



Digital Mosaic for Environmental Awareness: Integrating Sustainability into Visual Art

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Abstract. The convergence of digital art and environmental advocacy presents unique opportunities for raising awareness and promoting sustainability. This paper explores the use of digital mosaics to convey complex ecological issues and integrate sustainable practices. Digital mosaics, composed of numerous smaller images, offer a powerful metaphor for interconnected ecosystems, illustrating how individual actions contribute to global environmental change. Through case studies such as the Ocean Mosaic and Biodiversity Mosaic, this study demonstrates how digital mosaics highlight issues like marine pollution, biodiversity loss, and climate change. By using energy-efficient digital tools, these artworks reduce the environmental footprint of their production. Digital mosaics serve as educational tools and catalysts for collective environmental action by engaging global audiences through interactive platforms. The study concludes that digital mosaics represent a sustainable approach to environmental art, contributing to the Sustainable Development Goals (SDGs) by inspiring awareness and action.

Keywords: Digital Mosaics, Environmental Awareness, Sustainable Art Practices, Digital Art, Ecological Activism.

1 Introduction

As environmental challenges, such as climate change, deforestation, and pollution, have intensified, the imperative for sustainable solutions across all sectors, including the arts, has become increasingly urgent. Digital art, especially digital mosaics, presents an innovative approach to addressing these issues. Unlike traditional art forms, which often require resource-intensive materials like canvases and paints, digital mosaics rely on digital tools that reduce the environmental footprint significantly. This study explores how digital mosaics, by portraying interconnected ecosystems and environmental issues, can both raise awareness and promote action towards achieving the Sustainable Development Goals (SDGs). Digital mosaics offer a compelling visual metaphor for global environmental change, emphasizing how individual actions contribute to broader sustainability efforts. Artists are investigating methods to mitigate the environ-

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mental impact of their work, while simultaneously utilizing their craft to raise awareness of ecological issues. In this context, digital mosaics have garnered recognition as an innovative medium, offering a sustainable approach to artistic creation [1]. Through the assemblage of numerous smaller digital images into a cohesive whole, digital mosaics convey complex visual narratives and reduce the ecological footprint traditionally associated with art production [2].

The environmental benefits of digital art are thus substantial. In contrast to traditional media that necessitate physical materials, such as canvases, paints, and solvents, digital mosaics employ technology to create compelling artworks without the resource-intensive processes involved in material sourcing and production. Research has demonstrated that digital tools can effectively reduce waste and energy consumption, aligning artistic practices with global sustainability goals, including Sustainable Development Goals (SDGs) [3].

In addition to sustainable production, digital mosaics possess the advantage of accessibility. The digitization of art facilitates widespread distribution through online platforms, rendering environmental art more readily available to a global audience. This visibility plays a crucial role in educating the public about ecological issues and fostering environmental consciousness, particularly among the digitally engaged younger generations [4]. The capacity of digital mosaics to visually represent the interconnectedness of ecosystems is significant, as it emphasizes how seemingly minor individual actions can contribute to broader environmental change.

This study examines the role of digital mosaics in promoting environmental awareness and integrating sustainable practices into the art-making process. It elucidates the artistic significance of digital mosaics and their potential to contribute to global sustainability efforts.

2 Literature Review

The relationship between art and environmental activism is long established, with visual art often serving as a medium for communicating ecological concerns. The advent of digital technologies has expanded the potential of art to raise environmental awareness, particularly through digital mosaics. These innovative art forms allow artists to engage global audiences while integrating sustainability into their methods of production [5].

2.1 Digital Art and Environmental Awareness

Research shows that digital art, when distributed via online platforms, effectively reaches diverse audiences and fosters engagement with environmental issues. Digital artworks can transcend geographical boundaries and present complex ecological challenges in a visually compelling manner, thereby enhancing public awareness [6]. Roth (2021) highlight the role of visual storytelling in encouraging pro-environmental be-

haviors. Through the use of engaging visual metaphors, such as digital mosaics representing the interconnectedness of ecosystems, artists can influence viewers to consider the broader environmental impacts of their actions [7].

2.2 Sustainable Practices in Visual Art

As the need for sustainability grows, artists are shifting from resource-intensive practices to digital tools that significantly reduce waste and energy consumption. Digital mosaics, in particular, offer an eco-friendly alternative to traditional art forms by eliminating the need for physical materials such as paint and canvas. Digital exhibitions further reduce the environmental footprint, as artworks can be displayed virtually, cutting down on transportation and gallery-related energy consumption.

2.3 Digital Mosaics as a Medium for Environmental Discourse

Digital mosaics are particularly effective in illustrating the interconnectedness of ecological systems. Each tile within a mosaic can symbolize different aspects of nature, such as water, air, plants, or animals, offering a powerful visual metaphor for environmental complexity [8, 9]. Online mosaic projects have also fostered community involvement, encouraging individuals to contribute to collective environmental actions. Such projects demonstrate how digital mosaics can raise awareness while promoting participation in global sustainability initiatives.

2.4 Challenges and Opportunities

Despite the benefits of digital art, there are challenges. Energy consumption associated with digital platforms, particularly high-resolution artworks and interactive technologies, is a growing concern. Emerging solutions, such as energy-efficient data centers and renewable energy-powered platforms, may mitigate these issues [10–12]. Ensuring equitable access to digital technologies remains another challenge, particularly in regions with limited infrastructure.

3 Methodology

3.1 Conceptual Design and Theme Development

The creation of the digital mosaic began with the conceptualization of a theme centered on environmental sustainability. Key environmental issues such as climate change, deforestation, ocean pollution, and biodiversity loss were selected based on their relevance to global ecological concerns. The mosaic design emphasized the interconnectedness of ecosystems, with each sub-image representing elements like water, air, soil, plants, and animals. Consultations with environmental experts ensured the accuracy of the ecological themes represented in the artwork [2].

3.2 Technical Tools and Digital Processes

For the technical execution, Adobe Photoshop and Mosaic Creator were chosen for their efficiency in assembling complex compositions while minimizing energy consumption [13, 14]. Images were sourced from royalty-free libraries such as Unsplash and Pixabay, ensuring that no new photography was required, thus reducing energy consumption related to content creation.

The assembly of the digital mosaic involved arranging thousands of small images into a cohesive composition. Using Mosaic Creator software, tiles were placed based on color and thematic relevance. The entire process was completed virtually, eliminating the waste typically associated with physical art materials [15].

3.3 Sustainability Integration

Sustainable practices were integrated into the production process by eliminating the need for physical materials and utilizing energy-efficient digital tools. Computers powered by renewable energy sources and eco-friendly servers further minimized the environmental footprint. Carbon-offsetting measures were adopted by supporting reforestation projects and renewable energy initiatives [8, 16, 17].

4 Case Studies

The use of digital mosaics as a medium for promoting environmental awareness and integrating sustainable practices has been gaining traction in recent years. This section presents several case studies and examples of how digital mosaics have been effectively used to communicate ecological issues, engage global audiences, and promote sustainability.

4.1 The Ocean Mosaic – Raising Awareness of Marine Pollution

The Ocean Mosaic effectively demonstrates the devastating impact of marine pollution by integrating thousands of images of plastic debris into a cohesive visual representation of an ocean.



Fig. 1. Digital Mosaic Representing Marine Pollution

At first glance, the mosaic appears to depict a clean ocean, but upon closer inspection, viewers see that it is composed entirely of plastic waste, symbolizing the hidden but pervasive problem of marine pollution. This visual metaphor serves as a powerful educational tool, raising awareness about the magnitude of ocean pollution [17–19].

4.2 Biodiversity Mosaic – A Collaborative Initiative

Collaborative digital art initiative that invited participants worldwide to submit images representing species and ecosystems threatened by climate change. The mosaic, composed of these submissions, illustrates the fragility of global biodiversity. The project emphasized public participation, creating a shared visual representation of ecological preservation and employing sustainable digital practices such as energy-efficient servers [20].



Fig. 2. Digital Mosaic Representing Biodiversity

4.3 Climate Action Mosaic – A Global Campaign for Sustainability

The Climate Action Mosaic, developed by the Green Futures Collective, was part of a global campaign promoting climate action. Each tile represented individuals or organizations committed to reducing their carbon footprint, symbolizing the collective effort to combat climate change. The mosaic, launched as part of the United Nations Climate Action Summit, engaged the public by encouraging participants to submit their climate-positive actions, further fostering environmental responsibility. The use of entirely digital tools eliminated the need for physical materials, contributing to the project's sustainability.



Fig. 3. Digital Mosaic Representing Climate Action

4.4 Forests of the Future – Addressing Deforestation

The Forests of the Future mosaic explores deforestation in the Amazon rainforest using satellite imagery to illustrate forest loss over time. This mosaic contrasts the diminishing forest with images of flourishing wildlife, highlighting the urgency of forest conservation. The project was paired with an interactive platform providing detailed information on deforestation rates and potential restoration solutions. By using renewable energy-powered servers, this ensured the sustainability of the digital production.



Fig. 4. Digital Mosaic Representing Deforestation

5 Discussion

The case studies in this paper highlight the significant role that digital mosaics can play in promoting environmental awareness while integrating sustainable practices into the art-making process. By combining visual storytelling, public engagement, and eco-conscious production methods, digital mosaics have proven to be a powerful tool for environmental education and collective action.

5.1 Effectiveness of Digital Mosaics in Raising Environmental Awareness

Digital mosaics are uniquely effective in conveying complex environmental messages through a unified and visually appealing format. By assembling hundreds or even thousands of smaller images into a single narrative, digital mosaics mirror the interconnectedness of ecosystems, a key concept in addressing global environmental challenges. In projects such as the Ocean Mosaic and Forests of the Future, digital mosaics successfully communicate the scale and urgency of issues like marine pollution and deforestation. These mosaics allow viewers to explore both the intricate details and the broader scope of environmental degradation, making the artworks highly impactful.

Moreover, the visual metaphor of interconnectedness serves as a reminder of collective responsibility. Each tile in the mosaic represents a small yet meaningful contribution to the overall composition, symbolizing how individual actions—such as reducing plastic use or supporting biodiversity—can collectively lead to significant environmental improvements. This parallel between visual art and environmental action fosters an understanding of the importance of each individual's role in addressing ecological crises.

5.2 Sustainability in Digital Art Practices

The sustainability of digital mosaics over traditional art forms is another key advantage. Unlike conventional artworks that rely on resource-heavy materials such as paint, canvas, and chemicals, digital mosaics are created using software and digital tools, which drastically reduce the environmental impact. Projects like the Ocean Mosaic and Climate Action Mosaic demonstrate how digital technologies can be harnessed to create impactful art without contributing to waste and pollution. Furthermore, energy-efficient tools and carbon-neutral hosting platforms, such as those used in the Biodiversity Mosaic, are paving the way for more sustainable digital art practices [21]

While digital technologies pose challenges, such as energy consumption, projects like these have adopted measures to mitigate these impacts, such as the use of renewable energy sources and carbon-offsetting programs.

5.3 Challenges and Future Opportunities

While digital mosaics offer a promising approach to sustainable art, challenges remain. The energy required for large-scale digital projects and interactive platforms can be significant, and greater adoption of energy-efficient solutions is necessary to fully realize the environmental benefits of digital art. In addition, equitable access to digital technologies remains a concern, particularly in regions with limited infrastructure.

Despite these challenges, the future of digital mosaics in environmental discourse is bright. As technology continues to evolve, digital mosaics will likely become more sophisticated and immersive, allowing for even greater public engagement in environmental sustainability efforts.

6 Conclusions

Digital mosaics represent a significant innovation in the intersection of art and environmental advocacy. Through the use of digital tools, artists can create visually compelling and meaningful works that raise public awareness of pressing ecological issues while minimizing the environmental impact associated with traditional art production. The case studies in this paper, such as the Ocean Mosaic, Biodiversity Mosaic, Climate Action Mosaic, and Forests of the Future, demonstrate the effectiveness of digital mosaics in communicating complex environmental messages. These projects emphasize the interconnectedness of ecosystems and the importance of individual contributions to environmental stewardship.

The transition to sustainable art practices through digital technologies marks a critical shift in the art world, showcasing that creativity and environmental responsibility can coexist. As digital platforms expand, the potential for digital mosaics to reach a global audience and promote collective action toward sustainability will only grow. This study concludes that digital mosaics are a powerful medium for environmental awareness and sustainable art, contributing to the Sustainable Development Goals (SDGs) and inspiring both individuals and communities to take action for a more sustainable future.

References

1. Sanchez, E., Vinueza, R., Izurieta, X., Rey, N.: Use of muralism to promote awareness about aquatic ecosystems and wise water consumption in northwestern Ecuador. *Ocean Coast Manag.* 190, (2020).
2. Zhang, S., Pensyl, R.: Research on the Ecological Orientation of Digital Public Art and Its Relationship with Urban Development. In: *Proceedings of the 2021 Conference on Art and Design: Inheritance and Innovation (ADII 2021)* (2022).
3. Pratono, A.H., Nawangpalupi, C.B., Sutanti, A.: Achieving sustainable development goals through digitalising creative works: some evidence from social enterprises in Indonesia. *Digital Economy and Sustainable Development*. 1, (2023).
4. Kusá, A., Piatrov, I.: Perception of global environmental problems by Generation C and its marketing communication preferences. *SHS Web of Conferences*. 74, (2020). <https://doi.org/10.1051/shsconf/20207401021>.
5. Doyle, L., Anderson, F., Choy, E., Mould, D.: Automated pebble mosaic stylization of images. *Comput Vis Media (Beijing)*. 5, (2019).
6. Varinlioglu, G., Oguz, K., Turkmen, D., Ercan, I., Turhan, G.D.: Work of Art in the Age of Metaverse: Exploring digital art through augmented reality. In: *Proceedings of the International Conference on Education and Research in Computer Aided Architectural Design in Europe* (2022).
7. Roth, R.E.: Cartographic Design as Visual Storytelling: Synthesis and Review of Map-Based Narratives, Genres, and Tropes. *Cartographic Journal*. 58, (2021).
8. Atkinson, J.K.: Environmental conditions for the safeguarding of collections: A background to the current debate on the control of relative humidity and temperature. In: *Studies in Conservation* (2014).
9. Mbeshu-Mhlauli, N.C.: Fostering Economic Sustainability within Rural Families in South Africa through Visual Arts and Crafts. *E-Journal of Humanities, Arts and Social Sciences*. (2024). <https://doi.org/10.38159/ehass.2024537>.
10. Spiegel, S.J., Thomas, S., O'Neill, K., Brondgeest, C., Thomas, J., Beltran, J., Hunt, T., Yassi, A.: Visual storytelling, intergenerational environmental justice and indigenous sovereignty: Exploring images and stories amid a contested oil pipeline project. *Int J Environ Res Public Health*. 17, (2020).
11. Minami, T., Ohtani, Y., Ohshima, S., Nagasaki, K., Ito, Y., Nakanishi, H., Yasuhara, R., Funaba, H., Yamada, I., Akiyama, T.: Development of a high-speed full digital processing phase detector for interferometry, (2018).
12. Stoliarchuk, O., Binkivska, K., Khrypko, S., Spudka, I., Chop, V., Chornomordenko, I., Salo, H.: Interaction of Digital Trends and Sustainable Development: The role of Contemporary Art. *European Journal of Sustainable Development*. 13, (2024). <https://doi.org/10.14207/ejsd.2024.v13n1p278>.
13. Abdoh, S.A.: Art and sustainability: can digital technologies achieve sustainability? *Journal of Cultural Heritage Management and Sustainable Development*. 14, (2024). <https://doi.org/10.1108/JCHMSD-03-2022-0038>.
14. Hassan, N.F., Ali, A.E., Aldeen, T.W., Al-Adhami, A.: Video mosaic watermarking using plasma key. *Indonesian Journal of Electrical Engineering and Computer Science*. 22, (2021). <https://doi.org/10.11591/ijeecs.v22.i2.pp619-628>.
15. Schürholz, D., Castellanos-Galindo, G.A., Casella, E., Mejía-Rentería, J.C., Chennu, A.: Seeing the Forest for the Trees: Mapping Cover and Counting Trees from Aerial Images of a Mangrove Forest Using Artificial Intelligence. *Remote Sens (Basel)*. 15, (2023). <https://doi.org/10.3390/rs15133334>.

16. Qu, M., Cheer, J.M.: Community art festivals and sustainable rural revitalisation. *Journal of Sustainable Tourism*. 29, (2021).
17. Goodfellow, P.: The artwork as an ecological object, (2020).
18. Matias, A., Carrasco, A.R., Pinto, B., Reis, J.: The role of art in coastal and marine sustainability. *Cambridge Prisms: Coastal Futures*. 1, (2023).
19. Oye, A.: Digital Mosaic: Media, Power, and Identity in Canada. *Canadian Journal of Communication*. 42, (2017). <https://doi.org/10.22230/cjc.2017v42n2a3179>.
20. Sousa, F.: Collaborating for Sustainable Access to Digital Art: A Project Overview. *Studies in Conservation*. (2024). <https://doi.org/10.1080/00393630.2024.2325839>.
21. Gils, B. Van, Weigand, H.: Towards Sustainable Digital Transformation. In: *Proceedings - 2020 IEEE 22nd Conference on Business Informatics, CBI 2020* (2020).

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