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The XR Stream – Grand Challenges for Ocean and Cities from a London Perspective

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Abstract

In 2024, we brought London closer to the ocean: Nearly 700 design students at the Royal College of Art participated in the Grand Challenge 2023/24. In teams of five, the students were tasked with tackling challenges around London and the Ocean from a design perspective. The challenge involved multiple methodologies, including design engineering, speculative design, service design, materials- and fashion-related approaches. Each team had one month to develop a compelling proposal.

Fifty students participating in the Grand Challenge were able to join the Extended Reality/XR Stream: Ten teams of five students each came up with different design solutions using the Unreal Engine 5. This paper presents how Unreal Engine 5 was introduced to students through lectures and hand-on sessions, and how XR technologies were employed to creatively interpret the original brief of the Grand Challenge and how it inspired our students to come up with unique design propositions.

In particular, we discuss here two case studies in detail: X-River and SuDScape. These two student projects were among the top 13 teams exhibited at the final Grand Challenge show, offering insights and recommendations for incorporating XR into design education.

Introduction

The RCA Grand Challenge is the largest single-institution postgraduate design project in the world. It brings together students from across the Royal College of Art's School of Design to collaborate on interdisciplinary solutions to pressing global issues [1]. The initiative promotes cross-disciplinary thinking and creative problem-solving, grounded in both local and global contexts. Three of the authors (EH, CA, BS) served as the main organizers of the 2023/24 Grand Challenge with support from AH, PA and Christopher Ross. Driven by the NEMO (New Economic Models for the Ocean) project [2], [3], this edition of the Grand Challenge focused on the theme *Ocean & Cities*, encouraging students to address ocean-related challenges through innovative design practices. As part of the RCA's role as a UNESCO Ocean Decade Implementing Partner, the Grand Challenge contributed to global efforts aimed at reversing the decline in ocean health [4].

Nearly 700 students from a wide range of MA programmes, including Design Products, Fashion, Innovation Design Engineering, Intelligent Mobility, Service Design and Textiles, explored the brief *Ocean & Cities* from a design perspective. Through this lens, students were empowered to propose meaningful, forward-thinking design interventions with broad societal impact. 50 students were selected to participate in the *Extended Reality (XR)* Stream which used Unreal Engine 5 to develop design proposals. After a four-week design sprint, the student teams submitted video presentations showcasing their concepts, from which 13 projects were shortlisted. These were nominated by tutors and selected by the organizing team. In this paper, we outline the structure of the XR Stream lectures, detail how the XR technologies and Unreal Engine were introduced to students and review two shortlisted student projects as case studies (Figure 1).

Figure 1. XR Stream Case Studies: Here, two cases studies out of ten XR Stream of the Grand Challenge 2023/24 will be discussed: X-River and SuDScape.

Objective

The RCA Grand Challenge 2023/24: *Ocean & Cities* brought London closer to the ocean by addressing a wide range of design challenges at the intersection of land and sea. The initiative aimed to support behaviour change among citizens and organizations by leveraging ocean science, co-design methodologies, and place-based approaches to enhance urban resilience against ocean-related impacts of climate change and to reduce the impacts of cities on the ocean. All student groups responded to the same *Ocean & Cities* brief within the context of London. Each group was assigned one of London's 32 boroughs or the City of London, grounding their design proposals in specific local sites. These proposals aim to reveal and strengthen the unique connections between local communities and the ocean.

A key contribution of this initiative is the introduction of ocean-related issues to a school-wide cohort of diverse design students, many of whom had not previously considered the ocean in their practice. This is particularly significant given that, although the ocean covers 71% of our planet, the vast majority of design activity occurs on land and remains largely unaware of its impact on marine systems. By embedding ocean literacy into design education, the Grand Challenge encourages emerging designers to broaden their environmental awareness and consider their role in shaping planetary futures.

Our specific objective in introducing Unreal Engine 5 and XR technologies was to explore how these tools can enhance students' ability to generate more effective design solutions in response to the *Ocean & Cities* theme. Additionally, we aimed to investigate the pedagogical value of integrating immersive technologies into design education, particularly in fostering experiential learning, interdisciplinary thinking and speculative design capabilities.

Related Work

Unreal Engine and XR in Design Education

Integrating Unreal Engine and XR technologies into design education has gained significant attention in recent years, offering transformative potential for pedagogy and practice. These tools provide immersive and interactive environments that enhance learning experiences, foster creativity and prepare students for the evolving demands of design professions. Unreal Engine, a robust real-time 3D creation platform, has been instrumental in advancing design education. Its capacity to produce high-fidelity visualizations and interactive environments [5] allows students to engage in realistic simulations, thereby enhancing their spatial awareness and design competencies. Furthermore, the integration of Unreal Engine into educational XR technologies, encompassing *Virtual Reality (VR)*, *Augmented Reality (AR)*, and *Mixed Reality (MR)*, have been increasingly incorporated into design curricula to create immersive learning environments. The use of Unreal Engine in creating VR simulations has proven beneficial in fields such as epidemic education, where immersive scenarios can facilitate deeper comprehension of complex situations [6]. A study has demonstrated the potential of XR to enhance postgraduate design students' engagement and understanding, particularly during exceptional circumstances such as the COVID-19 pandemic [7]. Also, in the context of COVID-19, a Unity 3D-based VR environment has been developed to support safety protocol-based training for patients and staff [8]. The incorporation of XR technologies in design curricula offers students hands-on experience with tools that are increasingly prevalent in the industry. This exposure not only enhances technical proficiency but also encourages innovative approaches to design challenges. However, the successful integration of these technologies requires addressing challenges related to accessibility, content creation and the alignment of XR experiences with educational objectives [9].

Unreal Engine and XR Facilitating Design

In recent years, Unreal Engine and XR technologies have significantly transformed product and UX design by fostering more collaborative, immersive and iterative workflows. XR environments powered by real-time engines like Unreal have been shown to enhance collaboration, enabling co-located and remote teams to co-create and review designs within shared immersive spaces. For example, co-creation studies found that XR design environments let even non-experts actively participate in early design discussions [10]. Garcia et al. observed that XR co-review sessions support clearer communication and faster decision-making, particularly when stakeholders are physically dispersed [11]. Such activities have been shown to increase design alignment and streamline decision-making across distributed teams [12].

In terms of prototyping, XR platforms offer low-cost, high-fidelity virtual alternatives to physical mock-ups. Grünefeld et al. introduced "VRception" [13], a toolkit enabling rapid XR prototyping in Unreal, which streamlined concept iteration and usability testing. Similarly, Horvat et al. demonstrated that VR-based prototyping significantly improved creative engagement and spatial understanding among designers compared to traditional CAD tools [14].

Immersion in XR environments also leads to more authentic user experiences, which are critical for user-centred design. For example, the ReLive framework combines immersive VR views with synchronized desktop interfaces, enabling designers to relive and analyse user interactions within virtual prototypes, leading to more informed design decisions [15]. Furthermore, the use of real-world contexts in immersive prototyping, such as combining 360-degree videos with dynamic computer-generated interfaces, has been shown to enhance the evaluation of pedestrian interfaces by providing realistic environmental cues [16].

Overall, Unreal Engine and XR technologies enhance the design process by promoting deeper user insight, more fluid collaboration and more efficient prototyping, contributing to better design outcomes.

Method

Group Composition

In the general Grand Challenge lectures taking place in November 2023, all students were encouraged to engage directly with citizens and other stakeholders in their assigned boroughs, employing co-design and place-based approaches. Potential opportunities for design interventions included, for example, products, materials, identities, experiences, systems, services and simulations.

A comprehensive overview of the timeline of the Grand Challenge 2024 XR Stream is illustrated in Figure 2.

In September 2023, around three months before the Grand Challenge 2023/24 started, all students who were interested in XR technologies, or who identified XR as an appropriate solution for a potential design proposal, were invited to register for the XR Stream by completing a sign-up form.

In the form, students were asked for their professional background and their current study program, as well as details regarding their technical background. This included experiences a) with XR platforms Unreal Engine or Unity 3D, b) modelling environments like Blender, Rhino or AutoCAD, as well as c) coding experience like C++/C#/OpenGL or Python.

The coding experience was used to create a score from 0 (no knowledge), over 1 (Beginner) and 2 (Intermediate), to 3 (Advanced). The scores were summed up to help generate a rating for each individual student in terms of coding experience.

In addition, all students were able to submit an optional justification of why they wanted to join an XR team. This was especially helpful if the technical skillset of an individual was lacking:

"Could you leave us a comment about your motivation to participate in an Unreal training workshop? How do you envision this training can support your team's project? Could you tell us if you have any previous experience and/or projects developed on this/similar platforms? Could you post the link? 100 words max."

Each team of five was then created by taking the following criteria into account:

- Each team should have at least one person (up to three) with Unity 3D or Unreal experience.

- The overall score in terms of coding experiences for each group should be similar.
- Each group was supposed to be mixed in terms of academic programs as well as professional backgrounds. As the number of students signing up per program strongly differed, some student teams had up to two people from the same program.

For example, the *X-River* concept, described later in this paper, was developed by a team that included one student from Innovation Design Engineering, two from Design Products, and two from Service Design.

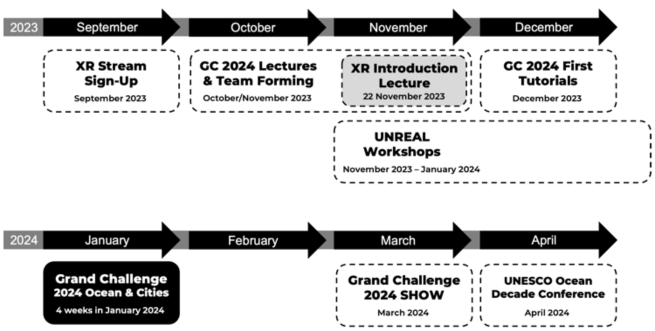

Figure 2. Grand Challenge 2023/24 XR Stream Timeline.

Technology

In some cases, the software was employed to visualize scenarios and proposed solutions; in others, it was used to develop gamified experiences. Additionally, other XR and 3D environments were used complementarily to support idea development.

We selected head-mounted displays (HMDs) as our primary virtual reality hardware. Since their introduction by Sutherland in 1968 [17], HMDs have undergone significant technological advancements. A major leap occurred in 2013 with the release of the Oculus Development Kit 1, marking the beginning of more accessible consumer VR. For this project, we used one of its modern successors - the Meta Quest 2.

The Quest 2 was chosen for its affordability, portability and ease of setup, making it especially well-suited for educational settings. Importantly, it integrates well with Unreal Engine 5, supporting OpenXR and offering straightforward deployment of VR content created in UE5. Its wireless capabilities and onboard processing allow students to test immersive experiences without being physically connected to a high-performance computer. This streamlined workflow enables faster prototyping and iteration, making the Quest 2 a practical and effective tool for teaching immersive design with real-time 3D engines.

For the 50 students who participated in the XR Stream, each group was provided with a Meta Quest 2 headset along with a Link cable. They were also given access to graphic workstations in the RCA's XR Lab on the Battersea campus. In this way, the students were able to connect the Meta Quest 2 directly with the graphic workstation using Unreal 5 – without the need to compile a mobile stand-alone version using Android – which would have added another layer of complexity.

Lessons Learned from Grand Challenge 2021–22

We had previously organised a VR workshop in the Grand Challenge 2021/22 which received highly positive feedback from participating students [18], many of whom described it as one of their most rewarding experiences at the RCA. Several students even suggested transforming the workshop into a standalone elective course, highlighting its perceived value and impact on their design education. Key strengths identified included the opportunity to work with emerging XR technologies, the collaborative nature of the group work and the overall organization of the workshop. Students particularly appreciated the hands-on engagement with the Quest 2 and the integration of immersive design tools into their practice.

However, a number of important challenges and areas for improvement also emerged. One recurring theme was the fast pace of the workshop. Although students found the sessions engaging, some struggled to keep up with the technical content, particularly those with limited prior experience in 3D engines or coding.

While the availability of recorded sessions helped to some extent, the compressed timeline limited opportunities for deeper exploration of core concepts, such as the logic behind Blueprints in Unreal Engine. Another challenge was related to timing. Some students expressed a desire for the technical sessions to be held earlier in the term, ideally before the winter break, to allow additional time for independent practice and exploration. Additionally, team dynamics varied, with some students feeling under-supported in realizing their creative visions, especially when technical implementation relied heavily on one or two group members.

These insights were instrumental in shaping the improved structure of the XR Stream of Grand Challenge 2023/24, with adjustments made to the pacing, scheduling and support provided to students engaging with XR and Unreal Engine 5.

Lecture and Workshop Setup

As most participating students were new to Unreal Engine 5, a series of workshops was organized by RS, consisting of three in-person sessions which were focusing on a) World Building – Landscapes, b) World Building – Cities, and c) VR Templates in UE5 (Figure 2). These sessions were designed to equip at least 1–2 students from each group with the skills needed to create virtual environments using UE5 and share these insights with their teams.

The workshops were complemented by one introduction lecture on XR which students could attend in November 2023, covering: a general introduction to XR and its terminology, some historical context, applied technology during the workshop, example projects from the Grand Challenge VR Workshop 2021/22, as well as introduction to the XR Team from technical services, who provided additional student support during the project.

Results

Ten teams presented distinct XR-based design propositions at the conclusion of the RCA Grand Challenge 2023/24. Nearly all teams showcased functional Unreal Engine 5 prototypes during their final presentations. As part of the final submission, each team produced a video that addressed diverse design challenges. These challenges included issues such as flooding, air and water pollution, rising stress levels among citizens, and the loss of biodiversity.

The proposed solutions ranged from promoting recycling and mudlarking practices to exploring coastal community architecture and identifying potential intervention sites for flood mitigation. Other projects supported the local seafood industry or introduced innovative formats such as gamified experiences and museum exhibition setups to engage the public. Two of the XR Stream teams ranked in the top 13 of 140 groups and will be discussed here in the Case Study section (Figure 1).

Case Studies

We deliberately selected the two shortlisted student projects to present in this paper, with the aim of demonstrating how Unreal Engine and XR technologies were applied to address complex design challenges. These case studies highlight not only the technical implementation of immersive tools, but also how they supported creative exploration, stakeholder engagement and the communication of speculative future scenarios within the context of the *Ocean & Cities* theme.

Case Study 1: X-River

X-River is a project that utilizes VR to train volunteers in riverfly monitoring – taking the London borough Harrow as a starting point for the investigation.

It is an immersive experience for recording invertebrate numbers in local rivers as an indicator of pollution levels (Figure 3). The project aims to empower citizens to become stewards of nearby water bodies, fostering a stronger connection to ocean health. Using VR as a training tool offers significant advantages by making riverfly monitoring more engaging and accessible to a wider audience, including schoolchildren. Additionally, it can function as an experiential museum exhibit or a tool to raise awareness at community events across local boroughs. As a result, X-River has the potential to improve the accuracy of pollution data in London's rivers and support infrastructure and policy-level changes.

X-River was developed by a team of five interdisciplinary designers with expertise in Service Design, Design Products and Innovation Design Engineering. At the outset, the team combined their skills to map the problem space and explore the potential impact of XR technologies. During the project they used Unreal Engine and Blender to create 3D assets, characters, rigs, animations and immersive environments, and to develop interactive VR experiences for the Meta Quest 2. A notable feature of the project was the implementation of a functional virtual magnifying glass using Unreal Engine Blueprints, allowing users to closely inspect digital representations of riverflies (Figure 4). The team also used Figma to design UI elements such as environmental indicators tied to specific species which were overlaid within the VR headset (Figure 5).

Throughout the project, the group collaborated closely with the Zoological Society of London and the Harrow Nature Conservation Forum. After experiencing the X-River demo, both organizations recognized its potential to expand the reach of riverfly monitoring and expressed interest in exploring funding opportunities to support its continued development.

The working UE5 prototype implemented a number of proposed functionalities discussed here. In this way, it is possible to move around the river location, pick up different objects on a table, collect water with a bucket and pour it into a regular tray (Figure 6), as well as use a magnifying glass to observe the riverflies in the water (Figure 7). This environment was showcased during the Electronic Imaging conference 2025 in Burlingame/San Francisco and received many positive comments.

Figure 3. X-River: When the VR experience first loads, the player can choose the river environment to practice riverfly monitoring. This river environment was inspired by those found in the London borough of Harrow.

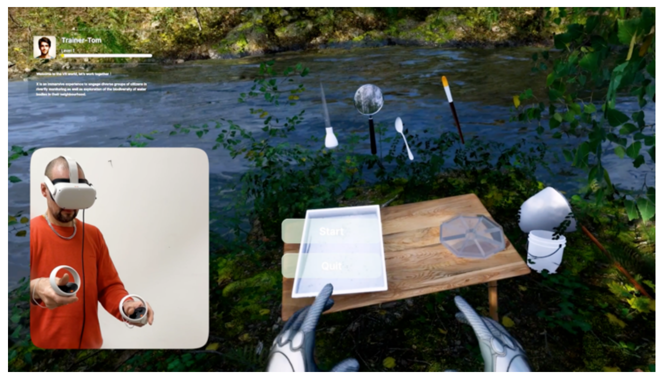

Figure 4. X-River: The player has a selection of tools, including a pipette, magnifying glass, spoon, paintbrush, hand net, bucket, regular tray and 8-section divided tray.

Figure 5. X-River: Whilst kick-sampling, the user can see the underwater environment and UI elements help to understand whether the user is holding the net at the correct angle.

Figure 6. X-River: Once the sample has been collected, it can be poured into the regular tray sitting on a table back on the riverbank.

Figure 7. X-River: Using the functional magnifying glass, the player can observe riverflies and separate them for analysis in the 8-section divided tray.

Case Study 2: SuDScape

SuDScape is a project that leverages VR and AR technologies to support climate resilience and improve flood management in the London Borough of Lambeth, an area significantly impacted by surface water flooding.

The platform should enable designers of *Sustainable Drainage Systems (SuDS)* to visualise, test and iterate site-specific interventions in flood-risk zones, ultimately enhancing urban planning and decision-making. Through its AR component, SuDScape also is intended to promote community engagement by translating complex spatial and mapping data into accessible human-centred experiences.

Surface water flooding poses considerable challenges to both marine ecosystems and urban infrastructure. It carries pollutants into local waterways, contributing to ocean pollution, while simultaneously disrupting city life by flooding streets and properties. In Lambeth, secondary research and interviews with local climate change and sustainability officers identified this issue as a top concern, with more than 46,950 residential and over 3,000 non-residential properties currently at risk.

In response, the local council has adopted SuDS as a key mitigation strategy. Building on this framework, this student team developed an end-to-end intervention journey from identifying potential implementation sites to visualising and evaluating design outcomes with the goal of increasing the effectiveness of existing infrastructure. The innovation of SuDScape lies in its integration of policy frameworks and environmental data into an immersive XR experience. Developed by a team of five interdisciplinary designers with backgrounds in Service Design, Design Products, Innovation Design Engineering, and Fashion, the platform combines technical functionality with a strong emphasis on inclusivity and communication.

Whereas the X-River project was developing a functional gamified prototype with UE5, SuDScape was focusing on using XR tools to visualize the overall vision using VR as well as AR technologies, resulting in a more conceptual approach. The VR component supports three core stages: (1) identification of intervention sites through borough-wide VR exploration (Figure 8), (2) simulation of SuDS interventions to visualise and iterate potential solutions, and (3) impact analysis through simulated rainfall and runoff scenarios. Complementing this, the AR interface offers a low-cost, smartphone-based tool for residents to view proposed interventions in situ and provide informed feedback.

Council stakeholders expressed interest in the platform's potential beyond its initial scope, particularly in how it could be integrated into ongoing digital twin initiatives for urban planning (Figure 9 and Figure 10). Feedback gathered during testing revealed that over 80% of residents responded positively, highlighting improved understanding and a greater willingness to participate in local environmental initiatives (Figure 11 and Figure 12).

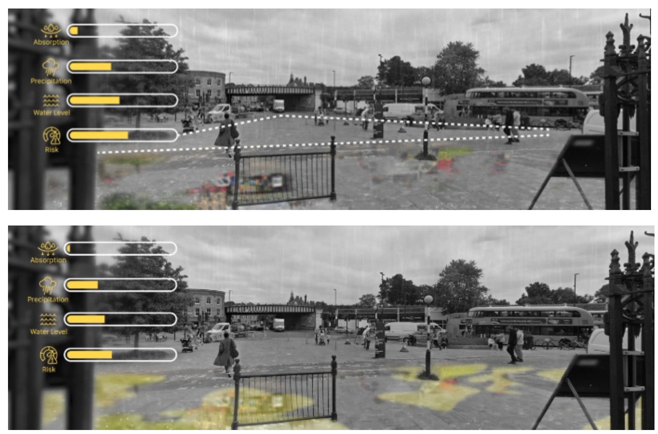

Figure 8. SuDScape (VR): The VR experience highlights impact areas and visualizes SuDS interventions designed to address surface water flooding. The impact of the two interventions visualized here are indicated by the variables absorption, precipitation, water level, and risk.

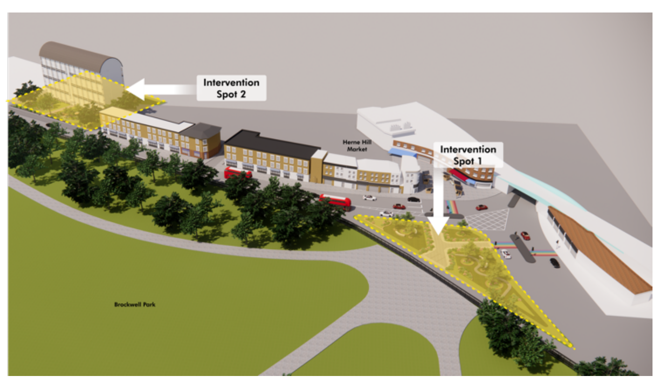

Figure 9. SuDScape (VR): In the VR experience, a council member can navigate the mapped water accumulation areas to identify potential intervention spots.

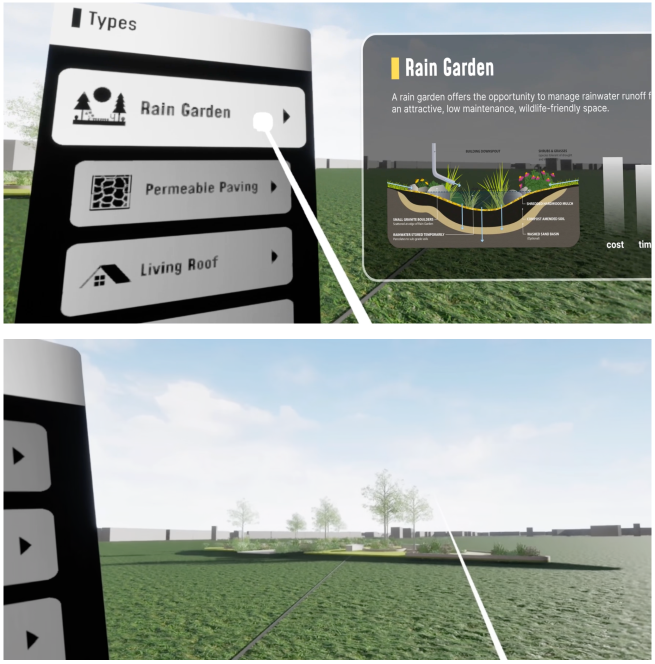

Figure 10. SuDScape (VR): In the VR experience, a council member can experiment with SuDS interventions to assess their impact, review statistics, and prioritize the most effective solutions.

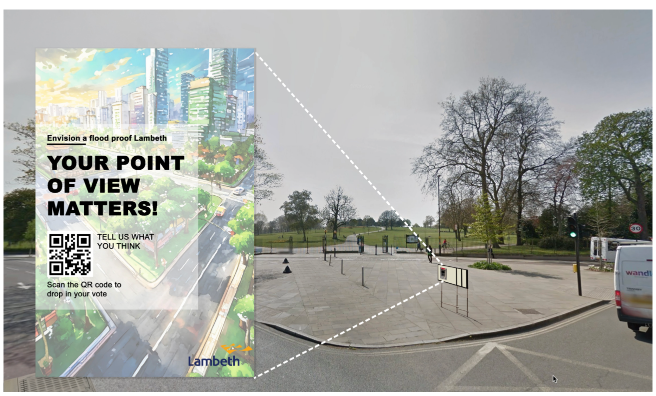

Figure 11. SuDScape (AR): The platform communicates SuDS interventions to everyday citizens using simplified, non-technical language and collects their feedback using an AR interface.

Figure 12. SuDScape (AR): Through the AR interface of a mobile phone, citizens can explore different SuDS intervention options and provide feedback.

Exhibitions & Demo Sessions

All shortlisted design proposals, including *X-River* and *SuDScape*, were showcased in the Grand Challenge Final Exhibition, held in the Hangar exhibition space in the Studio Building from 21 March – 26 March 2024, at the RCA Battersea Campus in London then at the UNESCO Ocean Decade Conference in Barcelona (10–12 April 2024) (Figure 2) [19].

X-River was demonstrated in three sessions during the Electronic Imaging Symposium 2025 in Burlingame/San Francisco: in the demo session, and as part of the two sister conferences Engineering Reality of Virtual Reality (ERVR) and Stereoscopic Displays and Applications (SD&A) by author BS [20]. It received numerous positive comments and feedback from attendees (Figure 13).

Figure 13. Demo Session for the Engineering Reality of Virtual Reality 2025 conference of The XR Stream project "X-River" from Zak Berry and colleagues, explored on a Meta Quest 2 headset by Daniel Sandin. In the background a screenshot of the corresponding Unreal Engine 5 environment.

Discussion & Outlook

The integration of Unreal Engine 5 and XR technologies into the RCA Grand Challenge 2023/24 demonstrated the potential of immersive tools to enhance design education, interdisciplinary collaboration and public engagement. This work builds upon our previous research, where we examined the usefulness of VR technologies in the context of Immersive Design Engineering [21], as well as profited from our Grand Challenge VR Workshop 2022/23 analysis [18].

By embedding emerging technologies within a real-world design challenge focused on climate resilience and ocean-related issues, the XR Stream provided students with not only technical skills but also a deeper understanding of how digital tools can translate complex information into accessible experiences for diverse audiences. Unlike many existing XR applications that focus primarily on simulation or entertainment [22], our approach embeds XR in the early phases of the design process, enabling iteration, reflection and co-creation with non-expert users. This pedagogical application positions students not just as makers of immersive content, but as facilitators of complex systems thinking.

The two featured case studies, X-River and SuDScape, exemplify how XR can be employed to address different dimensions of environmental design: *X-River* utilised VR to train volunteers in riverfly monitoring while also serving as an educational exhibit and public engagement tool. *SuDScape*, on the other hand, illustrated how XR could support urban planners and council stakeholders in visualizing sustainable drainage systems and engage residents through augmented reality. Whereas X-River was focusing on VR, SuDScape was exploring VR as well as AR technologies in the context of the project. Both projects highlight the growing relevance of immersive design in areas traditionally outside the scope of digital interaction such as biodiversity monitoring and climate adaptation infrastructure. Additionally, both projects reflect the value of VR in data visualization and analysis-related contexts [23], where immersive technologies can support analytical reasoning and decision-making. This aligns with the growing field of Immersive Analytics [24], which explores how 3D, interactive environments can support reasoning and decision-making beyond conventional 2D data dashboards.

From an educational perspective, the workshops and technical support offered throughout the XR Stream played a crucial role in enabling students - many of whom were first-time users of Unreal Engine 5 to conceptualize and build functioning immersive experiences. However, reflections from the previous year's Grand Challenge revealed areas for improvement, such as pacing, technical support and group dynamics. In response, the 2023/24 edition introduced earlier workshop sessions, additional technical mentoring and deliberate interdisciplinary team formation. These adjustments significantly improved students' capacity to translate speculative ideas into functioning XR prototypes.

The use of Meta Quest 2 headsets proved to be both accessible and powerful, enabling real-time iteration and effective presentation of immersive content. Integration with Unreal Engine 5 enabled students to create immersive environments with high visual fidelity and complex interactions, such as virtual magnification, dynamic simulations, and responsive user interfaces. This hands-on experience gave students a valuable foundation in using XR not only as a creative tool but as a medium for communicating policy-relevant issues to broader audiences.

Feedback from external stakeholders such as local councils, conservation organizations and conference attendees further validated the relevance of the XR projects beyond academic settings. Their interest in exploring funding opportunities and potential implementation pathways suggests a strong support for continued collaboration between design education and civic or environmental sectors.

Looking ahead, the potential of XR and game engine technologies in design education is substantial. As digital twins, smart city planning and community-driven innovation become more prevalent, XR can serve as a bridge between abstract data and tangible experiences. Future iterations of the XR Stream could explore deeper integration with real-time data, AI-driven simulation and multi-user collaboration, expanding the pedagogical and practical applications of immersive technology.

In conclusion, the XR Stream within the RCA Grand Challenge highlights a growing need and opportunity for immersive technologies in design education. It also demonstrates how these tools can foster cross-sector collaboration, amplify public understanding of complex environmental challenges and contribute to more inclusive, informed and impactful design outcomes.

Abbreviations

- 2D two-dimensional
- 3D three-dimensional
- AR Augmented Reality
- HMD Head-Mounted Display
- MR Mixed Reality
- SuDS Sustainable Drainage Systems
- VR Virtual Reality
- XR Extended Reality (including VR, AR, MR)

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References

[1] "The Grand Challenge 2023/24: Ocean & Cities," RCA Website. Accessed: Apr. 06, 2025. [Online]. Available: https://www.rca.ac.uk/research-innovation/projects/grand-challenge-2023-24-ocean-cities/

[2] B. Sommer *et al.*, "Virtual Reality Workshop at the Grand Challenge 2022–A Review with two Case Studies," in *Electronic Imaging*, San Francisco, USA: Society for Imaging Science and Technology, 2023, pp. 1–7. doi: https://doi.org/10.2352/EI.2023.35.2.SDA-388.

[3] A. Hall, E. Hodson, C. Amaral, P. Anderson, B. Sommer, and C. Ross, "De-anthropocentrising ocean object relations," in *P/References of Design*, Budapest, Hungary: Royal College of Art, 2024.

[4] UNESCO Ocean Decade, "Royal College of Art announces role as UN Ocean Decade Implementing Partner," Ocean Decade. Accessed: Apr. 06, 2025. [Online]. Available: https://oceandecade.org/news/royal-college-of-art-new-decade-implementing-partner/

[5] "Unreal Engine | Features," Unreal Engine. Accessed: Apr. 05, 2025. [Online]. Available: https://www.unrealengine.com/en-US/features

[6] Z. Liang, Y. Xing, K. Guan, Z. Da, J. Fan, and G. Wu, "Design Virtual Reality Simulation System for Epidemic (Covid-19)

Education to Public," in *Proceedings of the 4th International Conference on Control and Computer Vision*, in ICCCV '21. New York, NY, USA: Association for Computing Machinery, Nov. 2021, pp. 147–152. doi: 10.1145/3484274.3484297.

[7] Z. Lin *et al.*, "Towards an immersive virtual studio for design engineering," in *Electronic Imaging*, San Francisco, USA: Society for Imaging Science and Technology, 2023, pp. 1–7. [Online]. Available: https://doi.org/10.2352/EI.2023.35.2.SDA-226

[8] S. Sharma, S. T. Bodempudi, and A. Reehl, "Virtual Reality Instructional (VRI) module for training and patient safety," *Electron. Imaging*, vol. 33, pp. 1–6, 2021.

[9] O. G. McGrath, "Some Considerations for Designing and Supporting XR Experiences in Classroom Settings," in *Proceedings of the 2024 ACM SIGUCCS Annual Conference*, in SIGUCCS '24. New York, NY, USA: Association for Computing Machinery, Mar. 2024, pp. 34–38. doi: 10.1145/3599732.3641321.

[10] S. Chowdhury and M. A. Schnabel, "Laypeople's Collaborative Immersive Virtual Reality Design Discourse in Neighborhood Design," *Front. Robot. AI*, vol. 6, Oct. 2019, doi: 10.3389/frobt.2019.00097.

[11] I. Garcia and J. Verlinden, "Exploring the use of virtual reality in co-reviewing designs," in *Human Factors in Virtual Environments and Game Design*, AHFE Open Acces, 2022. doi: 10.54941/ahfe1002063.

[12] H. El-Jarn and G. Southern, "Can co-creation in extended reality technologies facilitate the design process?," *J. Work-Appl. Manag.*, vol. 12, no. 2, pp. 191–205, Jul. 2020, doi: 10.1108/JWAM-04-2020-0022.

[13] U. Gruenefeld *et al.*, "VRception: Rapid Prototyping of Cross-Reality Systems in Virtual Reality," in *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, in CHI '22. New York, NY, USA: Association for Computing Machinery, Apr. 2022, pp. 1–15. doi: 10.1145/3491102.3501821.

[14] T. Drey, J. Gugenheimer, J. Karlbauer, M. Milo, and E. Rukzio, "VRSketchIn: Exploring the Design Space of Pen and Tablet Interaction for 3D Sketching in Virtual Reality," in *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*, in CHI '20. New York, NY, USA: Association for Computing Machinery, Apr. 2020, pp. 1–14. doi: 10.1145/3313831.3376628.

[15] S. Hubenschmid *et al.*, "ReLive: Bridging In-Situ and Ex-Situ Visual Analytics for Analyzing Mixed Reality User Studies," in *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems*, in CHI '22. New York, NY, USA: Association for Computing Machinery, Apr. 2022, pp. 1–20. doi: 10.1145/3491102.3517550.

[16] Y. Wang, M. Hoggenmüller, G. Zhang, T. T. M. Tran, and M. Tomitsch, "Immersive In-Situ Prototyping: Influence of Real-World Context on Evaluating Future Pedestrian Interfaces in Virtual Reality," in *Extended Abstracts of the CHI Conference on Human Factors in Computing Systems*, in CHI EA '24. New York, NY, USA: Association for Computing Machinery, May 2024, pp. 1–8. doi: 10.1145/3613905.3651071.

[17] I. E. Sutherland, "A head-mounted three dimensional display," in *Proceedings of the December 9-11, 1968, fall joint computer conference, part I*, ACM, 1968, pp. 757–764.

[18] B. Sommer *et al.*, "Virtual Reality Workshop at the Grand Challenge 2022–A Review with two Case Studies," in *Electronic Imaging*, San Francisco, USA: Society for Imaging Science and Technology, 2023, pp. 1–7. doi: https://doi.org/10.2352/EI.2023.35.2.SDA-388.

[19] "Grand Challenge 2023/24: Ocean & Cities Exhibition," RCA Website. Accessed: Apr. 06, 2025. [Online]. Available: https://www.rca.ac.uk/news-and-events/events/grand-challenge-202324-ocean-cities-exhibition/

[20] A. J. Woods, T. Kawai, B. Sommer, and N. S. Holliman, "36th Annual Stereoscopic Displays and Applications Conference–Introduction," in *Electronic Imaging*, Society for Imaging Science and Technology, 2025.

[21] B. Sommer, C. H. Lee, N. Martin, and V. Torrisi, "Immersive Design Engineering," presented at the Electronic Imaging, Jul. 2020. doi: 10.2352/ISSN.2470-1173.2020.2.SDA-265.

[22] M. Billinghurst, A. Clark, and G. Lee, "A Survey of Augmented Reality," *Found Trends Hum-Comput Interact*, vol. 8, no. 2–3, pp. 73–272, Mar. 2015, doi: 10.1561/1100000049.

[23] B. Sommer *et al.*, "3D-stereoscopic immersive analytics projects at Monash University and University of Konstanz," *Electron. Imaging*, vol. 2017, no. 5, pp. 179–187, 2017, doi: 10.2352/ISSN.2470-1173.2017.5.SDA-109.

[24] K. Marriott *et al.*, *Immersive analytics*, vol. 11190. Springer, 2018.

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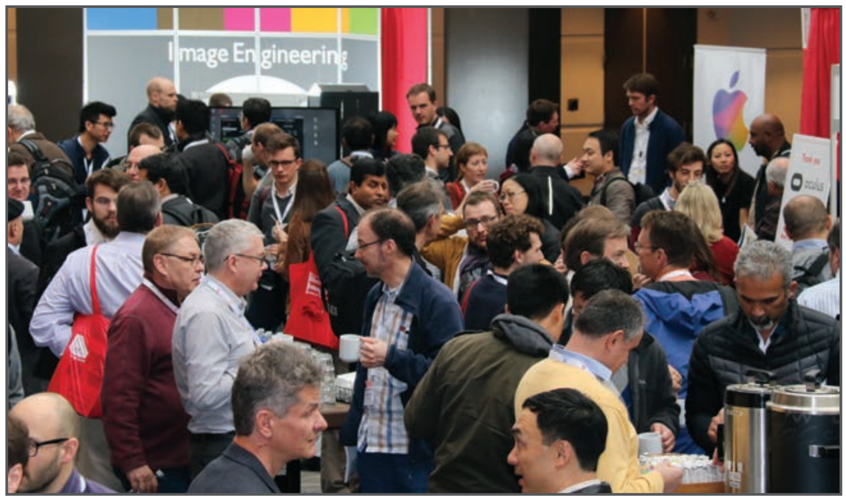

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