MindSpaces 2nd Open Call

Mindspaces is a Lighthouse project belonging to the STARTS initiative. The main goal of the Starts is the inclusion of artists in innovation projects funded by the research programme Horizon 2020. To encourage collaboration of research projects and artists, STARTS funds STARTS residencies of artists in technology institutions and of scientists and technologists in studio of artists.

Mindspaces is a rich and complex project where artists are meant to collaborate at all levels with the partners and the different methodologies and techniques. The support of the EC allows Mindspaces to offer residencies, which could last for up to 12months. This long-term approach adds incentive for outstanding artists, enhances the potential for outstanding transferable results and allows time for residents to integrate into the research framework. Furthermore, it reflects the very notion of a Lighthouse project.

Mindspaces will offer a number of artist residencies. Residents will become part of the research team, which aims to develop, implement and assess art installations that will highlight the cultural significance of urban sustainability issues, as well as offering potentially paradigm-shifting designs of indoor work and living environments.

Mindspaces (www.mindspaces.eu) is a 3y research project financed by the European Commission STARTS/Lighthouse projects started on Jan 1th 2019. In this project artists, scientists, architects, engineers and technology experts closely collaborate under a novel working model scheme to propose innovative designs to address societal challenges faced by cities as they expand, and the evolving needs in functionality and emotional resonance of modern day workplace and housing interiors. Art has the capacity to transcend established theoretical and conceptual frames and act in cross-disciplinary ways, as it provides space for what is called "lateral" thinking, that is to address issues with an 'out of the box' approach.

Mindspaces Residencies are cross-disciplinary residencies of a collaborative nature. They offer no fixed accommodation, but include required travel to partner laboratories, research hubs and meetings. Interested applicants are expected to read the project description and propose a specific project, which contributes to the spirit and objectives of Mindspaces. The residency is open to artists of all types and experience, but preference will be given to those whose practices have previously engaged with science, emerging technologies, and/or interactive installations, AR/VR installations, architectural design and art in public spaces.

The two main challenges for the artists are:

- To think, research and propose artistic inputs, installations or actions whic h will be discussed with specific technological partners of Mindspaces for the creation of AR/VR solutions
- Propose how to dynamically adapt the spaces (in VR) based on the information coming from MindSpaces technologies and from the environment (e.g. citizen's emotions and feelings captured from social media, detected behavior of people around the area of interest, day, time, weather etc.).

Successful applicants will receive a lump sum of 40.000eu max for a duration up to max 12Mo that includes travel and material budgets. This can be paid in installments and is conditional on monitoring of the progress. Residents will be expected to achieve their project aims, contribute to the overall project and write a report of their experience as a member of the MindSpaces team.

The MindSpaces platform

A platform encompassing the technologies of MindSpaces will be provided to support the artist(s) and/or architect(s) in designing solutions for both indoor and outdoor environments as described. This platform will offer effective support in defining/conceptualizing a project, in scanning and virtualizing environments, researching them, and in capturing and visualizing emotional and behavioral data in real, or in near real time, and in using it to refine, improve, and adapt designs. The platform is essentially composed of the following three distinct but interoperable tools:

AR/VR tool (responsible partner: NURO)

A AR/VR tool based on Unity 3D will allow artists to set up their installations in virtual space, and conduct tests and simulations. This tool will also support control over parameterized 3D models in real time. It is conceived to help artists in analyzing the sensory input from users while experiencing the spaces in an immersive near real-life environment. A key challenge for the selected artists will be to use their artistic skills in order to translate how the VR (indoor or outdoor) environment can be adapted based on the captured changes in the environment and in the user emotional states

Project manager system (responsible partners: McNeel and NURO)

A project manager system based on Rhino3D will help artists to seed the project with concepts, concerns, locations, and requirements. The seeds will allow automatic search and retrieval tools to compose interesting and relevant datasets for the project. The project manager supports the management of digital resources related to artist's project, including those generated by the different services and technological components developed in the project.

3D editor (responsible partners: McNeel and NURO)

A sophisticated 3D editor based on Rhino3D will allow artists to build their projects and model their solutions. It supports the use of parameterized 3D models that can be connected to live data sources (e.g. sensors) in a custom manner. Artists can program animations, functions, and reactions to control the parameterized models by using compatible tools (e.g. Grasshopper).

The artists will be provided technical support and training in order to take full advantage of the platform.

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The MindSpaces technologies

MindSpaces is performing research and development of several cutting edgetechnologies. The selected applicants will be involved in the development, and/or can make use of one or more of the technologies below, in order to propose and implement a work of art in the context of the project use cases.

Textual analysis for extracting user emotions, feelings, and needs from use case related texts (responsible partners: CERTH and UPF)

The collection of texts might include tweets of certain profiles or from particular locations, news describing recent events, user biographies and thoughts, opinions on public and office spaces from art- and design-oriented blogs and forums, etc. Data extracted by CERTH will help UPF understand users' background, their current emotional state, and their opinions on some project related questions. UPF will provide means for generating texts from abstract structured data, for example, to verbalize ideas or augment VR scenes with textual descriptions.

Physiological signals for emotional state estimation (responsible partners: CERTH and MU)

CERTH will provide means to extract users' emotional states through the analysis and processing of physiological signals, e.g. electroencephalogram (EEG), Galvanic Skin Response (GSR) and Heart Rate (HR) measurements. CERTH and MU will develop technologies for estimating emotional states while users interact with a VR environment and corresponding art installations.

Visual data for human behavioral analysis (responsible partners: CERTH and MU)

CERTH will provide means to capture videos in indoors and outdoors environments. MU will provide a video analysis service that will assess the reactions and behaviors of users in each proposed environment. MU's visual behavior analysis will process video recordings in order to understand the flow of humans either as individuals or as groups. Trajectory analysis, object tracking, human-human interactions and Pose

estimation methods will be taken into consideration for the detection of activities and behaviour analysis over time.

Aesthetics and style extraction from visual content (responsible partner: CERTH)

CERTH will extract aesthetics and styles from visual content and provide it to the artists and creatives to build novel 3D-artworks or spaces. The aesthetics information will be extracted either from archival material (cultural heritage artefacts in paintings, images of artwork, video footage) or provided by the end-users. This material could be used as inspiration for novel or culturally-relevant designs.

Semantic representation and data integration (responsible partner: CERTH)

Semantic Web technologies will be used to intelligently combine and fuse the contextual information that is generated through the MindSpaces environmental and physiological monitoring solutions, such as emotions and physiological measurements. The achieved situational and emotional awareness will be translated into emotion-driven adjustments and changes to the 3D model space, fostering emotionally-relevant and functional design.

Space sensing for 3D reconstruction for interior and exterior spaces(responsible partner: U2M).

3D models of the interior workspaces, the houses and the exterior places of city of L'Hospitalet will be available via the platform. Especially in the exterior space scenario, massive 3D data will be produced for the artists to exploit. 3D models of small in house items could also be available. The 3D information will be in the form of 3D models and point clouds and they would also be displayed in VR/ AR environment of the platform. At the same time, the original raw data, which will be collected for creating the 3D content, will also be available via the MindSpaces platform. The raw data will be collected by a handful of sensors and sources, suc h as images from drones, satellites and vehicle platforms, terrestrial scanners and scanners on vehicle, GPS and IMU signals and historical photographs.

The MindSpaces use cases

The project proposed by the applicants should be connected with one of the following use cases of the MindSpaces project.

Pilot Use Case 1: Outdoors urban environment

The use case will be showcased in the city of L"Hospitalet de Llobregat, a city located in the metropolitan area of Barcelona. Being Catalonia"s second city, with a population of more than 262.000 inhabitants, it faces major challenges regarding high urban density, high levels of multiculturalism and an industrial past which has shaped the city. The past 20 years have brought intensive urban, economic and cultural programs creating today a dynamic metropolis that attracts artists, new companies and new population.Tecla Sala Cultural Center and surroundings is a central area in L"Hospitalet holding several projects on contemporary visual arts regarding training, creation, production and exhibition. It is also a pleasant urban park connecting the north and the south of the city and a future neuralgic area with new perspectives of flows once the intermodal metro and train station will be opened. This area will be the spatial base of work that will host the artists' installations, and will serve as a final exhibition space of the result of the work led bythe artists.
The pilot use case for "Designing of improved, attractive city spaces",intents to improve urban design in a rapidly expanding city by addressing new challenges that may arise related to the city's functionality, mobility, attractiveness, protection of culture and environment. MindSpaces will aim to increase sensitivity and awareness towards the cultural significance and current issues of the city, related to the environment and mobility, through innovative art installations in key locations. Thus, MindSpaces will raise visibility of the city's cultural value and increase awareness of issues related to its expansion, particularly environmental, mobility and other socially sensitive concerns. It can also generate environments that are amenable to new types of social interaction and new degrees of social connectivity with the urban fabric. This, in turn, will improve touristic potential, the wellbeing of citizens, quality of life in the area, as well as its overall economic activity. The pilot will use advancedmodelling software (e.g. Rhino, Grasshopper) to produce blueprint documentation of the area, and propose new urban design schemes that showcase its cultural visibility and importance, generate new types of social interaction, and draw attention to issues it is facing regarding environmental pollution and mobility (e.g. air or water pollution, traffic congestion).

Main challenges

1) A professional architecture office (ZHA) and an academic architecture unit (AUTH), have been assigned to collaborate with city council of the City De L'Hospitalet, art curators (EsproncedaCentre of Art and Culture) and artists of the consortium and the open call, in order to produce outdoors architecture and urban design proposals for an urban area of special cultural interest. ZHA and AUTH will cooperate with the selected artists from the 'Open call' to deploy artistic projects that are aligned with the mission of MindSpaces and STARTS, bringing technology to urban design, human centered thinking, ethics and values closer to its technical deployment. The citizens will experience the proposed urban design in the outdoors area itself, through artistic interventions potentially expressed via new spatial installations linked with a VR environment. **Art projects (virtual or physical) will contribute to the definitionof a psycho-geographic and economic character of the city, catalyzing new processes of local identification with public spaces within local neighborhoods**.Art installations may provide direct representations of cultural assets, reproductions or projects on the historical urban fabric. Urban challenges, like mobility issues or environmental pollution data, aim to elicit interest and engagement in these issues from city dwellers and visitors. **Additionally, installations may generate a platform for new types of social interaction within the urban context. User's emotional and cognitive responses will be indirectly assessed by a combination of environmental and physiological sensors appropriately chosen for each installation (EEG, motion sensors, activity sensors, video etc.**The MindSpaces public installations may dynamically change according to the artists' sense of aesthetics, in response to the sensor feedback from the public, so as to arrive at the most emotionally appealing and functional design proposal, which will be generated through the collective behavior of the participants.

2) In order to leverage the powerful data sources of MindSpaces platform, projects partners have identified and analyzed the key parameters of urban space, such as Topography, Materials,Vegetation,Light(natural /artificial lighting conditions), Movement, Existing infrastructure (roads, pedestrians, equipment)**Artists may help to identify relationships between these parameters or new ones, with human emotion and behavior.**The development of a design simulator in VR enables us to test many design options and parameters without the expense of changing physical designs. Understanding emotional and physiological feedback in these virtual environments gives us the means to gather generalizable and specific insights to be applied in generating new models in an iterative process.

PUC 2: Inspiring workplaces

Inspiring Workplaces is a Pilot Use Case designed to test and develop the MindSpaces platform specifically for designing better quality workplace environments. MindSpaces research partners collect and analyzebehavioral, emotional, and textual data from people inhabiting workplace environments physically and virtually (AR/VR environments) to develop design and analysis tools used in designing workplaces. Artists, architects, and designers will leverage the tools and data insights to explore and envision improved workplace environments.In recent years, aesthetically and functionally innovative workspaces are being created which are more capable of enabling the dynamic communication that is needed within today's networked society. Increasing opportunities for positive social interaction in work environments leads to improved productivity and creativity across departments and teams.

The pilot use case for "Inspiring Workplaces" aims to create emotionally appealing work environments that are inspiring, allow more dynamic and diverse social behavior, lead to increased and improved worker collaboration, productivity and well-being.

Main challenges

1) For the second pilot, talented artists and creative thinkers are called to propose ideas, concepts, interventions, and designs for new and innovative solutions to designing more inspiring and effective offices of the future. Artist's proposals should contribute to the ideation and development of, and/or utilize the MindSpaces platform (in the concept of an authoring tool and interaction tools for measuring public reactions via VR and EEG, as described in the above section) and data insights in their conception. **Artists will be asked to propose solutions that can be measured to improve the performance of office space design based on considerations such as promotion of emotional well-being, improved productivity, increased flexibility, and the enabling and encouraging of dynamic social interaction and collaboration.** To develop their work, artists and creative thinkers will have access to 3D digital models of potential office space designs, and, for the purpose of the project demo, to the 3D model of the existing workspace, which will be re-designed via the artists' contribution, as well as data provided through the MindSpaces platform and should be capable of interacting with these media. Artists will contribute to rethinking the notion of how offices can be designed as well as by creating interventions and full design proposals for office spaces potentially taking on the following roles:

- Conceptualize fundamentally new approaches to office design which provide productive user requirements / considerations that contribute to the development of the MindSpaces platform.
- Design virtual 3D VR interventions for existing office spaces or architect's designs.
- Design virtual 3D VR office space designs entirely.
- Propose and install physical interventions in real world office spaces.

2) In parallel with studying real office environments, a series of experiments will be conducted by producing 3D virtual workplace environments, which can be experienced in virtual reality. Each experiment will involve changing design parameters such as material or lighting conditions, colour, proximity to natural light, and features and organizational office layouts. **Artists are invited to work with these parameters or to propose others that may affect human emotion and behavior.** Human users will experience each variation in VR while researchers collect physiological and EEG data to understand the user's emotional and physiological signals in relation to what they experience. Among others, researchers will study emotional and physiological data in response to different options for artificial and natural lighting, materials and material contrast, color, spatial proportion, spatial organization, and specific spatial conditions. These insights will then be generalized to guide the biasing of parameters in the design of improved workplaces.

PUC 3: Emotionally-sensitive functional interior design

Architectural and interior design has always aimed at creating emotionally appealing and functional environments. But it is only in recent years that emotional effects and the usability/functionality of a designed space are being assessed in an objective and quantifiable manner Quantitative data using multiple sensors are now showing great potential to support design. Additionally, the widespread availability of digital representations of past aesthetic trends and features enables their innovative re-use and integration in new designs. MindSpaces will combine these trends, enabling the realization of aesthetically sensitive interior design that integrates the end user's responses and leverages specific aesthetic features that appeal to certain target groups.

The use case will be piloted on seniors‟ homes in the city of Paris, in collaboration with project partner eSeniors.

Main challenges

1) The third use-case address challenges of a sensitive audience, i.e. senior peopleand their domestic inhabitation. Artists and creative thinkers are called to propose innovative, art related ideas concerning the quality of these environments and the level of emotional and functional friendliness. **Selected artists in collaboration with architects will propose an art installation inspired for a senior individual's living space.** The senior will be between 60 and 85 years-old, have no particular health or mental illness and live independently. MindSpaces proposition is to focus on the topics of emotional support and affective state, such as solitude, loss, etc. Additionally, solutions for practical issues can be potentially suggested, since they are of a sometimes more explicit character (accessibility, security, life rhythm, health, etc.).

This can modify many aspects of seniors' lives and increase the level of emotional and practical comfort. The art works may be presented to the senior through adapted supports (3D, virtual reality headsets). The artists will be provided with the 3D plan of the senior living space as well as information coming from sensing cameras and interviews about the senior habits in his/her home. The emotional state of the seniors will be measured through technological means, with non-invasive EEG and physiological sensors. This will allow the determining of emotions felt by the senior in interaction with the artwork in his/her living space.

The main results gathered thanks to these focus groups and interviews are that, in general the seniors are looking for in an artistic creation, to feel a wide range of emotions:**to feel inspired, to connect with others and to understand the world around them.** There is generally a positive feeling at home, a feeling of safety, but issues such as noise, limited luminosity and the small size of Parisian homes or crowded interior living spaces were pointed out. Seniors responded that they highly value the contact with nature and the outdoors in general, as well as that they appreciate a comfortable and well equipped house.

2) In order to leverage the powerful data sources of MindSpaces platform, projects partners have identified and analyzed the key parameters of interior space, such as Materials, Interior Vegetation,Light (natural /artificial lighting conditions), Interiors equipment(furniture, smallobjects, decoration)**Artists may help to identify relationships between these parameters or new ones, with human emotion and behavior.**The development of a design simulator in VR enables us to test many design options and parameters without the expense of changing physical designs. Understanding emotional and physiological feedback in these virtual environments gives us the means to gather generalizable and specific insights to be applied in generating new models in an iterative process.

The MindSpaces consortium

Centre for Research and Technology Hellas (CERTH): data collection from sensors (visual data, EEGs, HRs, etc.), crawling web and social media, aesthetics and style extraction, emotion detection and semantics analysis.

Maastricht University (MU): visual behavioral analysis and emotional state recognition from physiological signals.

University PompeuFabra (UPF): text analysis, sentiment analysis and text generation services.

Aristotle University of Thessaloniki (AUTH): expertise in architectural design, urban design and landscape design (natural and urban); guidance in use cases and the evaluation of the proposed designs.

MCNEEL Europe (MCNEEL): 3D design software tools provider and development of architecture and designing software.

up2metric (U2M): expertise in 3D spaces reconstruction; creates immersive 3D experiences for use in Virtual and Augmented Reality apps.

NUROGAMES GMBH (NURO): provides development for adaptive AR/VR environments; orchestrating system integration.

ZahaHadid (ZHA): innovative design solutions and knowledge in spatial design, agent based simulation / analysis, and VR integration.

Maurice Benayoun (MoBen): is a pioneer in digital arts and has strong expertise in interactive exhibition design.

analogNative (AN): is a technology-driven art and design studio and lies at the intersection of media arts and architecture with using machine intelligence.

Espronceda (ESP): has experience in the fields of the culture and art, organizing different, multi-disciplinary, cultural and educative programs.

e-Seniors (ESE): aims at fighting e-exclusion by providing access to and training in ICT to seniors and/or disabled people.

L'Hospitalet de Llobregat (CdH): will bring to the project the context of the city as the living lab of the project.

City University Hong Kong (CityUHK): examines the impact of art approaches on urban, architectural and interior design