

## The Use of Augmented Reality and Photography to Raise Awareness of Environmental Wellness

## استخدام الواقع المعزز والتصوير الضوئي لرفع الوعي بالصحة البيئية

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Lujain Yousif Mirza

<https://orcid.org/0000-0003-2119-0328>

[MirzaLujain@gmail.com](mailto:MirzaLujain@gmail.com) [haalhumaidan@pnu.edu.sa](mailto:haalhumaidan@pnu.edu.sa)

(Assistant Professor) School of Arts & Design, Visual Arts Department / Photography, Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia.

**Haifa Abdulrahman Alhumaidan**

<https://orcid.org/0000-0003-0635-1170>

[haalhemidan@pnu.edu.sa](mailto:haalhemidan@pnu.edu.sa)

(Assistant Professor) School of Arts & Design, Department of Graphic Design & Digital Media, Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia.

**Huda Abdulrahman Alnabhan**

<https://orcid.org/0009-0005-0421-3454>

[haalnabhan@pnu.edu.sa](mailto:haalnabhan@pnu.edu.sa)

(Lecturer) School of Arts & Design, Department of Graphic Design & Digital Media, Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia.

لوجين يوسف مرزا

<https://orcid.org/0000-0003-2119-0328>

[MirzaLujain@gmail.com](mailto:MirzaLujain@gmail.com) [haalhumaidan@pnu.edu.sa](mailto:haalhumaidan@pnu.edu.sa)

(أستاذ مساعد) قسم الفنون البصرية، كلية التصميم والفنون، جامعة الأميرة نورة بنت عبد الرحمن، الرياض، المملكة العربية السعودية.

**هيفاء عبد الرحمن الحميدان**

<https://orcid.org/0000-0003-0635-1170>

[haalhemidan@pnu.edu.sa](mailto:haalhemidan@pnu.edu.sa)

(أستاذ مساعد) قسم التصميم الجرافيكي والوسائط الرقمية، كلية التصميم والفنون، جامعة الأميرة نورة بنت عبد الرحمن، الرياض، المملكة العربية السعودية.

**هدى عبد الرحمن النهبان**

<https://orcid.org/0009-0005-0421-3454>

[haalnabhan@pnu.edu.sa](mailto:haalnabhan@pnu.edu.sa)

(محاضر) قسم التصميم الجرافيكي والوسائط الرقمية، كلية التصميم والفنون، جامعة الأميرة نورة بنت عبد الرحمن، الرياض، المملكة العربية السعودية.

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### Abstract

Plastic pollution and environmental degradation pose growing challenges to environmental and public well-being, yet traditional awareness campaigns often struggle to generate sustained public engagement or behavioral change. This study examines how augmented reality (AR) and photography can be integrated to enhance environmental awareness and encourage pro-environmental attitudes through interactive visual communication. Conducted in Riyadh, Saudi Arabia, the research adopts a descriptive-analytical approach that combines practice-based artistic production with audience engagement analysis. The study was implemented across four phases. First, community-led environmental cleanup activities were documented through photography. Second, a curated selection of these photographs was presented in a public exhibition, where selected images were enhanced using AR to activate short video narratives. Third, public interaction and engagement were evaluated using a structured questionnaire administered to exhibition visitors via QR code. The findings indicate that AR-enhanced photography significantly increased participants' environmental awareness and emotional engagement compared to non-interactive images. A notable increase was also observed in participants' willingness to engage in future environmental initiatives following the exhibition. Qualitative responses further highlighted the role of immersive storytelling in fostering empathy, reflection, and a sense of personal responsibility toward environmental well-being. Based on these findings, the study recommends that designers adopt AR as a storytelling tool in environmental communication, educational institutions integrate interactive visual projects into sustainability-related curricula and policymakers support community-based AR exhibitions as part of public engagement strategies. The study demonstrates that combining creativity, technology and environmental action can offer an effective and resonant model for sustainability communication.

### Keywords

Photography, interactive design, augmented reality, environmental awareness, Saudi Arabia,

### المخلص

يشكل التلوث البلاستيكي وتدهور البيئة تحديات متزايدة أمام البيئة والصحة العامة، إلا أن حملات التوعية التقليدية غالبًا ما تعجز عن تحقيق مشاركة جماهيرية مستدامة أو تغيير سلوكي. تتناول هذه الدراسة كيفية دمج الواقع المعزز والتصوير الفوتوغرافي لتعزيز الوعي البيئي وتشجيع المواقف الإيجابية تجاه البيئة من خلال التواصل البصري التفاعلي. أُجريت البحث في الرياض، المملكة العربية السعودية، واعتمد منهجًا وصفيًا تحليليًا يجمع بين الإنتاج الفني القائم على الممارسة وتحليل تفاعل الجمهور. تُفذت الدراسة على أربع مراحل. أولاً، وُثقت أنشطة التنظيف البيئي التي قادها المجتمع المحلي من خلال التصوير الفوتوغرافي. ثانيًا، عُرضت مجموعة مختارة من هذه الصور في معرض عام، حيث جرى تحسين صور مختارة باستخدام الواقع المعزز لتفعيل مقاطع فيديو قصيرة. ثالثًا، قُيم تفاعل الجمهور ومشاركته باستخدام استبيان مُنظَّم وُزِع على زوار المعرض عبر رمز الاستجابة السريع (QR code). وتشير النتائج إلى أن التصوير الفوتوغرافي المعزز بتقنية الواقع المعزز زاد بشكل ملحوظ من الوعي البيئي لدى المشاركين وتفاعلهم العاطفي مقارنةً بالصور غير التفاعلية. وأظهرت النتائج زيادة ملحوظة في رغبة المشاركين في الانخراط في مبادرات بيئية مستقبلية بعد المعرض. وأكدت الاستجابات النوعية دور السرد القصصي التفاعلي في تعزيز التعاطف والتأمل والشموخ بالمسؤولية الشخصية تجاه سلامة البيئة. وبناءً على هذه النتائج، توصي الدراسة المصممين بتبني الواقع المعزز كأداة سرد قصصي في التواصل البيئي، والمؤسسات التعليمية بدمج المشاريع البصرية التفاعلية في مناهجها الدراسية المتعلقة بالاستدامة، وصناع السياسات بدعم معارض الواقع المعزز المجتمعية كجزء من استراتيجيات المشاركة العامة. وتُبين الدراسة أن الجمع بين الإبداع والتكنولوجيا والعمل البيئي يمكن أن يُقدم نموذجًا فعالاً ومؤثرًا للتواصل بشأن الاستدامة.

### الكلمات المفتاحية

التصوير الضوئي، التصميم التفاعلي، الواقع المعزز، الصحة البيئية، المملكة العربية السعودية.

## Introduction

In recent years, there has been a growing emphasis on the importance of addressing environmental concerns and promoting sustainable practices to improve overall community wellness (Leporelli & Santi, 2019). This includes not only physical aspects like pollution and resource management, but also the psychological and social dimensions of environmental engagement. Researchers have highlighted the need for a transdisciplinary approach that combines urban design, architecture, psychology and environmental science to develop holistic solutions (Clarke et al., 2019). One promising avenue is the use of interactive design and photography to foster public awareness and participation in environmental conservation efforts (Viña, 2010).

The Psychology of Sustainability and Sustainable Development provides a valuable framework for understanding the complex relationships between the built environment, human behaviour, and ecological wellbeing (Leporelli & Santi, 2019). Studies have shown that thoughtful, human-centric design of public spaces can encourage greater community engagement and environmental stewardship (Viña, 2010). Similarly, the use of visual media like photography has been identified as a powerful tool for evoking emotional responses and motivating pro-environmental actions (Viña, 2010). By integrating these elements, this research investigates the potential for interactive design and photography to raise awareness and promote environmental wellness within urban communities.

Despite the growing use of visual media in environmental awareness campaigns, many initiatives continue to rely on passive forms of communication that do not sustain public engagement or effectively motivate behavioural change. Photography has long been used to document environmental issues; however, when presented in static formats, its capacity to generate emotional involvement and long-term impact is often limited. At the same time, augmented reality (AR) has emerged as a promising interactive technology, yet its application in environmental awareness initiatives, particularly when combined with photographic storytelling, remains insufficiently explored.

Within the Saudi Arabian context, there is a lack of empirical research examining how AR enhanced photography can be used as a practical tool to increase environmental awareness, emotional engagement, and willingness to participate in environmental action. This gap highlights the need for a focused investigation into whether integrating augmented reality with photography can enhance public engagement beyond traditional awareness approaches. Accordingly, this study addresses the problem of how immersive and interactive visual technologies can be effectively employed to promote environmental wellness in public and educational settings.

### **Objectives of the Study**

Addressing environmental sustainability requires innovative communication strategies that can effectively translate awareness into meaningful public engagement and behavioural change. While numerous environmental campaigns and educational initiatives exist, conventional communication methods often struggle to effectively capture attention or inspire lasting behavioural change. Visual media, particularly photography, has historically played a significant role in documenting environmental issues, yet its impact can be enhanced through interactive design and emerging technologies.

This study explores how interactive design and photography can serve as powerful tools in raising awareness of environmental wellness. By integrating digital interaction with visual storytelling, this approach can create immersive experiences that deepen public engagement and encourage pro-environmental behaviours. Furthermore, recent technological advancements, particularly in augmented reality, offer novel opportunities to enhance the effectiveness of visual media in environmental education. Examining the intersection of these elements provides valuable insights into how innovative techniques can be leveraged to promote a greater sense of environmental responsibility within communities. In this context, this study seeks to answer a key question: How can interactive design, photography and emerging technologies, such as augmented reality, be integrated to enhance public awareness, community engagement and pro-environmental behaviours? Addressing this question is particularly important as there remains a significant gap in understanding how these



elements can be effectively combined to foster sustainable attitudes and actions. This study aims to bridge this gap by investigating the potential of integrating interactive design and photography to promote environmental awareness and encourage community participation in sustainability efforts. The findings will contribute to both academic research and practical applications, offering valuable insights for environmental educators, policymakers and designers seeking to enhance public engagement through innovative media strategies.

### **Research Questions**

- As explained previously, the following are sub-questions drawn from the key question that this study aims to answer:
- How does integrating interactive design, photography and augmented reality (AR) influence public awareness of environmental wellness?
- To what extent does AR-enhanced photographic storytelling increase emotional engagement and audience interaction compared to non-interactive images?
- Does exposure to interactive visual media increase individuals' willingness to participate in environmental initiatives?

### **The literature review**

#### **The Role of Photography in Environmental Awareness**

Photography has long been a powerful medium for documenting and raising awareness about environmental issues. By visually capturing the impacts of human activity on nature, photography has influenced environmental policies, conservation efforts, and public perception. Over time, it has evolved from a tool of passive documentation to an active force in environmental activism, fostering awareness and encouraging action (Seelig, 2015). The role of photography in environmental activism dates to the late 19th and early 20th centuries when images played a significant role in conservation movements (Haines, 1996). One of the earliest and most influential examples is the work of William Henry Jackson, whose photographs of the Yellowstone region in the 1870s were instrumental in persuading the U.S. Congress to establish Yellowstone as the first national park (Jackson, 1873). His images showcased the pristine beauty of the American wilderness, underscoring the importance of

preserving it for future generations (Schullery, 2003). In a more contemporary context, Spanish photographer Daniel Beltrá has made significant contributions to environmental activism through his compelling aerial photographs. His work focuses on capturing large-scale environmental degradation caused by industrial activities, such as deforestation in the Amazon and the Deepwater Horizon oil spill, exposing the hidden consequences of human actions on the environment (Beltrá, 2013). Beltrá's images aim to raise public awareness and inspire conservation efforts. His commitment to environmental storytelling has earned him global recognition, including awards such as Wildlife Photographer of the Year in 2011 (Beltrá, n.d.).

Similarly, Swiss photographers Mathias Braschler and Monika Fischer have utilized their craft to highlight the human impact of climate change. Their project, "The Human Face of Climate Change," presents portraits of individuals worldwide who have been directly affected by environmental changes (Braschler & Fischer, 2011). By focusing on personal stories, Braschler and Fischer aim to humanize the abstract concept of climate change, making it more relatable and urgent to the public (Braschler & Fischer, 2025). Their work has been exhibited internationally, contributing to the global discourse on environmental responsibility.

These examples demonstrate the enduring power of photography in environmental activism, from its historical roots to its contemporary applications, effectively engaging audiences and advocating for the preservation of our natural world. In modern environmental campaigns, photography remains a crucial tool, with organizations such as Greenpeace and National Geographic utilizing compelling imagery to expose environmental degradation, climate change and biodiversity loss (Guiwanon, 2025). Widely circulated through social media and traditional journalism, these powerful visuals provoke public discourse, raise awareness and often lead to policy changes or grassroots movements advocating for environmental protection (Yale Climate Communication, 2025).

### **Photography as a Tool for Social and Ecological Change**

Beyond its historical significance, photography remains an essential tool for social and ecological change, playing a pivotal role in shaping environmental consciousness.

Visual storytelling could evoke emotions and create a sense of urgency, making environmental issues more relatable to the public (Thawley, 2021). Powerful imagery can shift public perception, challenge dominant narratives and inspire communities to act (Thawley, 2021). One example of photography's transformative power is its role in climate change communication. A study conducted by Yale Climate Communications (2021) highlights how emotionally resonant images can motivate people to engage with environmental causes. The study found that images depicting human interaction with nature, such as communities suffering from pollution or activists working to clean up the environment, resonated more with audiences than abstract data or scientific reports alone (Yale Climate Communication, 2021). This suggests that visual storytelling is an effective strategy in prompting behavioural change and encouraging sustainable practices.

Moreover, photography has been used as a means of reclaiming spaces and advocating for environmental justice, emphasizing that photography can serve as a tool for activism, offering marginalized communities a way to highlight their struggles against environmental injustice (Holm, 2018). By documenting pollution, deforestation and the impact of industrial waste, local activists have successfully drawn global attention to environmental crises that might otherwise go unnoticed.

With the rise of digital platforms and social media, the accessibility and reach of environmental photography have expanded significantly. Platforms like Instagram and Twitter allow activists to disseminate impactful images instantaneously, fostering collective action on a global scale. This shift has empowered individuals and organizations to leverage photography not only as a form of documentation but also as a catalyst for real-world change (Puentes, 2021).

## **Augmented Reality (AR) in Art and Public Education**

### **The Evolution of AR in Art and Public Engagement**

AR has revolutionized the way art is created, experienced and shared with the public. Initially confined to specialized applications, AR has rapidly evolved to become an accessible tool for artists and cultural institutions (Alahari et al., 2023). This technology allows for the seamless integration of digital elements into the

physical world, creating immersive and interactive experiences that blur the lines between reality and virtual content. Artists now use AR to transform public spaces into dynamic canvases, overlaying digital artworks onto buildings, streets and landscapes. Museums and galleries have embraced AR to enhance exhibitions, providing visitors with additional information, interactive elements and virtual reconstructions of historical artifacts (Jung et al., 2020). The democratization of AR technology through smartphones has further expanded its reach, enabling the public to engage with art in unprecedented ways (O'Dwyer et al., 2021). From location-based AR installations to interactive storytelling experiences, this technology has opened new avenues for artistic expression and public engagement, fostering a more participatory and inclusive art ecosystem (Zhang et al., 2024).

### **The Effectiveness of AR in Raising Awareness**

The effectiveness of AR in raising awareness has been a subject of growing interest in recent years. AR technology has shown promise in creating immersive experiences that can enhance user engagement and facilitate deeper understanding of complex subjects, including environmental issues (Marín Rodriguez et al., 2023). Research indicates that AR applications can significantly improve motivation and learning outcomes in educational and exhibition contexts. By providing interactive and engaging content, AR has been utilized to raise awareness and promote conservation efforts in environmental education (Marín Rodriguez et al., 2023). The integration of AR with visual media, such as photography, has been found to create a multi-sensory experience that transcends passive observation, leading to higher retention and emotional resonance with the presented material (Li, 2024). Studies have demonstrated that AR-enhanced media can deepen reflection and acceptance even among informed audiences. In environmental awareness campaigns, AR-integrated exhibitions serve not only as introductory tools for the unaware but also as reinforcement and motivation for those already inclined toward sustainability. This suggests that AR has the potential to impact a wide range of audiences, regardless of their pre-existing knowledge levels. The effectiveness of AR in raising awareness is further supported by its ability to make abstract concepts more tangible and personalized. By allowing



users to interact with digital content overlaid on the physical world, AR creates a participatory learning model where viewers become emotionally involved with the content rather than merely consuming information passively (Algerafi et al., 2023).

Research in environmental psychology emphasizes that emotionally engaging experiences are more likely to lead to lasting behaviour change. The capacity of AR to create such experiences makes it a valuable tool in public-facing environmental campaigns (Soon et al., 2023). Evidence suggests that interactive AR exhibitions do more than inform; they inspire, influence and activate audiences (Kabir and Kang, 2024). However, it is important to note that while AR shows great promise in raising awareness, its effectiveness may vary depending on factors such as the specific implementation, target audience and context of use. Further research is needed to fully understand the long-term impacts of AR-enhanced awareness campaigns and to optimize their design for maximum effectiveness.

### **AR in Environmental and Social Projects**

AR has emerged as a powerful tool for enhancing public engagement and awareness in environmental and social projects. Within the Saudi context, immersive technologies have also been explored as tools for sustainable environmental development. Alshehri (2023), published in Saudi Art and Design Journal, examined the role of virtual reality design in activating sustainable tourism and enhancing environmental awareness, highlighting the potential of digital environments to foster engagement and economic sustainability. The research highlighted how immersive digital environments can support economic sustainability while strengthening cultural and environmental engagement. Although the study focused primarily on virtual reality within tourism contexts, it underscores the broader potential of immersive technologies in activating public interaction with environmental spaces.

The evolution of AR in art and public engagement has been rapid, transforming from specialized applications to an accessible tool for artists and cultural institutions. AR now enables the transformation of public spaces into dynamic canvases, overlaying digital artworks onto buildings, streets and landscapes. Museums and galleries have embraced AR to enhance exhibitions, providing visitors with additional

information, interactive elements and virtual reconstructions of historical artifacts (Cantone et al., 2023; Zhang et al., 2024). Research indicates that AR applications can significantly improve motivation and learning outcomes in educational and exhibition contexts. By providing interactive and engaging content, AR has been utilized to raise awareness and promote conservation efforts in environmental education. The integration of AR with visual media, such as photography, has been found to create a multi-sensory experience that transcends passive observation, leading to higher retention and emotional resonance with the presented material (Crogman et al., 2025; Kiourexidou et al., 2024). Studies have demonstrated that AR-enhanced media can deepen reflection and acceptance even among informed audiences (Jiang et al., 2022; Khalil et al., 2023; Silva & Teixeira, 2022; Zhou & Li, 2024). In environmental awareness campaigns, AR-integrated exhibitions serve not only as introductory tools for the unaware but also as reinforcement and motivation for those already inclined toward sustainability. This suggests that AR has the potential to impact a wide range of audiences, regardless of their pre-existing knowledge levels. The effectiveness of AR in raising awareness is further supported by its ability to make abstract concepts more tangible and personalized. By allowing users to interact with digital content overlaid on the physical world, AR creates a participatory learning model where viewers become emotionally involved with the content rather than merely consuming information passively (Zhang et al., 2024)

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### **Public Participation in Environmental Wellness**

Public involvement plays a key role in environmental conservation by making policies more effective and widely accepted (Dietz & Stern, 2008). According to Reed (2008), when people take part in decision-making, diverse perspectives and



local knowledge are incorporated, leading to more sustainable and context-sensitive solutions. In addition, research demonstrates that public participation improves environmental initiatives and strengthens communities' sense of responsibility toward conservation efforts (Beierle & Cayford, 2002). It also builds trust in environmental policies and encourages the adoption of eco-friendly behaviours (Rowe & Frewer, 2000). Strengthening participatory approaches further enhances community resilience, positioning individuals as active agents of change rather than passive recipients of environmental policies (Webler et al., 1995).

Beyond policy and governance contexts, participation has also been emphasized within contemporary artistic practices as a means of fostering environmental awareness. Research published in the Saudi Art and Design Journal highlights how interactive art, within the framework of sustainable development, transforms a static object into a dynamic participatory experience (Naqqar, 2024). By engaging audiences directly in the artistic process, interactive works strengthen the relationship between artwork, environment and public consciousness, positioning participation as a central component of sustainable artistic practice. Such approaches demonstrate that environmental engagement can extend beyond institutional frameworks into cultural and creative domains.

Therefore, actively involving the public—whether through policy processes or participatory artistic practices—is essential for advancing long-term environmental sustainability and wellness. Despite these benefits, participation processes may face several challenges. The literature emphasizes that effective public participation requires trust, transparency and fair communication mechanisms (Reed, 2008). When these elements are weak or absent, participation initiatives may fail to achieve their intended outcomes and can result in dissatisfaction or reduced engagement.

Financial struggles, lack of time, and limited access to information also prevent many people from getting involved (Beierle & Cayford, 2002). Additionally, some cultural and institutional barriers make community members feel their voices are not valued, leading to disinterest and withdrawal from environmental efforts (Webler et al., 1995). Another challenge is the complexity of environmental issues, which





Providing education and resources allows people to engage more confidently, reducing knowledge gaps and fostering collaboration (Rowe & Frewer, 2000). Additionally, digital tools and social media platforms can be leveraged to expand outreach and make participation more convenient for a broader audience. Encouraging long-term community engagement through voluntary work, training programs and interactive forums can further enhance public commitment to environmental conservation (Dietz & Stern, 2008). By addressing these issues with well-planned strategies, environmental projects can gain long-term public support and be more effective in achieving the needed goals.

Photography has been instrumental in enhancing environmental awareness and promoting social change since the late 19th century. From William Henry Jackson's seminal images of Yellowstone to contemporary works by photographers such as Daniel Beltrá and the duo Mathias Braschler and Monika Fischer, visual storytelling has consistently demonstrated its capacity to evoke emotions, alter public perception and inspire action on environmental issues (Humanitarian Photography, 2015; Spiegel, 2019; Van House, 2011). The advent of digital platforms and social media has further amplified the reach and impact of environmental photography, enabling instant dissemination of powerful images and fostering collective action on a global scale. This democratization of visual media has empowered individuals and organizations to use photography not just as a documentation tool, but as a catalyst for real-world change.

AR has emerged as a promising technology in environmental awareness campaigns, offering immersive and interactive experiences that enhance user engagement and facilitate deeper understanding of complex environmental issues. By integrating AR with visual media like photography, awareness campaigns can create multi-sensory experiences that lead to higher retention and emotional resonance with the presented material. Research indicates that AR-enhanced exhibitions can deepen reflection and acceptance among diverse audiences, regardless of their pre-existing knowledge levels. The technology's ability to make abstract concepts more tangible and personalized creates a participatory learning model that inspires, influences, and

activates audiences.

Public participation remains crucial in environmental conservation efforts. Engaging communities in decision-making processes leads to more effective and widely accepted policies, while also fostering long-term commitment to environmental initiatives. However, challenges such as a lack of trust, financial constraints and complexity of environmental issues can hinder public involvement. To overcome these barriers and increase public participation, it is essential to implement diverse engagement strategies, provide clear communication, offer education and resources, and leverage digital tools. By addressing these challenges and creating accessible, meaningful ways for people to engage, we can foster a more collaborative and sustainable approach to environmental conservation. As we move forward, the integration of powerful visual storytelling techniques, innovative technologies like AR and inclusive public participation strategies will be key to raising awareness, inspiring action and ultimately addressing the pressing environmental challenges of our time.

### **Methodology**

This study adopts a descriptive-analytical research approach, combining elements of case study methodology and observational evaluation to examine how interactive photography and augmented reality (AR) can be used to raise public awareness of environmental wellness. The research design integrates practice-based artistic production with audience engagement analysis, allowing the study to document the development of a real-world environmental initiative while evaluating public interaction, perception and behavioural intention. Quantitative and qualitative data were collected through an exhibition-based questionnaire and observational notes, providing insight into participants' experiences and responses to the interactive content.

### **Research Design**

The study follows a multi-phase research design consisting of four interconnected stages. These phases include documenting community-led environmental cleanup activities, presenting the outcomes through an interactive AR-enhanced photography



exhibition, evaluating public interaction and engagement and analysing the resulting data. This phased structure allowed the research to combine artistic documentation with empirical assessment, offering both contextual depth and evaluative insight into the effectiveness of interactive visual communication.

### **Research Tools and Instruments**

The primary research tools used in this study included documentary photography, augmented reality (AR) media and a structured questionnaire administered to exhibition visitors. Photography functioned both as a creative output and as a research instrument for visual documentation of environmental action and public participation. AR technology was employed to enhance interactivity by embedding short video narratives within selected photographs. The questionnaire served as the main data collection instrument for measuring environmental awareness, audience engagement and behavioural intention.

### **Research Procedures**

The research procedures were implemented sequentially across three phases.

#### **Phase One: Documenting Environmental Cleanup**

The first phase of this project focused on documenting a series of community-led cleanup campaigns on the outskirts of Riyadh, Saudi Arabia. These desert areas, commonly visited for camping and quad biking, often accumulate significant waste due to heavy foot traffic and limited public services.



Figure 2: Volunteers participating in community cleanup on the outskirts of Riyadh. Photograph by the author (2023).

Initiated in 2021 by three residents, Dr. Lujain Mirza, Fernando Pérez Fraile and Pierre Cacha. The Big Clean-Up began as a personal effort to address the growing issue of litter in natural spaces. Grounded in environmental ethics and civic responsibility, the campaign aimed not only to restore the beauty of these landscapes but also to raise public awareness about environmental stewardship (Beierle & Cayford, 2002). Events were held once or twice a month during the cooler season (November to April) and open to all members of the community, including families and youth. Volunteers were provided with gloves, biodegradable bags, reflective vests and water refill stations. Recruitment took place through Instagram and WhatsApp, drawing a steadily growing audience and reinforcing the role of social media in environmental activism (Puentes, 2021).

As a leading photographer and researcher, the author visually documented each event, capturing the scale of waste, the engagement of participants and the transformation of the site. These images later formed the foundation for the interactive exhibition phase. Occasionally assisting with clean-ups, focusing primarily on storytelling through photography, which has been recognized as a powerful medium



for environmental communication and action (Yale Climate Communication, 2025). Waste collected was sorted on-site into general and recyclable categories. General waste was reported through Riyadh Municipality's "MyCity" app, ensuring timely collection. Recyclable plastics were delivered directly to local recycling centres, aligning with Saudi Arabia's sustainability goals and circular economy strategies (Reed, 2008).

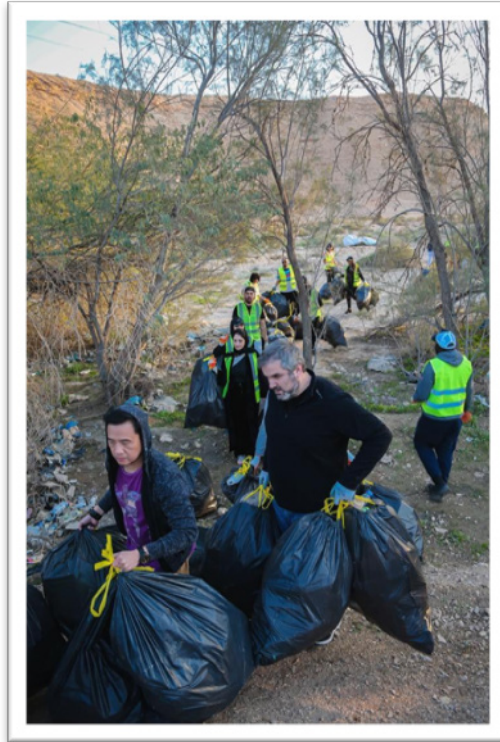


Figure 3: Volunteers participating in community cleanup on the outskirts of Riyadh, Photograph by the author (2024), Red Sands, Riyadh, KSA.

By April 2025, over 37 events had taken place, involving more than 960 volunteers and removing approximately 4,700 kilograms of waste. The campaign demonstrated that simple, inclusive and consistent action can foster meaningful community participation in environmental wellness.

Phase Two: Interactive Photography Exhibition with AR

The second phase involved organizing a one-week interactive photography exhibition held at an on-campus gallery at Princess Nourah bint Abdulrahman University. The exhibition aimed to engage both the university community and the public through visual storytelling. A creative selection of photographs documenting the cleanup initiatives was displayed, ten of which were enhanced with AR elements.

Visitors used their mobile devices to scan AR-enabled photographs, triggering short video interviews with individuals featured in the images. These videos addressed topics such as littering, recycling, and motivations for environmental volunteering, transforming static photographs into dynamic narratives and fostering deeper audience engagement.

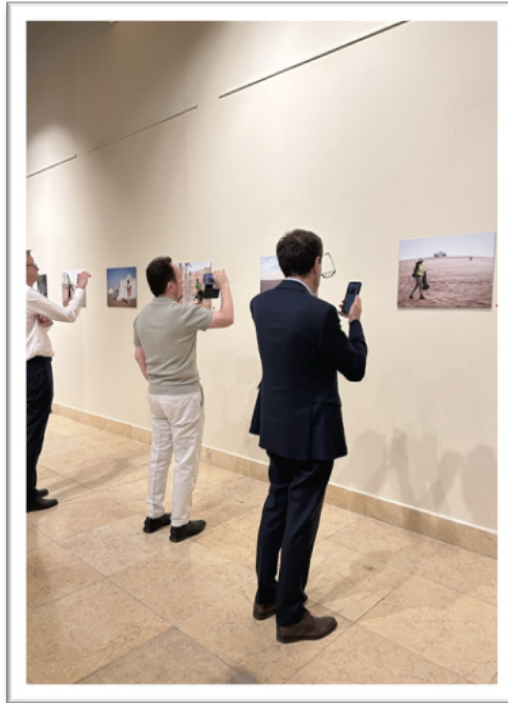


Figure 4: Interactive photography exhibition using augmented reality.  
Photograph by the author (2024), Princess Nourah University, Riyadh, KSA.



### **Phase Three: Evaluating Public Interaction and Engagement**

To evaluate the exhibition's impact, a structured questionnaire was administered to visitors via a QR code placed at the exhibition exit, resulting in 62 completed responses. The questionnaire included a combination of closed-ended Likert-scale questions and open-ended questions. Likert-scale items measured participants' levels of environmental awareness, engagement with interactive and non-interactive photographs and willingness to participate in future environmental initiatives. Open-ended questions invited participants to share reflections on their experience, emotional responses, and suggestions for improvement.

In addition to survey data, observational notes were recorded during the exhibition to capture patterns of interaction, time spent engaging with AR content and instances of social dialogue among visitors. The sample size of 62 participants was considered appropriate for the exploratory and practice-based nature of this study. Rather than aiming for statistical generalization, the research sought to evaluate audience engagement, perception and behavioural intention within a real-world exhibition context. Similar to qualitative and mixed-methods studies in exhibition and interactive media research, the emphasis was placed on depth of response, experiential feedback and interpretive insight rather than representativeness.

The study is therefore positioned as descriptive and evaluative, focusing on how participants interacted with AR-enhanced photographic content and how their awareness and attitudes were influenced by the experience. The findings provide context-specific insights into the effectiveness of interactive visual communication, while acknowledging that broader generalization would require larger and more diverse samples in future research.

#### **Validity and Reliability of the Questionnaire**

The questionnaire was created to align with the research goals and with existing literature on environmental awareness and public involvement. To ensure the questions made sense and fit the study, professors at Princess Nourah bint Abdulrahman University, who are experts in visual arts and research methods, reviewed them. They provided feedback on how clear and relevant the questions were and how well they

aligned with the study's goals. Small changes were made based on their suggestions before the questionnaire was distributed. Because the study was mainly about exploring and describing, we made sure it was reliable by carefully writing the questions and using the same process to give out the questionnaire during the exhibition.

### **Data Analysis**

Quantitative data from the questionnaire were analysed using descriptive statistical methods to identify trends in awareness, engagement and behavioural intention. Qualitative data from open-ended responses and observational notes were analysed thematically to identify recurring patterns related to emotional engagement, perception and motivation. The integration of quantitative and qualitative analysis enabled a comprehensive evaluation of the exhibition's impact.

### **Findings and discussion**

#### **Observations from Public Response**

Throughout the exhibition, it was evident that visitors were particularly drawn to the interactive, AR-enhanced photographs. Many spent noticeably more time engaging with these images, scanning them to trigger embedded videos in which volunteers shared their personal reflections. This interactive layer appeared to foster curiosity, empathy and deeper emotional engagement. Visitors were often observed discussing the content with others, suggesting that the exhibition encouraged not only personal reflection but also social dialogue.

In total, 36 participants left written comments. These remarks described the exhibition as "inspiring," "eye-opening," and "deeply moving". Several visitors expressed a desire to see the exhibition presented in public venues or expanded to include additional stories, particularly of groups actively working on environmental initiatives. Such suggestions highlight the potential for broader community outreach through mobile or city-based versions of the exhibition.

### **Questionnaire results**

The survey results revealed a high baseline of environmental awareness among respondents: 93.5% reported that they already had a strong understanding of environmental protection prior to attending. Despite this, the exhibition succeeded in

making a measurable impact. The results showed that 75.8% of the participants are Strongly Agree; 21% are Agree that the exhibition further increased their awareness, with only 3.2% remains Neutral.

### **Interactive photography was identified as a particularly powerful tool:**

An overwhelming 96.7% of respondents acknowledged that interactive photography enhanced their awareness, with the majority (69.3%) reporting a strong impact and an additional 27.4% expressing general agreement. In comparison, non-interactive photographs were also seen as effective, but to a lesser degree where 51.6% are Strongly Agreed they had an impact and 37.1% are Agree. When asked to directly compare the two formats, 71% of respondents stated that interactive photography was more impactful.

Responses also shed light on participants' environmental engagement. Prior to the exhibition, only 27.4% were Strongly Agree that they were already active in environmental campaigns, while 29% were Neutral and 29% were either Disagree or Strongly Disagree. However, following the exhibition, there was a significant shift in intent: 43.5% are Strongly Agree, and 40.3% are Agree that they are now willing to participate in future environmental campaigns.

The findings from this phase demonstrate that interactive, AR-integrated photography can play a significant role in not only increasing environmental awareness but also in shifting attitudes toward action. Even among an audience with high pre-existing awareness, the exhibition provided a deeper understanding and motivation for involvement. This reinforces the idea that immersive, emotionally resonant media formats are effective tools for public engagement in sustainability initiatives.

**Table 1. Participants' Environmental Awareness and Engagement Before and After the Exhibition**

Measure	Before the Exhibition (%)	After the Exhibition (%)
High environmental awareness	93.5	96.8
Willingness to participate in environmental campaigns	27.4	83.8

Measure	Before the Exhibition (%)	After the Exhibition (%)
Perceived impact of interactive photography	—	96.7

As shown in Table 1, participants reported a clear increase in both environmental awareness and willingness to participate in environmental initiatives following their engagement with the interactive exhibition.

### Public Awareness and Engagement Outcomes

#### Assessing Public Awareness Before and After Viewing the Exhibition:

The data collected in Phase Three revealed that 93.5% of participants had already reported a strong environmental awareness before attending the exhibition. However, 75.8% are Strongly Agree. In addition to that, 21% are Agree that the exhibition further increased their awareness. This suggests that interactive, visual storytelling can reinforce and deepen pre-existing knowledge. This indicates not merely an increase in awareness but a qualitative enhancement in how environmental issues are understood and emotionally processed.

This finding supports existing literature asserting that immersive media, especially those integrating narrative and interactivity, can lead to higher retention and emotional resonance (Yilmaz & Goktas, 2017). In this case, the exhibition provided not just information but a compelling visual experience that allowed viewers to connect emotionally with the environmental volunteers' stories. According to Leporelli and Santi (2019), visual and interactive environments can contribute to sustainability by creating spaces for empathy and reflection, leading to more meaningful engagement with complex ecological issues. Furthermore, this result reflects a significant educational implication: AR-enhanced media can deepen reflection and acceptance even among informed audiences. Such exhibitions serve as introductory tools for the unaware and as reinforcement and motivation for those already inclined toward sustainability.

### Measuring Engagement Levels with Interactive Content

The data demonstrate a higher engagement level with the AR-integrated photographs when comparing interactive and non-interactive formats. A total of 96.7% of participants

reported that interactive photography increased their awareness, with 69.3% indicating a substantial impact. In contrast, while non-interactive photography was still appreciated (with 88.7% agreeing or strongly agreeing to its impact), it lacked the same emotional and cognitive engagement level.

This aligns with findings by Blatterste et al. (2021), who demonstrated that augmented reality (AR) applications enhance user motivation and learning by transforming abstract concepts into tangible and personalized experiences (Blatterste et al, 2021). In this exhibition, the ability to listen to real stories while viewing images provided participants with a multi-sensory experience that transcended passive observation. This interactive format promotes a participatory learning model, where viewers are not merely information consumers but become emotionally involved in the content (Holm, 2018).

Notably, 83.8% of participants expressed willingness to participate in environmental campaigns after the exhibition, a significant increase compared to pre-exhibition activity levels. This shift suggests that engagement with interactive content can promote awareness and behavioural intention. Research in environmental psychology emphasizes that emotionally engaging experiences are more likely to lead to lasting behaviour change (Dietz & Stern, 2008).

The use of Augmented Reality (AR) in educational and exhibition contexts has been shown to enhance user engagement and learning outcomes. Research indicates that AR can create immersive experiences that improve motivation and enable deeper understanding of complex subjects (Yılmaz, Küçük, & Göktaş, 2017). In the context of environmental education, AR has been effectively used to raise awareness and promote conservation efforts by providing interactive and engaging content (Ladykova et al., 2024; Lee et al., 2024). The findings of this study contribute to this growing field by demonstrating how combining interactive design with photography can elevate public awareness and strengthen behavioural intentions toward environmental wellness.

### **Comparison with Previous Studies**

The findings of this study are consistent with previous research on the use of augmented reality and interactive media in environmental and educational contexts.

Similar to the results reported by Blattgerste et al. (2021), participants in this study demonstrated higher engagement and motivation when interacting with AR-enhanced content compared to static visual formats. Likewise, Leporelli and Santi (2019) emphasize that emotionally engaging and immersive environments contribute to deeper reflection and pro-environmental attitudes, which aligns with the observed increase in participants' awareness and willingness to engage after the exhibition.

However, while prior studies such as Lee et al. (2024) focused primarily on AR applications in formal educational or museum settings, the present study extends this work by demonstrating the effectiveness of interactive photography in a community-oriented and practice-based exhibition context. This suggests that AR-enhanced visual storytelling can be impactful not only in institutional learning environments but also in public-facing, socially driven initiatives, particularly within the Saudi cultural context. The before and after comparison presented in Table1, further supports the effectiveness of AR integrated photography in enhancing environmental awareness and behavioural intention, reinforcing conclusions drawn in previous studies on immersive media and sustainability communication.

### **The Effectiveness of Interactive Design and Photography in Raising Environmental Awareness**

The results revealed that interactive photography, when supported by AR, is a highly effective medium for environmental communication. Survey data indicated that 96.7% of participants felt their environmental awareness increased through interaction with AR-enhanced photographs, compared to 51.6% for non-interactive images. This difference highlights the unique strength of interactive visual storytelling in bridging cognitive and emotional understanding.

Unlike traditional awareness campaigns that rely on textual or statistical data, interactive photography transforms environmental information into an experiential encounter. It allows audiences to "feel" rather than merely "learn". This aligns with Leporelli and Santi's (2019) concept of the psychology of sustainability, which emphasizes emotional and sensory engagement as essential components of fostering sustainable mindsets. In this study, photographs documenting real cleanup efforts,



combined with participants' recorded reflections, created a sense of authenticity and immediacy that static imagery alone could not achieve. The exhibition also demonstrated that creative communication tools can transform environmental education into a form of participatory art. By merging aesthetics, emotion, and interactivity, the project offered a multidimensional learning experience that appealed to both intellect and empathy, reinforcing the idea that art-based engagement can effectively drive social and ecological change (Holm, 2018; Puentes, 2021).

### **The Role of AR in Enhancing Public Engagement:**

AR served as the technological bridge between art and audience, enabling deeper and more sustained engagement. Visitors spent noticeably more time interacting with AR-enabled works, scanning, discussing and revisiting the same images. This aligns with the findings of Lee, Pan, and Chen (2024), who demonstrated that augmented reality in exhibition contexts promotes participatory viewing and deeper visitor engagement through interactive visual experiences (Ladkova et al., 2024; Lee et al., 2024). The integration of short videos and sound created a multi-sensory dialogue that transformed passive observation into active participation. This finding supports Blattgerste et al. (2021), who emphasized that AR promotes learning and motivation by making abstract concepts more tangible and personalized. Similarly, experiential reviews have shown that AR-integrated learning tools enhance engagement and motivation by combining visual, audio and experiential elements (Ibáñez & Delgado-Kloos, 2018; Garzón, Pavón, & Baldiris, 2019). In this exhibition, AR transformed photographs into "living narratives," amplifying empathy and curiosity. Furthermore, 83.8% of participants reported willingness to participate in future environmental initiatives after attending the exhibition, a strong indication that interactive engagement can influence behavioural intention.

From a broader perspective, these findings indicate that AR can inspire a deeper sense of environmental citizenship, encouraging individuals to see themselves as part of the environment rather than apart from it, fostering empathy, shared responsibility, and meaningful action. This is particularly relevant in Saudi Arabia's ongoing cultural and environmental transformation, aligning with Vision 2030's goals that emphasize

innovation, cultural participation, and sustainability (Reed, 2008; Dietz & Stern, 2008).

### **Psychological and Emotional Responses to the Exhibition**

The emotional dimension of the exhibition was among its most significant outcomes. Visitors frequently described the experience as “moving”, “eye-opening” and “motivating”. Such responses reflect the exhibition’s capacity to evoke empathy and reflection, emotional processes shown to be critical in motivating sustainable behaviour (Leporelli & Santi, 2019).

The integration of real voices and faces through AR personalization created a sense of shared responsibility and connection. Instead of theoretical warnings about pollution, viewers encountered relatable human stories, individuals who cared for their environment. This emotional engagement encouraged visitors to reconsider their daily habits, illustrating how interactive storytelling can bridge the gap between awareness and personal accountability.

From a psychological perspective, these results reinforce the importance of emotionally important encounters in strengthening retention and motivation. They support the argument that sustainability education must extend beyond factual instruction to include empathy driven experiences that engage both heart and mind. The project, therefore, not only raised awareness but also humanized the concept of environmental wellness, reinforcing arguments by Leporelli and Santi (2019) and Holm (2018) on the role of visual arts in sustainable learning.

While the outcomes of this study are promising, several limitations should be acknowledged. The study’s audience primarily consisted of university students, academic staff and individuals who had previously participated in community cleanup initiatives. As many participants demonstrated moderate to high levels of pre-existing environmental awareness, this introduces a potential sampling bias, which may limit the external validity and generalizability of the findings. Specifically, the results may not be fully representative of populations with lower environmental awareness or limited prior engagement in sustainability initiatives. While the exhibition proved effective in deepening awareness and motivation among an already informed audience,



its impact on broader or less environmentally engaged publics requires further investigation.

Future research could strengthen external validity by presenting similar AR-integrated exhibitions in a wider range of public settings, such as shopping malls, parks, or community centers and by engaging audiences with more diverse socio-cultural backgrounds and varying levels of environmental literacy. Additionally, the survey captured short-term feedback collected immediately after the exhibition, leaving the long-term behavioural impact unmeasured. Longitudinal studies are therefore recommended to assess whether the increased awareness observed translates into sustained pro-environmental behaviours over time. Another limitation relates to the production of AR content, which requires interdisciplinary collaboration and access to specialized digital tools. These requirements may pose challenges for replication or large-scale implementation without institutional or organizational support. Despite these constraints, the study demonstrates that low-cost AR technologies and widely accessible mobile devices can still achieve meaningful educational and emotional impact. The findings offer valuable implications for educators, curators, and environmental organizations, illustrating how the integration of photography and interactive design can function as an effective communication model for public engagement, environmental education, and creative sustainability initiatives.

**This study is defined by several spatial, temporal and contextual limits that frame its scope and findings**

The research was conducted in Riyadh, Saudi Arabia. Data collection took place during community-led environmental cleanup activities on the outskirts of the city and during an interactive photography exhibition held at Princess Nourah bint Abdulrahman University. Accordingly, the findings reflect environmental engagement within an urban Saudi context and may not be directly generalizable to rural settings or different cultural environments. The environmental documentation activities were conducted between 2021 and 2024 as part of an ongoing community initiative. However, the empirical component of this exploratory study, including the interactive exhibition and post-exhibition data collection, was implemented over a defined one-

week period in 2024. As such, the findings capture short-term changes in awareness and engagement rather than long-term behavioural outcomes.

The study focused on exhibition visitors and participants, including university students, academic staff, and individuals with prior interest in environmental or community activities. Consequently, the results primarily reflect the perspectives of audiences with moderate to high initial environmental awareness and may differ when applied to populations with limited prior exposure to environmental initiatives. These defined limits clarify the scope of the study and provide appropriate context for interpreting the findings.

### **Visual Documentation of the Project**

The visual documentation captures the evolution of community-led cleanup efforts and the exhibition's interactive impact. Photographs taken throughout the project illustrate both environmental transformation and social collaboration. They depict volunteers removing waste, restoring natural spaces and fostering a visible sense of environmental responsibility. Ten of these photographs were later integrated into the AR exhibition, representing diverse moments of participation and reflection. When scanned, the images revealed embedded video reflections of volunteers discussing their motivations and values, transforming static visuals into personal narratives. This interactive element allowed audiences to engage with environmental stories dynamically, encouraging empathy and reflection rather than passive observation.



Figure 5: A visitor engaging with AR-activated photographs during the exhibition.

Photograph by the author (2024), PNU, Riyadh, KSA.

Together, the photographs and accompanying AR content document the project's process and implementation, complementing the survey data by providing observational evidence of audience interaction and participation. This visual record supports the study's methodological transparency and illustrates how interactive photography can be applied in practice within environmental awareness initiatives.



Figure 6: The exhibition space as a site of dialogue. Viewers engaging with AR-integrated photographs exploring environmental wellness. Photograph by the author (2024), PNU, Riyadh, KSA.

## Conclusions

This study demonstrates that the integration of interactive design, photography and AR can significantly enhance public awareness and engagement in environmental well-being. The incorporation of augmented reality into the exhibition transformed environmental themes into interactive experiences that promoted empathy and reflection. Quantitative findings revealed substantial improvements in awareness and willingness to engage, while qualitative responses highlighted the emotional impact and a deeper personal connection to environmental issues. The results suggest that interactive visual storytelling is an effective strategy for sustainability communication. Governments, educators and non-governmental organizations can adopt similar approaches to improve environmental literacy and foster community involvement. In the Saudi context, these activities align with Kingdom Vision 2030, which emphasizes cultural innovation, community engagement and environmental sustainability. This approach combines aesthetics with technology, redefining environmental education



as an emotionally engaging and socially relevant experience. Future research should expand the sample to include a more diverse range of participants and contexts and implement ongoing assessments to evaluate whether the exhibition's impact results in sustained behavioural changes, such as continued volunteering, recycling or support for environmental causes. Comparing the content of AR-enhanced and traditional exhibitions can provide valuable insights into the influence of interactive technologies on cognitive knowledge and emotional involvement in environmental education. Furthermore, fostering multidisciplinary collaboration among artists, designers, environmental scientists and psychologists is essential for advancing the understanding of how interactive design can effectively promote sustainable attitudes and behaviours. This research illustrates that creativity, when combined with sustainability, can shape collective awareness. Through this exhibition, artists conveyed environmental well-being not only through information but also through emotion, participation and shared experience. The study affirms that art does not merely reflect reality; it actively transforms it.

### **Recommendations**

Based on the findings of this study, several practical recommendations can be proposed for designers, educational institutions and policymakers seeking to enhance environmental awareness through interactive visual media.

For designers and visual practitioners, the study highlights the importance of integrating interactive technologies, such as augmented reality, into photographic and exhibition design. Designers are encouraged to move beyond purely aesthetic presentation and adopt storytelling-driven, participatory approaches that combine visual documentation with personal narratives. Using AR tools and

mobile-compatible platforms can make interactive environmental projects more accessible and scalable, particularly in public and community-based settings.

For educational institutions, interactive photography exhibitions can serve as effective tools for experiential learning and sustainability education. Universities and schools are encouraged to incorporate AR-enhanced visual projects into art, design and environmental studies curricula to foster emotional engagement and critical

reflection. Collaborative projects involving students, educators and local communities can further strengthen environmental awareness while promoting interdisciplinary learning between art, technology and social responsibility.

For policymakers and cultural decision-makers, the findings suggest that interactive visual communication can play a meaningful role in public engagement strategies related to environmental sustainability. Supporting community-based exhibitions, public installations and mobile AR experiences in non-traditional venues such as parks, cultural centers and public spaces can help reach broader audiences. Policy support in the form of funding, partnerships and access to public spaces can enable the wider adoption of creative, technology-driven approaches aligned with national sustainability and cultural development goals.

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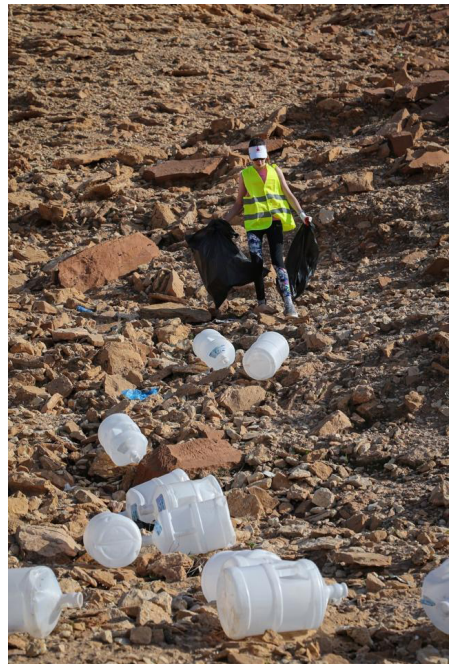
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## Appendix A – Photographic Documentation of Cleanups







## Appendix B – Exhibition Documentation

