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Visualizing Air Pollution Through New Media: A Case Study of “Polluted Currents” Exhibition

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This research examines the use of new media and interactive art to communicate air pollution awareness in the exhibition “Polluted Currents,” held at Warin Lab Contemporary from November 29, 2022, to January 25, 2023. The study explores how new media art can effectively address environmental issues, focusing on PM2.5 and PM10 pollution through three interconnected artworks

The exhibition included “Data Flow,” a generative art piece visualizing real-time air quality data; “Footstep of Impact,” an interactive installation where visitors’ movements generated pollution effects on a terrain map; and “Visage Reaction,” which used facial detection to confront viewers with their environmental impact. Together, these works provided an immersive and educational experience.

Non-participant observation and Interviews with gallery executives, curators, academics, artists, and collectors highlighted the effectiveness of digital technology and audience interaction in raising awareness. Experts praised the fusion of art, science, and technology for simplifying complex data, though concerns about costs and maintenance were noted. This study underscores the potential of new media art to drive social change through meaningful aesthetic engagement.

Keywords: Generative Art, Interactive Art, Air Pollution, Environmental Communication, Creative Research

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Introduction

Air pollution is a critical environmental challenge in Thailand, particularly during winter when PM2.5 and PM10 levels often reach hazardous levels (Pollution Control Department, 2024). Scientific data on such issues can be difficult for the public to grasp, highlighting the need for alternative communication methods. New media art provides a powerful platform to make these complex topics more accessible and engaging.

The Polluted Currents exhibition was designed to transcend traditional data presentation by integrating scientific information, digital technology, and audience interaction. It featured three key artworks: Data Flow, which transformed air quality data into real-time generative animations; Footstep of Impact, where visitors stepped on an interactive floor to witness the environmental consequences of their actions; and Visage Reaction, which challenged viewers to confront their role in the environmental crisis. Together, these works created an immersive learning experience that bridged the gap between data and understanding.

Research Objectives

1. To analyze the use of new media art in communicating environmental issues
2. To study methods of creating audience engagement through interactive art
3. To evaluate the effectiveness of art in creating awareness of environmental problems

Hypothesis

This research hypothesizes that interactive new media art fosters more meaningful environmental engagement than traditional methods. It suggests that transforming scientific data into aesthetic experiences enhances accessibility (Manovich, 2001; Lumley, 2021), physical interaction strengthens behavior-consequence connections (Cox, 2013; Pinsky & Sommer, 2020), and technological self-confrontation deepens reflection on personal environmental responsibility (Edmonds, 2010; Hornby, 2017). Together, these elements aim to deepen understanding of environmental issues and inspire actionable change.

Conceptual Framework

This research integrates three key theoretical frameworks:

1. New Media Art Theory: Drawing from Manovich's (2001) concepts of numerical representation, modularity, automation, variability, and transcoding, which enable interactive and dynamic user experiences. This foundation supports the transformation of environmental data into responsive visual systems (Tufte, 1984).

2. Environmental Communication: Based on Cox's (2013) strategies for effective environmental communication, particularly: making the invisible visible, connecting actions to impacts, and stimulating behavioral change through meaningful engagement.

3. Experiential Learning Theory: Incorporating Kolb's (1984) experiential learning cycle with its four stages: concrete experience, reflective observation, abstract conceptualization, and active experimentation. This framework guides the design of visitor experiences through the exhibition.

These perspectives converge in a cyclical process: data representation which transforms scientific information into sensory experiences, leading to interaction that fosters viewer engagement, and ultimately cultivating awareness to inspire attitudinal and behavioral change. This integrated framework informed both the creation of artworks and the evaluation of their effectiveness in communicating environmental messages.

Research Methodology

1. Research Design

This research adopted a practice-based methodology, combining creative practice, qualitative research, and action research approaches (Candy & Edmonds, 2018). The study was structured into four phases, blending artistic creation with systematic inquiry to explore the intersection of new media art and environmental communication.

1.1. Exploration Phase: (July 3 - August 31, 2022): Literature review, technology exploration, and air quality data analysis

1.2. Development Phase: (September 4 - October 31, 2022): Concept development, technical experimentation, prototype creation, and installation

1.3. Exhibition Phase: (November 10, 2022 - January 25, 2023): Installation, observation of visitor interactions, interviews, and data collection

1.4. Analysis Phase (February 5 - March 29, 2023): Data processing, analysis, and report writing

The research scope encompassed creating and exhibiting three new media artworks at Warin Lab Contemporary over 77 days, focusing on Thailand’s PM2.5 and PM10 air pollution, digital technology creation processes, visitor engagement patterns, and perspectives from gallery executives, curators, academics, artists, and collectors. Warin Lab Contemporary was selected as the exhibition venue due to its established commitment to environmental art and specialized expertise in presenting contemporary artworks that address critical social and environmental issues. The gallery has developed proficiency in supporting new media installations that communicate environmental awareness through artistic expression, making it an ideal institutional partner for this research exploring the intersection of art, technology, and environmental communication. The gallery’s technical infrastructure and curatorial experience with environmentally focused exhibitions provided essential support for the complex installation requirements while ensuring appropriate context for evaluating the exhibition’s effectiveness in reaching audiences concerned with environmental issues.

2. Data Collection Methods

The research employed a dual-framework approach to data collection, addressing both the technical requirements of creating real-time responsive artworks and the analytical needs of evaluating their effectiveness as communication tools.

2.1.Data Collection for Real-Time Artwork Creation

The artwork utilized real-time air quality data from the World Air Quality Index (WAQI) API, providing continuous PM2.5 and PM10 updates across Thailand at one-minute intervals. This API was selected for its comprehensive coverage of Thai monitoring stations, standardized JSON formats, and reliable uptime, enabling dynamic visualizations that reflected actual air quality fluctuations rather than static datasets throughout the exhibition period.

Initial prototyping used Processing and p5.js environments to test API connections and explore visualization possibilities through particle systems and color mapping algorithms. The Processing framework facilitated rapid experimentation with data parsing and artistic concepts, while p5.js enabled web-based testing of API functionality. After validating technical feasibility through fifteen iterations, final implementations were developed in Unity 3D to achieve sophisticated particle systems and multi-screen coordination required for the 77-day exhibition period.

2.2. Data Collection for Impact Assessment and Analysis

The exhibition's effectiveness as an environmental communication tool was evaluated through systematic observation and expert consultation methodologies.

2.2.1.Non-participant observation: Using shadowing technique and unobtrusive observation to document visitor behaviors, time spent with each artwork, movement patterns, facial expressions, and verbal responses. Observations were systematically recorded using structured observation forms.

2.2.2.Semi-structured in-depth interviews: Conducted with purposively selected representatives from five expert groups. The interview protocol included open-ended questions designed to elicit detailed perspectives on aesthetic, technical, and social dimensions of the exhibition.

3. Exhibition Narrative Design

The exhibition employed a progressive narrative structure to guide visitors through three interconnected experiences:

3.1. Understanding Development: Beginning with foundational information through Data Flow

3.2. Making Connections: Exploring cause and effect through Footstep of Impact

3.3. Personal Reflection: Confronting personal responsibility through Visage Reaction

This sequential design aligns with Kolb's (1984) experiential learning cycle, guiding visitors from observation and reflection to conceptualization and action. The approach is further supported by case studies such as Hornby's (2017) analysis of Olafur Eliasson's work, which highlights the power of art to make climate issues tangible and emotionally resonant. Similarly, Pinsky and Sommer's (2020) Pollution Pods study demonstrate how immersive, sensory-driven art can effectively shift perceptions of air pollution and climate change. These examples underscore the value of narrativity and multisensory methods in communicating complex pollution problems, offering a compelling framework for engaging audiences and inspiring meaningful change.

4. Artwork Descriptions and Technical Implementation

4.1.Data Flow

This artwork translated real-time air quality data into aesthetic visual experiences through generative art (Galanter, 2003). The piece was designed to make invisible air pollution visible in a compelling and emotionally engaging format using Unity Engine, where custom particle systems and specialized shaders were developed to achieve the desired visual aesthetic. Real-time air quality data was obtained through an API connection to the World Air Quality Index (WAQI) service, allowing the artwork to reflect current PM2.5 and PM10 conditions. The visual output was presented on six 46-inch LED screens arranged in a 3x2 grid configuration, creating an immersive visual field that surrounded the viewer as shown in Figure 1.

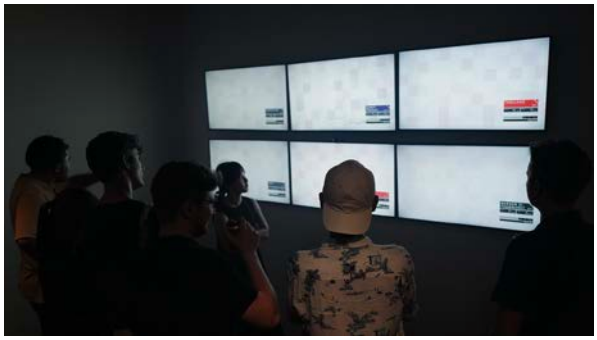

Figure 1 Visitors Engage with Real-Time Air Quality Visualization
Source : Researcher’s Documentation / (Pongpan Suriyapat, 2023)

The system was programmed to operate continuously throughout the exhibition, with data updates occurring every minute to maintain relevance and accuracy. A carefully calibrated color progression scheme was implemented, transitioning from white tones representing safe air quality levels through increasingly intense hues culminating in deep purple to indicate hazardous conditions. The movement patterns of the particles were deliberately designed to differentiate between pollutant types, with smaller, faster-moving particles representing PM2.5 and larger, more predictable movement patterns indicating PM10 particulates, mimicking their actual physical behavior in the atmosphere.

The visual aesthetics intentionally created a tension between the beauty of the flowing particles and the dangerous reality they represented. Data visualization parameters were meticulously calibrated to balance scientific accuracy with emotional impact, which

emphasizes clarity, precision, and effective communication of complex data (Tufte, 1983). This approach not only ensured the integrity of the scientific information but also enhanced its accessibility and emotional resonance for viewers, aligning with the exhibition's goal of fostering deeper engagement with environmental issues.

4.2.Footstep of Impact

This interactive installation created a direct connection between visitors' physical movements and environmental consequences, allowing people to see the immediate effects of their actions on air quality.

The installation was constructed using a series of 50x50 cm LED panels carefully arranged to form a topographical representation of Thailand's terrain, complete with varying elevations to simulate the country's geographical features. Beneath each panel, pressure-sensitive sensors were integrated to precisely detect visitors' footsteps, weight distribution, and movement patterns across the installation. The interactive system was powered by Unity Engine, featuring sophisticated physics-based particle systems programmed to respond directly to visitors' movements on the terrain. To enhance the authenticity of the experience, the installation incorporated actual pollution-causing materials strategically placed throughout the space, including charcoal fragments, industrial plastic pellets, and agricultural chemical fertilizers, creating a tangible connection to real-world pollution sources.

Overhead, multiple projectors were installed to display dynamic sky imagery that gradually transformed in response to the accumulated pollution levels generated by visitor activity. When pollution reached predetermined critical thresholds, concealed smoke generators would activate, releasing controlled amounts of actual smoke into the installation space. Special transition effects were carefully designed to create a seamless visual blend between the physical smoke rising from the installation and the digital projections overhead, merging the physical and virtual elements into a cohesive environmental experience.

The installation deliberately avoided clear beginning or ending points, reflecting the continuous and cumulative nature of environmental impacts. Visitor interactions generated both immediate visual feedback and contributed to gradually increasing pollution levels in the simulated environment as in Figure 2.

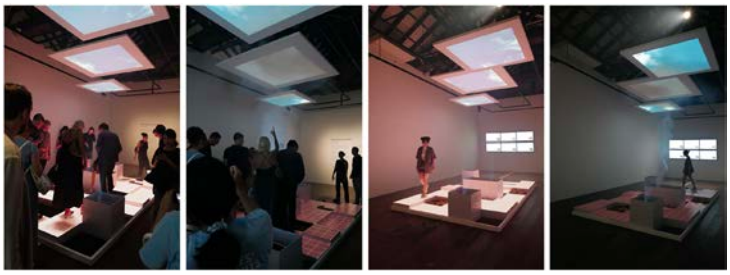

Figure 2 Visitors Interaction with the work, Bridging Real & Virtual Worlds
Source : Researcher’s Documentation / (Pongpan Suriyapat, 2023)

4.3. Visage Reaction

This artwork utilized facial detection technology to foster personal confrontation and reflection on individual roles in environmental issues. The installation featured four 42-inch LED screens in a 2x2 configuration at eye level, creating an intimate engagement with viewers. Discreet cameras, hidden within the structure and linked to the OpenCV library, enabled real-time facial detection and emotional analysis. A specialized algorithm captured visitors’ candid reactions as they moved through the space, storing these expressions for later display.

When viewers approached the installation, the screens revealed their captured facial images paired with contrasting text, such as “problem creator” vs. “problem solver” or “indifferent” vs. “take action,” challenging their environmental attitudes. Personal data collection adhered strictly to Thailand’s Personal Data Protection Act (PDPA), ensuring ethical handling of biometric information. The stark, high-contrast design—featuring deep black backgrounds and crisp white typography—created a somber, reflective atmosphere, as shown in Figure 3, encouraging deep introspection.

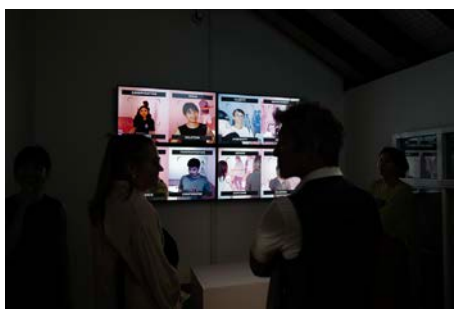

Figure 3 Visitors confronting the choices between ignorance and action
Source : Researcher’s Documentation / (Pongpan Suriyapat, 2023)

The work created psychological tension by juxtaposing visitors' spontaneous reactions with their conscious expressions when aware of being observed, prompting deeper reflection on personal responsibility for environmental issues.

5. Data Analysis Approach

Qualitative data from observations and interviews were analyzed using thematic analysis. This methodical process began with thorough familiarization with the collected data, followed by coding significant patterns that emerged. The research team then identified key themes and subthemes, which were subsequently reviewed, refined, and clearly defined before producing the final analysis. This systematic approach enabled the identification of meaningful patterns across diverse data sources and expert perspectives while ensuring analytical rigor throughout the research process.

Research Results

1. Visitor Responses and Behaviors

Non-participant observation revealed several significant patterns in visitor engagement with the exhibition as follow:

1.1. Extended Engagement: Visitors spent 20-30 minutes on average, significantly longer than typical art viewing times, indicating strong engagement with interactive elements.

1.2. Progressive Learning: Visitors showed clear development in understanding and emotional engagement, transitioning from aesthetic appreciation to critical questioning to personal reflection.

1.3. Behavioral Adaptation: With Footstep of Impact, initial playful movements evolved into deliberate, cautious interactions as visitors observed environmental consequences of their actions.

1.4. Return Visits: Frequent returns to specific artworks, especially Visage Reaction, suggested deeper processing of the exhibition's messages.

1.5. Social Interaction: Discussions among visitors indicated the exhibition successfully stimulated dialogue about environmental issues.

The observation data confirmed the effectiveness of the progressive narrative structure in creating deeper engagement with environmental topics.

2. Expert Perspectives

The semi-structured interviews with five expert groups revealed diverse insights on the exhibition's significance, challenges, and implications as folow:

2.1. Gallery Executives’ Perspectives

Gallery executives recognized the exhibition’s potential to attract younger audiences through technology integration while expressing concerns about financial and operational challenges. They highlighted high implementation and maintenance costs, the need for specialized technical staff with dual expertise in art and technology, and difficulties in developing sustainable business models for new media art. Physical gallery spaces also require substantial adaptations to accommodate specific technical requirements for lighting, electrical infrastructure, and climate control needed for electronic equipment.

2.2. Curators’ Perspectives

Curators valued the exhibition’s narrative structure while emphasizing the need to balance aesthetic value with information delivery. They raised ethical concerns regarding visitor privacy with facial detection elements and discussed the potential for applying similar approaches to other environmental topics. Curators noted that exhibitions must be adapted for different cultural settings, as presentations effective in Bangkok may require recalibration for rural communities or international venues with varying technological literacy levels and cultural attitudes toward environmental issues.

2.3. Academics and Media Perspectives

Academics and journalists positioned the exhibition within global trends in socially engaged new media art while highlighting its distinctive Thai characteristics. They praised its effectiveness in translating complex scientific data into accessible and emotionally resonant experiences. Discussions centered on educational applications for diverse audience groups and the exhibition’s role in advancing dialogue between art, science, and social issues in Thailand as a model for interdisciplinary collaboration that could address other national challenges.

2.4. Artists’ Perspectives

Fellow artists focused on technical implementation and creative processes, examining innovative approaches to data visualization and the integration of physical and digital elements. They discussed collaboration challenges between artists and technologists while expressing concerns about accessibility of similar technical approaches for artists with limited resources. These conversations prompted discussions about knowledge sharing and developing more affordable solutions for artists interested in environmental themes.

2.5. Collectors and Art Supporters’ Perspectives

Collectors and patrons discussed emerging paradigms for supporting technology

-based art, noting challenges in collecting and preserving digital and interactive artworks. They proposed alternative support models beyond traditional acquisition, including commissioning processes rather than finished products or investing in documentation of ephemeral installations. Many emphasized the need for institutional preservation protocols, suggesting collaboration between collectors, museums, and technology experts to establish best practices for digital art conservation.

Overall, the expert interviews revealed strong recognition of the exhibition's innovative approach while highlighting structural challenges within the Thai art ecosystem for supporting new media art. Despite diverse perspectives and priorities, there was consensus that such interdisciplinary approaches represented an important direction for contemporary art engaging with urgent social and environmental issues in Thailand.

3. Impact Assessment

Analysis of observation and interview data indicated three main areas of impact:

3.1. Perceptual and Cognitive Impact: The exhibition successfully increased understanding of air pollution issues among visitors, with experts confirming the effectiveness of data visualization approaches in making complex information accessible.

3.2. Emotional and Attitudinal Impact: Both visitors and experts reported strong emotional responses to the works, particularly the confrontational aspects of Visage Reaction and the cause-effect relationships in Footstep of Impact.

3.3. Behavioral Intent: A significant proportion of visitors expressed intentions to modify behaviors related to environmental impact after experiencing the exhibition, though long-term behavioral change could not be measured within the research timeframe.

The exhibition demonstrated particular effectiveness in helping visitors connect abstract environmental data with personal experience and responsibility, addressing a key challenge in environmental communication.

Conclusion and Discussion

This research demonstrates that new media art effectively bridges scientific environmental data and public understanding, confirming that interactive, multisensory experiences foster deeper engagement than traditional methods. The success of Polluted Currents is attributed to:

1. Multisensory Engagement: Integrating visual, auditory, and kinesthetic elements enhanced information processing.

2. Progressive Narrative: A sequential design guided visitors from understanding to reflection, creating a cohesive learning journey.

3. Real-time Data: Live environmental data added authenticity and urgency, surpassing static presentations.

4. Personalized Experiences: Interactive elements increased the personal relevance of environmental issues.

5. Aesthetic-Scientific Balance: Artworks maintained scientific accuracy while delivering emotional impact.

These findings align with Cox's (2013) strategies, such as making invisible pollution visible and linking actions to consequences, while extending Edmonds' (2010) framework by demonstrating how varied interaction levels support educational goals. However, challenges include:

1. Resource Intensity: High technical, financial, and human resource demands limit scalability.

2. Technical Complexity: Specialized expertise creates barriers for artists and institutions.

3. Audience Limitations: Physical installations reach fewer people than digital media.

4. Assessment Difficulties: Measuring long-term impact and behavioral change remains challenging.

Despite these limitations, new media art offers valuable tools for environmental communication, complementing broader public awareness strategies.

From the researcher's perspective, the impact assessment reveals that new media art creates transformative experiences across three critical dimensions: perceptual shifts where visitors develop deeper understanding of environmental data relationships, emotional engagement that transforms abstract issues into personal concerns, and behavioral changes demonstrated through concrete action commitments. This multi-dimensional impact suggests that artistic approaches to environmental communication possess significant potential beyond air pollution, extending to climate change visualization, biodiversity loss representation, and sustainable consumption awareness.

The researcher envisions that modern technology and the growth of art forms can be a medium for greater environmental awareness, especially art that is in public spaces,

online, and not limited to specific art spaces. Such expansion could democratize access to environmental education while maintaining the emotional resonance and personal relevance that traditional information-based approaches often lack. Future applications might include urban installations that respond to real-time environmental conditions, mobile platforms that bring interactive environmental art to diverse communities, and collaborative networks where local environmental data becomes the foundation for community-specific artistic interventions. This research ultimately demonstrates that the intersection of art, technology, and environmental science offers unprecedented opportunities for creating the widespread understanding and engagement necessary to address our most pressing environmental challenges.

Recommendations

Based on the research findings, recommendations are proposed to enhance the integration of art, technology, and environmental communication. For artists and designers, developing simplified technical frameworks and open-source resources can make environmental data art more accessible. Exploring hybrid physical-digital formats and scalable interactive experiences can expand project reach.

For cultural institutions, investing in technical infrastructure, staff training, and collaborations with scientific institutions ensures data accuracy and supports new media art. Long-term visitor research and archival protocols for digital artworks can sustain and measure their impact.

Environmental communicators should integrate artistic and interactive methods into education programs, develop metrics for attitudinal and behavioral changes, and form interdisciplinary teams combining scientific, artistic, and communication expertise. Insights from successful installations can inform broader strategies.

For future research, longitudinal studies, applications targeting specific demographics like youth and industry stakeholders, and the potential of VR, AR, and AI should be explored. Comparative studies on communication approaches can refine strategies for environmental awareness.

These recommendations build on the successes of the Polluted Currents exhibition while addressing its limitations, promoting a more impactful and inclusive approach to environmental communication through art.

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