- Natural environments
- Urban environments
- Heterogeneous environments

Natural environments include protected areas such as the National Park at Ainos mountain, Cephalonia or the Natura Park in Zakynthos, and areas of unique natural beauty such as beaches and caves. Urban recordings include places in the the towns of Lixouri and Zakynthos, and heterogeneous environments include a combination of the above, where nature and human culture are both present.

Figure 1. Recorded areas in Cephalonia and Zakynthos

2.3 Equipment, methodology and working conditions

Recording in the field can be different and often more difficult from the usual studio recording procedures. Apart from having to overcome weather difficulties and record in high quality, a major issue is designing the recording system with regard to the potentiality of the recorded space as material for utilization at later stages, meaning that the recording team should early set the recording specifications, depending on the way in which the audiovisual captures will be finally used, i.e. that the audiovisual material will be presented through a mobile

immersion platform such as A.R.T.E.[2] Thus, the aims of the recording team were: (a) to record in high quality audio and video using digital recording equipment in range up to 360°, (b) to capture "static" and discreet "spot" recordings of audio and video simultaneously, and also individual recordings/sources (audio only – video only) which would later be useful -during processing- for a realistic/artistic reconstruction of the space or other applications, (c) to capture "moving recordings" with panoramic video and/or audio, giving a sense of movement in one direction in a landscape, or rotating movement based on a central point, and (d), to capture in such way so as to assist in the final syncing of processed audio and video material for representing space panoramically. The above aims were considered for the majority of visited areas, taking into account the factors of mobility and weather conditions in different seasons.

The audio and video equipment was chosen according to the following technical specifications:

- Ability to record in professional high fidelity formats.
- Mobile and compact structures.
- Powered both by AC adaptors and batteries.
- Ability to record on SD memory cards for quick and easy storage.
- Weather-resistant structures in order to records in fields with extreme weather conditions.

Regarding the above, the following equipment was used:

- Portable audio recording systems: MOTU 896 MK3-MacBook Pro-Logic Pro (8-track), Tascam DR-680 (8-track), Tascam DR-100 (2- track)
- Microphones: Holophone H2-Pro, Studio Projects LSD2, AKG C414, 2x Neumann KM184, hydrophone.
- 5x portable digital video cameras (Full HD)
- DSLR photo camera
- Microphone stands and cables, windscreens for microphones.

The basic methodology that was followed during each recording session included:

(a) Choice of the exact recording spot and direction, for pre-selected and pre-visited areas, in accordance with the instructions of the consultant team, with regard to aesthetic and practical criteria. The team noted the coordinates of the spot for future recordings.
(b) Installation of equipment and testing for proper operation.
(c) Simultaneous recording (2-15 minutes per spot, depending on the content of the landscape) using 2 audio systems (stereo-surround) and multiple video cameras, with the use of 'clapboard' (audio signal) for synchronization.

[2] The recording team consisted of Apostolos Loufopoulos, Minas Emmanouil, Fanis Maragkos, Thanasis Epitidios and a small group of students from the TEI of Ionian Islands, Department of Sound Technologies and Musical Instruments.

As far as the audio recording techniques are concerned, 3 techniques were used in total: (a) stereo M/S (Mid/Side), (b) surround Double M/S and (c) the surround microphone Holophone H2-Pro. For each synced recording, one surround technique (Holophone or Double M/S) was simultaneously used with the M/S technique. Both M/S and Double M/S technique needed to be decoded in order to provide a realistic result regarding the recorded soundspace (both stereo or polyphonic up to 6.1 channels). On the other hand, Holophone H2-Pro is specifically designed for capturing discrete 7.1 channels, and this is the reason why there is no need for decoding for reproduction. All these techniques were specifically chosen by the team in order to test and compare their advantages and disadvantages during recording/reproduction, and deliver a variety of alternative captures for the same space, potentially useful in reconstruction and final projection. For example, sounds captured by Holophone proved very helpful at later stages, in reconstructing the environment in a realistic manner, as -when combined with proper speaker placement- the representation of the recorded space captured by this microphone is highly accurate. On the other hand, recordings delivered via the double M/S technique proved very helpful in artistic representations and transformations, due to the fact that decoding creates room for experimentation regarding the virtual dimensions of the projected audio space.

Figure 2. Double M/S and Holophone H2Pro

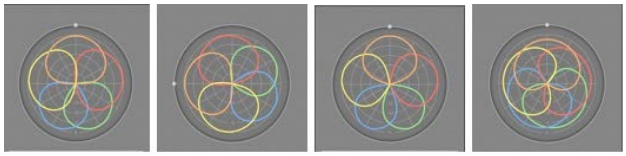

Figure 3. Double M/S surround decoding possibilities: space reconstruction through microphone angle alteration and speaker separation.

For the video recording the team customized a camera stand and installed five cameras in such a way as to be able to record with an angle up to 270°. All cameras recorded video in Full High Definition quality for best reproduction results and quality in processing. The DSLR photo camera was used for capturing the whole procedure and photographing the landscape with both single and panoramic takes.

The above-mentioned equipment and techniques were used by the recording team in a variety of different and demanding conditions. From the frozen landscape of the summit of mountain Ainos to the hot sun and pebbles of Myrtos beach, near or even into the water, on steep mountain slopes or in the foggy meadow. The next stage

was the demanding process of archiving and backing-up the material, in order to prepare the process of exploitation.

2.4 Realistic and Artistic Reconstruction

The exploitation phase of the project included, in big part, the reconstruction of environments electronically. During this process, the recorded material, audio and video, was synchronized and processed electronically, in order to create two types of audiovisual environments, or else 're-created' landscapes:

(a) Realistic approach: 'real' landscapes
(b) Artistic approach: transformed environments

In (a) a series of recorded spaces 'as is' was produced, creating a 10-15 minute multimedia presentation for surround sound (5.1) and five video projections (panoramic view). In this presentation one can observe the changing environment between different locations of the two islands, and also the transition between different seasons (winter-summer) for each of the same exact location.

In (b) a tetralogy of works was created (titled "The Fog") which can be regarded as "video art" using the language of electroacoustic music. "The Fog" refers thematically to the winter environments of mountain Ainos in Cephalonia, and constitutes a first effort to experiment artistically with the recorded material.

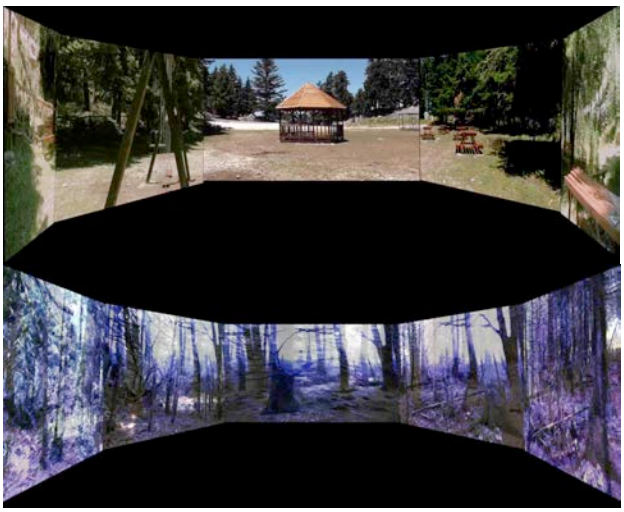

Figure 4. Realistic and transformed landscape (virtual preview of panoramic projection).

The elaboration of audio involved mixing in surround (5.1) and creating a virtual musical space via the transformation of sounds from the main projected landscape(s) in combination with a number of other sound-sources and sound-shapes[3]. Video was elaborated together with audio in many cases (mixing phase) and interestingly it was often 'cut' following the musical form -since the producing artists are mainly music composers- thus creating an interesting audiovisual structure, where image follows the temporal development of sound. Both audio and video materials have strong references to the locality of the environment but often carry strong transformations that lead the projected material to abstraction. A more detailed analysis of the artistic work produced as part of this project needs to be given individually elsewhere[4].

The above presentations constitute altogether a show of around 45 min in total, which so far has been presented in art festivals, conferences and educational courses.

For the projection of this presentation to listeners/spectators a projection medium needed to be developed specifically for this material, and thus the A.R.T.E. platform was materialized as an immersion space, to complete the initial idea.

3. A.R.T.E.: AUDIOVISUAL IMMERSION PLATFORM

3.1 Specifications

A.R.T.E. combines panoramic video projection with 5.1 surround sound. For the video projection a 9m x 1m cylindrical screen is used, consisting of 5 separate adjacent parts, each 1.80m x 1m, made from flexible material (PVC), which attach on a circular metallic frame. Projection on this cylindrical screen is achieved by 5 LED projectors, placed around the ceiling of the installation at 2.40m height, and projecting each on one of the 5 separate screen parts. For the projection of sound within the space of this installation 6 loudspeakers are placed in a typical 5.1 arrangement.

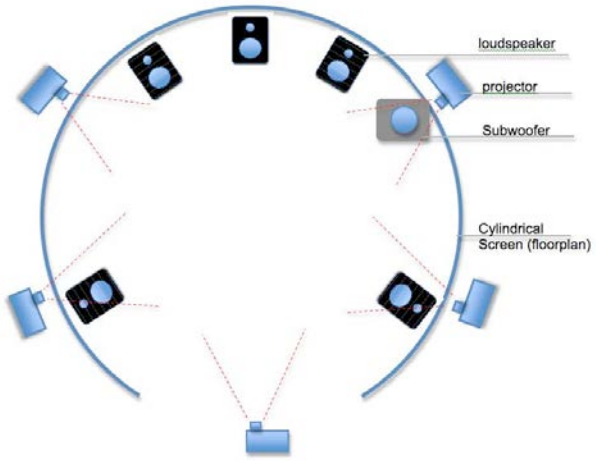

Figure 5. A.R.T.E. audiovisual setup: placement of loudspeakers and projectors.

As shown in the above Figure, each projector projects the image onto the opposite side of the screen, on one of the five parts. The projected image adjasts with the image from the next projector an so on, giving a total panoramic field of 270 degrees, which together with the surround sound allows for a panoramic audiovisual projection

[3] Sounds recorded individually i.e. human interactions with the environment, isolated sound-sources ("focused" recordings) and electronically generated material.

[4] A preview of the above is given online (`http://arte270.com`)in stereo sound and panoramic video on single screen.

around the visitor. For recorded spaces this creates a realistic impression and assists in the immersive experience of the projected recordings. To achieve the best possible results regarding this experience, the whole installation is covered with light-blocking surfaces, to isolate the visitor from external light and engage his/her attention in the projected audiovisual material.

The construction is mobile and light. The synchronized projection (audio and video) is driven by a central computer with an audio interface of multiple audio outs, and video interface(s) with multiple video outs as well. The projection format for the initially recorded material is 16:9 720p (HD) for each video projection and 24bit/48KHz for the surround sound.

Figure 6. A.R.T.E. structure: exterior and interior view.

3.2 Audiovisual Synchronization and Playback

A.R.T.E. is designed to project a maximum of 5-channel video, together with multi-channel audio playback in variable formats (mono, stereo, 2.1, 3.1, quad, 4.1, and 5.1 surround). In order to achieve that, A.R.T.E. uses "Millumin", software developed by Anomes (http://www.anomes.com), as its main playback engine. Millumin tools solve two major issues in A.R.T.E. applications: audio/video synchronization and distorted video-image correction through video mapping.

3.2.1 Millumin and A.R.T.E. applications

Millumin is a software especially designed for use in multi-projection systems, with multi-channel audio playback. It is able to handle several types of video and audio formats, as well as live sources, organize them in layers and compositions, and play them back through the discrete outputs of the system. Moreover, it offers several editing and automation tools that help you tweak in detail different aspects of the show. However, one of the most important tasks in Millumin is video mapping, a technique used for projecting an image on a non-flat surface, at several (especially non-vertical) angles (Figure 7). Thus, A.R.T.E. uses Millumin to overcome all the problems generated by the nature of its complex applications and build technically correct and well-presented shows.

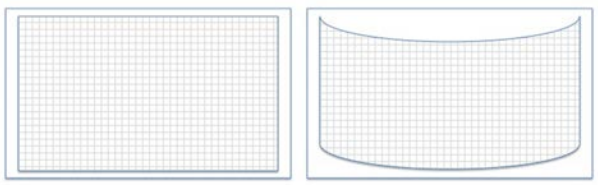

Figure 7. A correct (left) and a distorted/angled projection (right) on a flat surface.

More precisely, a default A.R.T.E. project in Millumin consists of:

• A working environment of 5 screens with total resolution of 9600x1080 pixels (5x full High Definition)
• 5 discrete video tracks/layers, each one assigned to a different screen
• 6 tracks of audio for 5.1 surround support

It is important to mention here that computer's performance is significant for choosing the appropriate file format for each project, since large formats may reduce system's stability and cause serious problems, like unsynchronized playback. And although Millumin supports a large variety of formats, Photo JPEG is recommended for better playback. At the current installation A.R.T.E. runs a 6400x720 pixels project (5xHD) along with surround 5.1, 48kHz/24bit audio.

However, as mentioned above, A.R.T.E. projects on cylindrical screens and the projectors used are placed on the top of A.R.T.E basis, which creates a wide projection angle. This fact would downgrade every show presented in A.R.T.E., technically and aesthetically. Thus, the best solution on this problem is the video mapping tools of Millumin.

Millumin provides an extended video mapping environment, with plenty of tools and capabilities. In A.R.T.E. a projection of a 144 (16x9) correction points grid is used as the map on which the image corrections are made. These points create a pattern of squares (grid) and if they move relatively to each other until the grid appears flat, then the projection on that screen is corrected, free from any distortions (pic.x). Millumin's video mapping tools can work in great detail and the number of correction points can be increased far from what is used in A.R.T.E. Nonetheless, video mapping is a hard and time consuming procedure so, the grid should be as detailed as needed and the number of points must be as low as possible. In addition, video mapping data are saved on each project, so, in the case of A.R.T.E., due to its stable construction, a default project is always used as start for correcting and finalizing the projections.

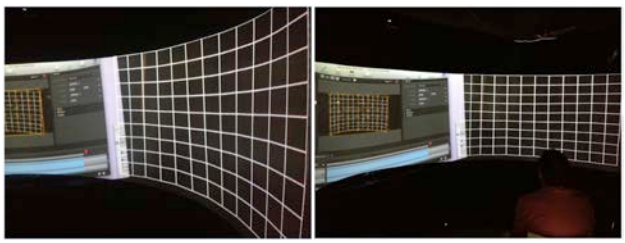

Figure 8. Video mapping A.R.T.E. screens in Millumin.

3.2.2 A.R.T.E. Development issues

Designing an instalation with specifications like A.R.T.E can be a very complex work and the designing team came across several issues concerning the construction and the overall performance. The most important of these issues are listed below:

(a) Designing a stable frame, while keeping the mobile character of the installation and looking good!
(b) Finding a suitable material for constructing the projection screens. This material should have a good projection surface and be easily packed and transfered. At this time, A.R.T.E. uses 2mm thick white foam PVC but still there is a great research by the team on this issue.
(c) Blocking the outcoming light while preserving proper ventilation and comfortable conditions for the visitors.
(d) Reducing the inner sound reflections caused by the screen surfaces. This is a very important issue as it alters the timbre of sound played inside the installation. To solve this, the speakers were placed on the floor with an angle towards up. In addition, some sound absorbing material will be placed in key positions inside A.R.T.E.
(e) Computer system limits: this was the most difficult problem the team had to face. Finding the appropriate format that would match good video/audio quality and system stability, using just one computer was a great research field. There were options for using more computers, running multiple copies of the software in sync, but the mobility factor plus the lack of time code syncing in Millumin led to a single-computer solution for A.R.T.E. at this stage.

Finally, it is important to say that the development team works on transferring the idea of A.R.T.E. in a larger and even a smaller scale.

4. CONCLUSIONS

Through a multimedia representation, such as via an immersion platform like A.R.T.E., new achievements and possibilities regarding perception and evaluation of natural and cultural heritage can be highlighted:

(a) A realistic representation of the actual space, now more accurate and detailed, allows for easier and more proper appreciation of the environment in different space and time.
(b) A wider and more informative capture may assist in preserving a wider variety of elements of our environment and human culture, as a heritage for future generations.
(c) New formats and combined projection media enhance artistic expression and bring new ideas for artistic creation and convergence between different arts and genres.
(d) Through the artistic transformation of the environment with such media, new culture is born and developed, where nature creates culture in new forms, with strong reference to the natural world.
(e) The possibility of virtually 'reconstructing' an environment in an immersion space -or a number of environments, different seasons etc- creates new applications in the field of education (environmental learning).

Future ideas include:

(a) The possibility of networking through such audiovisual representations (i.e. as 'portals' for visiting different spaces virtually) can bring together different cultures and societies and may highly assist in cultural promotion of important areas (museums, archeological areas etc)
(b) With the addition of interactivity and navigation control, new possibilities may emerge regarding applications such as video games and simulators, where immersive navigation through spaces is highly important.

Recording and preparing the material are determining factors for materializing successful projections such as the above. Throughout the described project, the valuable experience gained through the recording phase sums up in a few interesting facts that can be highlighted as well:

(a) The choice of recording methods determines the result, which should be considered as a guide for proper planning. Thus, as a fundamental principle in sound recording, the choice of microphones and recording techniques should be targeted to the desired utilisation, i.e. realistic or artistic sound representation as in the case described in 2.3.
(b) The choice of mobile recorders against computed-based systems in field recording may bring mobility and solve many technical issues but may cost in quality. In this case one should decide over these issues already during planning and testing.
(c) Testing and technical preparation is very important. Not only for the above-mentioned reason, but also since field recording often involves hard weather conditions, under which the equipment should be tested for proper operation prior to recording. During the early stages of the above-mentioned project pilot recording research was required to assist in proper planning, where preliminary recording sessions were conducted to ensure proper recording and familiarize with recording conditions and problems that might occur.
(d) Relationships are very important! As it has proven, recording in demanding conditions for long hours can be exhausting and may generate tension, a lot of which can be avoided if members of the recording team are willing to collaborate in order to achieve their tasks.
(e) Another important relationship here, one of ecologic importance, is the relationship between the human-recorder/observer and the natural environment (i.e. landscape or soundscape). This relationship can be developed during the recording process, where the human visitor should respect and acclimate to the natural environment in order to achieve the best recording results[5]. Also, for the artists/recordists this is the phase of developing sentimental links with the captured material (as immersing into the real world, gaining strong inspirational memories through senses), which are very important for the later stages of artistic creation.

The continuous development of audiovisual technology allows increasingly for realistic capturing, exploring, appreciating and evaluating the environment around us. This can gradually lead to more ecological awareness

[5] During recording sessions in natural environments with living organisms (insects, birds) such as the landscapes found on mountain Ainos, it has been especially evident that proper recording required for the human team to stay quite and relatively still for a short period before recording, as to allow for the landscape-soundscape to return to its normal state.

regarding our living environment, natural and cultural, where art and technology may constitute a solid ground for the development of this relationship. The project 'optic-acoustic ecology' at the Ionian Islands and the A.R.T.E. platform constitute efforts to materialize and explore the potential of the above mentioned ground, depending on the possibilities offered by the current audiovisual media, and through the new ideas and potentialities that emerge via their continuous development.

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