SUN

NEWSLETTER #01

MAY 2023

“Dear reader,
we are pleased to welcome you to the first Newsletter of the SUN XR project.

This is the first issue of a biannual Newsletter that will allow you to stay in touch with the progress of the project.”

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WELCOME ADDRESS

Social and hUman ceNtered XR – SUN, is an international Research and Innovation Action (RIA) project funded by the European Commission under the Horizon programme addressing the "HUMAN-CENTRED AND ETHICAL DEVELOPMENT OF DIGITAL AND INDUSTRIAL TECHNOLOGIES 2022 (HORIZON-CL4-2022-HUMAN-01) topic.

The project started on the 1st of December 2022 and will end on the 30th of November 2025. SUN project aims at investigating and developing extended reality (XR) solutions that integrate the physical and the virtual world in a convincing way, from a human and social perspective. The virtual world will be a means to augment the physical world with new opportunities for social and human interaction.

If you like to learn more about the project and subscribe to the Newsletter, please click at https://www.sun-xr-project.eu and follow us on social media.

INTERVIEW TO GIUSEPPE AMATO (CNR-ISTI), THE SUN XR COORDINATOR

What is the project about?

SUN XR stands for Social and hUman ceNtered eXtended Reality. SUN XR aims at investigating solutions to make extended reality real.

Extended Reality builds upon augmented and mixed reality, which in turn build on top of Virtual Reality. With virtual reality, users have access to virtual worlds using visors, smart devices, or computer screens. Users can only interact with the virtual world and are isolated from the physical world.

With augmented and mixed reality, the virtual world is overlayed on top of the physical world. Virtual objects are fused and synchronized with the physical world. In mixed reality, users can interact both with physical and virtual objects.

With extended reality, interaction between the two worlds becomes more realistic. With the use of haptic solutions, users can feel virtual objects. They can feel their weight. They can feel their temperature. They can feel their consistency. They can recognize their material. Virtual objects are digital twins of physical objects, not just visual representations of physical objects. Sensors are used to exchange information between the two worlds, for instance, to acquire and transfer physiologic parameters from physical users to their digital avatars. SUN XR identified a number of limitations in today's technology that prevent this from becoming real and aim at addressing and solving them.

How do you think XR can help social and human interaction?

Advancements in technologies have always had a social and human impact. Consider for instance smartphones, that allow us to continuously and pervasively interact and get in touch with our relatives, friends, and colleagues. We are always connected and never alone.

Once XR devices will be miniaturized enough and made pervasive, extended reality

will provide us opportunities for a step forward in social and human interaction. Imagine watching a movie having the realistic illusion of being seated next to your friend, or having lunch with your parents, while being physically in different sites.

Where will the results of the project be applied?

We will validate the solutions developed in SUN XR in three different pilot applications related to three social and human related scenarios: rehabilitation, industry, and aid to people with disabilities.

We will test SUN XR technology in a rehabilitation scenario, where XR will be used to provide guidance and feedbacks to patients concerning the exercise they are executing. The physiatrist and the patient will have the illusion of being in the same room, even if one is at home and the other is in his office. Within the industry scenario, we will validate the developed solutions by exploring XR usage in providing new opportunities for training workers and engineers. We will also explore the possibility of increasing safety in work environments by increasing the opportunities for social interaction among workers, even in difficult and noisy work conditions. Finally, we will also explore how XR can contribute to improve quality of life for people with motor and verbal disabilities. XR will leverage people's residual capabilities to allow them to execute actions (both physically and virtually), that they cannot perform elsewhere.

What are the main challenges of the project?

We identified four main challenges to be addressed: scalability in creating and reusing XR worlds for new applications; issues in realistically and convincingly integrating physical and virtual worlds; lack of convincing interfaces to simultaneously interact with physical and virtual worlds; resource and computational constraint of current devices for VR/AR/MR/XR.

To address these limitations SUN XR will investigate new 3D acquisition techniques which will go beyond capabilities of current laser scanning or photogrammetry solutions. We will leverage on AI to optimize and automatize 3D acquisition and we will use solutions for massive avatar creation. The physical world will be incrementally acquired while users use an

XR application.

We will define artificial intelligence-based techniques to dynamically and incrementally create links between physical objects and their digital twins, leveraging solutions based on lifelong and incremental learning. We will also define techniques for object acquisition that capture both visible and non-visible properties, such as mass distribution and materials of the objects.

We will explore the design of haptic devices that provide users with a realistic feeling when interacting with virtual objects. We will explore miniaturized mechanical and thermal actuators, EMG decoding solutions, and skin stretching actuators. We will also explore and define techniques based on multimodal interaction integrating gaze, gesture, and speech interaction. Interaction between humans and the integrated physical and virtual world shall be as much natural as possible.

We will explore advanced streaming solutions that allow high quality, in terms of resolution, photo realism, and speed, even in presence of low resource and computational power, by optimizing client-server interaction and balancing computation between the two. We will also leverage on AI to correct possible errors in data acquired and transferred to the end-user devices.

What is your end goal?

SUN XR aims at filling the technology gap to make extended reality real and easily usable, giving high importance to social and human related applications. We will give high relevance, not only to scientific and technological aspects, but also to ethical, legal, and social aspects, which will be thoroughly explored.

FIRST SIX MONTHS AND PROJECT MILESTONES

Project Milestones	Milestone Description	Month
MS1	Project inception	May 2023
MS2	Requirements and preliminary scenarios	Mar 2024
MS3	Specifications of SUN component, Architecture and pilot planning	May 2024
MS4	Preliminary Impact and dissemination assessment	May 2024
MS5	SUN Component and integrated platform first release	Jan 2025
MS6	Preliminary experimentation phase	May 2025
MS7	SUN Component and integrated platform final release	Jul 2025
MS8	Final experimentation phase	Nov 2025
MS9	Project completion	Nov 2025

During the first 6 months a lot of work has been done. In particular, the deliverable D1.3 on “Data Management and IPR issues” have been defined aiming to:

- Manage all the data collected, generated, or acquired during the lifecycle of the project.
- Define the rules concerning intellectual property ownership, access rights to background and results for the execution of the project and the protection of intellectual property rights (IPRs).

Moreover, the deliverable D7.2i “Communication and Dissemination Plan”, dealing with the communication and dissemination strategy, has been released.

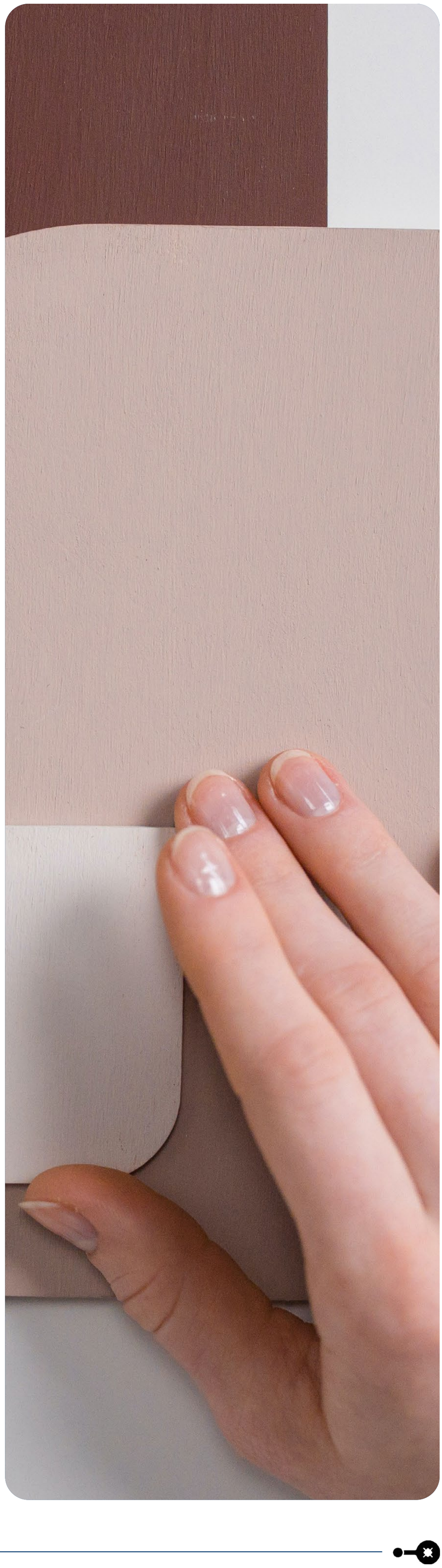
Since the start of the project, SUN has been presented in international events such as:

- https://roboticafestival.it/
- https://2023.ieee-ner.org
- Sport4Cancer Scientific Conference
- 2023 IEEE-EMBS
- NEM SUMMIT 2023
- Horizon Europe Malta Information Day.

SUN XR APPROACH TO THE ENHANCEMENT OF XR INTERACTIONS.

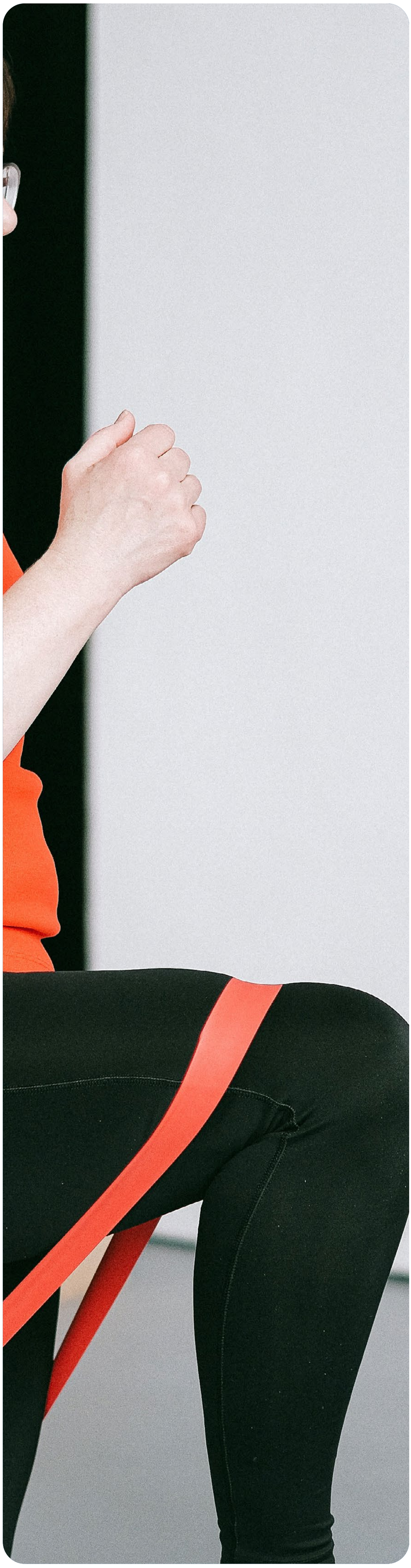
SUN aims to enhance, among other, XR interactions by incorporating wearable haptic interfaces and multisensory feedback.

Haptic feedback deals with the rendering of the sense of touch: in virtual reality, it allows to feel contacts with virtual objects, and interaction forces with the environment. Adding sense of touch not only increases engagement of the user and “realism”, but more importantly can provide relevant sensory information our brain constantly uses for manipulating objects in real life. On the other side, simulating touch is complex: there exist a variety of different contact cues (skin indentation, vertical force and lateral stretch, vibration and textures, surface orientation) we all perceive at the same time when touching an object, but requiring substantially different rendering devices for each of them. In addition, intensity of certain haptic stimuli (i.e. force at fingertips) can range from subtle contacts to noticeably high forces, hence requiring cumbersome actuators. Thinking about highly wearable VR



gear, alternative solutions to the bare replication of real haptic cues have to be found. In project SUN, Scuola Superiore Sant'Anna is developing compact and hi-fidelity actuators, capable of rendering well just the most informative haptic signal our brain uses for manipulation. In example, certain transients related to high-dynamic signals are useful to detect contact threshold with objects, slip and loss of contact, which are the most relevant events in a manipulation task. Our mechanoreceptors in finger-pads are extremely sensitive to these signals, hence requiring less power for miniaturized haptic actuators.

Following the concept of informative haptic feedback rather than simulation, it is possible to use haptics for high-level communication with the user. Distributed wearable haptic systems in place of gloves, worn at forearm or shoulder, can use sense of touch to provide information without blocking user's hands, hence useful in augmented reality applications.



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